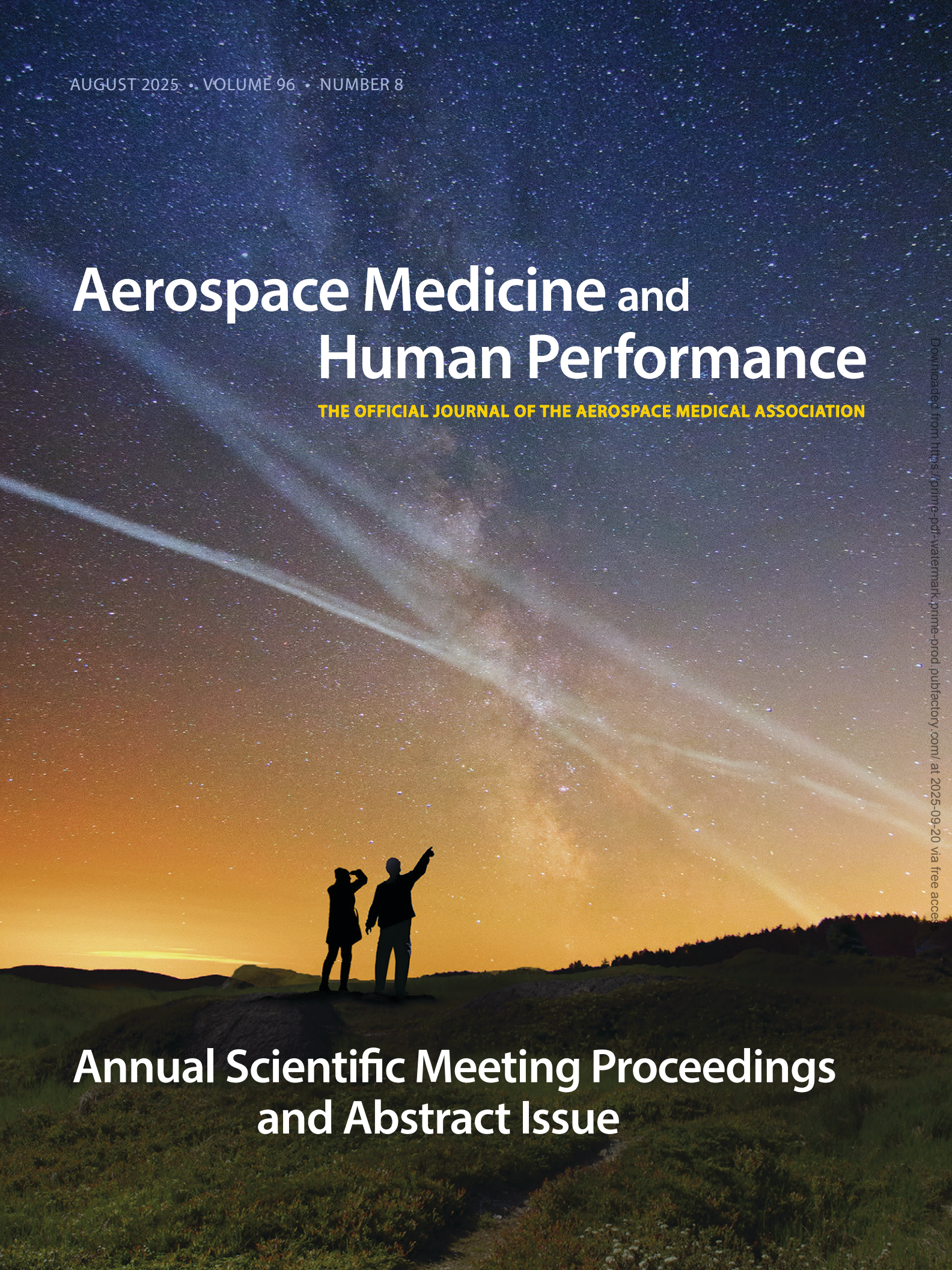
AUGUST 2025 • VOLUME 96 • NUMBER 8

Aerospace Medicine and Human Performance

THE OFFICIAL JOURNAL OF THE AEROSPACE MEDICAL ASSOCIATION



Annual Scientific Meeting Proceedings and Abstract Issue

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Aerospace Medicine and Human Performance

AUGUST 2025 VOLUME 96 NUMBER 8 [ISSN 2375-6314 (print); ISSN 2375-6322 (online)]

This journal, representing the members of the Aerospace Medical Association, is published for those interested in aerospace medicine and human performance. It is devoted to serving and supporting all who explore, travel, work, or live in hazardous environments ranging from beneath the sea to the outermost reaches of space.

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Aerospace Medicine and Human Performance

AUGUST 2025 VOLUME 96 NUMBER 8

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For Non-U.S. members, the entire membership fee is related to the activities of the Aerospace Medical Association to improve the professional knowledge and practice of its members. This includes subscription to the Association's professional journal, itself part of the education effort of the Association.

Specialties: Please select from the following list of specialties all that apply to you.

- ☐ Administrative Medicine – physicians
- ☐ Aerospace and Aviation Medicine
- ☐ Aerospace Flight Nursing
- ☐ Aerospace Human Factors & Human Engineering
- ☐ Aerospace Physiology
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- ☐ Aviation Medical Examiner
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- ☐ Bioengineering
- ☐ Biomedical Engineering
- ☐ Biophysics
- ☐ Cardiology or cardiovascular disease
- ☐ Certified in Aerospace Physiology
- ☐ Dermatology
- ☐ Development & Manufacturing Industry
- ☐ Diplomate, ABPM, Cert in Aero Med
- ☐ Emergency Medicine
- ☐ ENT
- ☐ Environmental Sciences
- ☐ Epidemiology
- ☐ Family Practice
- ☐ Forensic Medicine
- ☐ Gastroenterology
- ☐ General Practice
- ☐ General Surgery
- ☐ Geriatrics
- ☐ Hand Surgery
- ☐ Human Performance
- ☐ Human Systems Integration
- ☐ Hyperbaric Medicine
- ☐ Industrial or Occupational Medicine
- ☐ Industrial or Traumatic Surgery
- ☐ Internal Medicine
- ☐ Legal Medicine
- ☐ Life Insurance Medicine
- ☐ Life Science
- ☐ Maxillofacial Surgery
- ☐ Medical Anthropology
- ☐ Military Command
- ☐ Neurological Surgery
- ☐ Neurology
- ☐ Nuclear Medicine
- ☐ Nursing/Patient Transport
- ☐ Obstetrics and Gynecology
- ☐ Occupational Diseases
- ☐ Ophthalmology
- ☐ Optometry
- ☐ Orthopedic Surgery
- ☐ Otolaryngology and Otology
- ☐ Pathology
- ☐ Pediatrics
- ☐ Pharmacology
- ☐ Physical Medicine & Rehabilitation
- ☐ Physiology
- ☐ Plastic Surgery
- ☐ Preventive Medicine – General
- ☐ Proctology
- ☐ Psychiatry
- ☐ Psychology
- ☐ Public Health
- ☐ Pulmonary Disease
- ☐ Radiology & Roentgenology
- ☐ Research and Research Scientist
- ☐ Rheumatology
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2026 AsMA & UHMS Annual Scientific Meeting "Boundless Frontiers—Relentless Progress"

Sheraton Denver Downtown Hotel
Denver, CO, United States; May 17–21, 2026

Call for Abstracts Deadline: Jan. 4, 2026; ***NO Exceptions!***

The 2026 AsMA-UHMS Annual Scientific Meeting will be held in Denver, CO, United States. The theme for the 2026 Annual Scientific Meeting is **"Boundless Frontiers—Relentless Progress."** With emerging technology and new entrants into the aviation and space environment, it is now more important than ever to encourage the next generation of young people to consider entering career fields like aerospace medicine, engineering, aviation, maintenance, air traffic control, and remotely piloted vehicle operations, to name a few. To quote a staff member, "if a young person can't see it, they can't be it." Many of our youth have no awareness of the career opportunities in aerospace medicine. We need to be out in our schools and youth organizations telling our story. In addition, AsMA members will need to maintain a full awareness, and in many cases, a working knowledge of the innovations so we can better respond to needs of the aviation and space communities. The future will require us to think differently as the airspace system changes.

The Annual Scientific Meeting is the premier international forum to learn and discuss evolving trends and multidisciplinary best practices in research, clinical applications, human performance, and flight safety. The 2026 AsMA-UHMS Annual Scientific Meeting welcomes abstracts in the many areas related to Aerospace Medicine. For a complete list, see the box on p. 2 of this form.

AsMA ABSTRACT SUBMISSION PROCESS

LIMIT: 350 words/2500 characters including spaces; NO Tables or Figures or References should be included in the abstract. All abstracts must be submitted via the electronic submission system link on the meeting website: *https://asma-uhms-asm.org/abstracts/asma-call-for-abstracts.html*.

ATTENTION: You MUST use personal email addresses when entering your abstracts and those of your co-authors.

ABSTRACT PRESENTATION TYPES

The Annual Scientific Meeting highlights four types of presentation formats.

1. Poster: Individual Digital Poster presentations are integrated into a Poster session, grouped by topic. The presentation must be submitted as a PowerPoint with up to a maximum of 10 slides. Video and audio clips can be embedded. They will be displayed digitally. Posters are on display for two full days, each in an assigned space. Authors will be asked to present their poster for a single designated 90-min period on one of these days.

2. Slide: Standalone 15-minute slide presentation with questions/discussion that will be integrated into an oral slide session, grouped by topic. PowerPoint presentations will be organized by topic area and presented during 90-minute blocks of time, 6 periods of 15 minutes each. Individual PowerPoint Oral presentations are limited to 15 minutes, including 3–5 minutes for questions and discussion.

3. Panel: Invited Presentation that will link to support a Panel Overview containing five (non-case study) or six (case study) abstracts presented as a cohesive whole. Panels also have 90 minutes, ideally 5 presentations of 15 minutes each followed by a 15-minute discussion period.

4. Workshop: Invited Presentation that will link to and support a Workshop Overview. Overview abstracts should reflect the material to be presented in this long format for up to 8 hours of CME credit.

PRESENTATION CATEGORIES

There are two presentation categories based on the topic. (Templates and examples are provided for each type and will be available on the abstract submission website). Authors will be required to enter abstract text under the headings as described below.

1. Original Research: Material that is original in nature and has not been previously presented. Original analysis of a hypothesis involving data collection and analysis. Headings include Introduction, Methods, Results, and Discussion.

2. Education: Typically, a discussion of information that is already available.

a. Program/Process Review: Description of a program or process that is used to solve a problem or accomplish a task. Headings include Background, Description, and Discussion.

b. Tutorial/Review: An educational session intended as a review of established material. Headings include Introduction, Topic, and Application.

c. Case Study: A single clinical or human performance event. Headings include Introduction, Case Description, and Discussion.

PANEL GUIDANCE

Panels must be composed of a coordinated sequence of 5 abstracts that flow logically from one to another supporting the central theme. Panels must contain abstracts that allow 15 minutes of structured discussion at the end of the session.

Case Study Panels: Case Study Panels can have 6 abstracts and are intended to highlight a particular institution, community, or aeromedical issue, usually presented from the same institution or aeromedical community.

It is the responsibility of the Panel Chairperson to enter all supporting abstracts and to ensure that all supporting abstracts clearly describe how each supports the Panel theme. If the Panel theme is not clearly identified and/or the abstracts do not support a central theme, the Scientific Program Committee may decline the proposed Panel in total. Unrelated abstracts from a laboratory or organization do not constitute a Panel (unless they are Case Studies).

Panel Chairs are also responsible for preparing questions and discussion points to facilitate a moderated discussion with the audience during the sixth period. Each Panel speaker should cite or link directly to the Panel theme, and at the end of their talk should provide a logical segue to the next abstract.

WORKSHOP GUIDANCE

Rules for workshops and the review process are similar to those for Panels (above). Individual abstracts must be entered for each invited presenter and all necessary information must be entered in the same manner as all other abstracts, including financial disclosure statements. Course materials should be made available for registrants.

A separate registration fee is charged for Workshops registration. For additional information contact Gisselle Vargas, Deputy Executive Director, at gvargas@asma.org.

AsMA ABSTRACT SUBMISSION PROCESS

All abstracts must be submitted via the electronic submission system linked to on the association's website: *https://asma-uhms-asm.org/abstracts/asma-call-for-abstracts.html*. Click on the link to the abstract submission site--available on the AsMA home page and

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Meetings page on or about September 1, 2025. Authors with questions regarding the abstract submission process should contact AsMA directly at (703) 739-2240, x101 (Mrs. Rachel Trigg), email rtrigg@asma.org or x102 (Mrs. Stella Sanchez), email ssanchez@asma.org.

The following information is required during the submission process: Abstract title, presenting author information (including complete mailing and email addresses and telephone numbers), topic area (from list provided on back of form), contributing authors names, emails and institutions, abstract content **(LIMIT: 350 words/2500 characters including spaces), at least 2 Learning Objectives** (the Accreditation Council for Continuing Medical Education requires this for all presentations). In addition, three (3) multiple choice or True/False questions and answers are required for each Poster, Slide, and Panel presentation for enduring materials for CME credit. Read instructions online for additional details. ***Poster presenters are required to upload their poster as a PowerPoint in advance of the meeting no later than February 23, 2026, 11:59 PM ET.***

PLEASE NOTE: All Presenters (including panelists) are required to register for the meeting. *There is a discounted fee for non-member presenters. Registration limited to the day of presentation will be available on site.*

Financial Disclosure/Conflict of Interest/Ethics

Abstracts will not be accepted without a financial disclosure form. The form is included as part of the website abstract submission process. The presenting author must agree to comply. Scientific presentations at AsMA-sponsored events will adhere to the highest standards of scientific ethics, including appropriate acknowledgment or reference to scientific and/or financial sources. Presenters must avoid the endorsement of commercial products in their abstracts and during their presentations. There must be no advertisements on Posters, slides, or handout materials.

Presentation Retention Policy

AsMA will use live capture technology to record all oral presentations during the meeting. Recorded presentations will be made available to registrants after the meeting. Authors are required to provide permission for live capture and a nonexclusive license to repurpose the content. PDF copies of Poster presentations must be uploaded to the designated submission site.

Permissions and Clearances

It is the author's responsibility to obtain all necessary permissions and clearances prior to submission of the abstract. AsMA assumes no liability or responsibility for the publication of any submitted material.

Acceptance Process

Abstracts will be reviewed by a minimum of three members of the AsMA Scientific Program Committee. Acceptance will be based on the abstract's originality, relevance, scientific quality, and adherence to the guidelines provided. Criteria for non-acceptance include, but are not limited to: insufficient, inconsistent, or ambiguous data; commercialism; or reviews of previously published literature. Abstracts must be 100% complete upon submission, including all final data and results. How well authors abide by submission and format guidelines will also be one of the criteria used to determine acceptance of abstracts.

Presenters are limited to one Slide OR Poster AND one Panel presentation unless given specific prior permission by the Scientific Program Committee Chair, Amanda Lippert, at sciprog@asma.org. Following review by the Scientific Program Committee in January, all contributors will receive a notification of acceptance or non-acceptance by email. Accepted abstracts will be published in *Aerospace Medicine and Human Performance*.

While the Scientific Program Committee strives to honor the presenter's desired presentation format, for reasons such as space limitations or dissimilar content, an abstract may be changed to an alternative presentation format. Assignment of an abstract to either a poster or a slide presentation will be recommended by the Scientific Program Committee, but the final decision will be made by the Program Committee Chair.

Abstract Withdrawal

Withdrawing abstracts is strongly discouraged. However, if necessary, a request to withdraw an abstract should be sent to Amanda Lippert, the Scientific Program Chair, at sciprog@asma.org and Rachel Trigg at rtrigg@asma.org. The request for withdrawal must include the abstract title, authors, ID number, and reason for withdrawal. Abstract withdrawal decisions must be sent to the Scientific Program Chair as soon as possible.

Mentorship

Optional review / feedback for all presenters at AsMA 2026

AsMA is continuing its mentorship initiative for all authors for the 2026 Scientific Meeting. You have the option to submit a draft of your abstract to a group of senior AsMA members for review and feedback. If you have questions about this opportunity, please e-mail sciprog@asma.org. E-mail your abstract to sciprog@asma.org no later than December 15, 2025. The Program Mentor Group will review provide feedback via e-mail by December 22, 2025. The abstract will still need to be finalized in the submission system.

TOPIC AREAS: (These will be listed on a drop-down menu on the submission site. They are used to organize the abstracts into sessions.)

1: Human Performance
- 1.1 Personnel Selection
- 1.2 Training
- 1.3 Hypobaric & Hyperbaric Physiology
- 1.4 Thermal Physiology
- 1.5 Acceleration / Vibration/ Impact
- 1.6 Fatigue
- 1.7 Neurophysiology & Sensory (inc. Vision, Auditory, Vestibular, Spatial Disorientation)
- 1.8 Aerospace Human Factors & Psychology
- 1.9 Aerospace Human Systems Integration

2: Clinical Medicine
- 2.1 Aviation Medicine
- 2.2 Health Promotion and Wellness Programs
- 2.3 Medical Standards / Aircrew Health
- 2.4 Occupational / Environmental Medicine
- 2.5 Operational Medicine
- 2.6 Hyperbaric Medicine

3: Travel and Transport Medicine
- 3.1 Travel Medicine
- 3.2 Aeromedical Transport / Air Evacuation
- 3.3 Air Transport Medicine
- 3.4 Commercial
- 3.5 Pandemic Preparedness

4: Space Medicine
- 4.1 Space Medicine
- 4.2 Space Operations

5: Safety and Survivability
- 5.1 Escape / Survival
- 5.2 Flight Safety / Accident Investigation

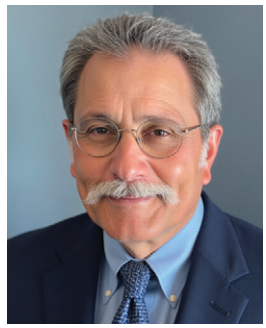
6: Other
- 6.1 History of Aerospace Medicine
- 6.2 Ethics

Follow the link on our website: *https://asma-uhms-asm.org/abstracts/asma-call-for-abstracts.html*

- **Submission hard deadline: Sunday, January 4, 2026, 11:59 PM ET (there will be no extensions)**
- Notice of acceptance by Saturday, January 31, 5 pm ET.
- **No updates to abstracts will be accepted after Saturday, February 28, 2026, 11:59 PM ET**
- **Poster presentations: PDF/PPT must be submitted to the UHMS by Monday, February 23, 11:59 PM ET - NO updates will be accepted after this date, not even on site.**

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95th Annual Scientific Meeting of the Aerospace Medical Association



Warren Silberman, D.O.

This year's joint meeting with the Undersea and Hyperbaric Medical Society was held at the Hyatt Regency Hotel in Downtown Atlanta from June 1–6th, 2025. On Saturday May 31st, the annual meeting of the International Airline Medical Association (IAMA) was held. This year's meeting was excellent! Actually, most of them are excellent.

A major portion of the morning was devoted to hearing physicians from the Centers for Disease Control and Prevention (CDC). This proved to be a great review for myself as I generally do not deal with their issues. The first speaker, Clive Brown, MBBS, MPH, discussed how the U.S. Port Stations function. There are currently 18 of them at major airfields.

One of the major takeaways from the CDC was from Lisa Rotz, M.D., from the Division of Global Migration. Her most important takeaway and, in my estimation, one of the most significant takeaways of the day was the use of wastewater sampling from aircraft coming in from other countries to the United States. The wastewater is sampled for different organisms to determine if there are any trends in medical diseases. According to Dr. Rotz the first wastewater sampling was performed in 1907 to detect the polio virus in order to forecast spread. A word you may want to remember is "Triturator". This is the truck that the wastewater from aircraft is emptied into.

The AsMA-UHMS conference actually began on Monday, June 2nd.

The 70th Louis Bauer Lecture was presented by Jeffrey R. Davis, M.D., MS, and was about innovation at NASA. He was a prior chief NASA flight surgeon, among his other positions. A quote was "good ideas can come from anywhere." Organizations have gaps occur where they need to solve problems. The organization can advertise their problems to the general public and offer a cash prize to solve them. An example one may have heard of was the Ansari X-Prize, where the X Prize Foundation offered $10,000,000 to the first non-government organization to launch a reusable crewed spacecraft into space twice within a 2-week period. Its purpose was to initiate development of low-cost spaceflight.



Jeffrey R. Davis gives the Bauer Lecture.

The UHMS Eric P. Kindwall Memorial Lecture was given by Shai Efrati, M.D., from the Sagol Center for Hyperbaric Medicine. It was entitled: "Experience with Treating Israel Defense Force (IDF) Soldiers." It was more than that! He began by discussing an Israeli soldier who originally had a minor injury. The soil in that area has *Aspergillus* spores that can gain entrance into wounds and result in necrotic tissues. He became quite ill, so they treated him with hyperbaric oxygen and over a long period of time, he survived. The hyperbaric oxygen (HBO) treatment is based on mitochondrial functioning on a cellular level that the dissolved oxygen affects. Low levels of oxygen, or hypoxia, is a very powerful inducer of gene expression, changes in metabolism, and regeneration. This process induces angiogenesis and stem cell proliferation with differentiation. The whole process is known as the "Hyperbaric-Hypoxic Paradox."

Another very interesting treatment was using HBO to treat post-traumatic stress disorder (PTSD). They discovered that individuals with PTSD demonstrate areas in the brain with lack of function and, after HBO treatment, the areas "light up" on scanning, implying success. They use HBO therapy on patients who have been tried and failed on most treatments. They can be up to 12 years with the condition. They have demonstrated success in treating these patients. The current recommended treatment protocol is 60 sessions at 2 ATA with 100% oxygen for 90 minutes with 5-minute air breaks. These are continued examples of the Hyperbaric-Hypoxic Paradox.

The 11th Eugen Reinartz Memorial Lecture was given by Mark Sirangelo, Ph.D., founding executive and former head of Sierra Nevada Space Systems. He was also the founding member and first chair of the Commercial Space Flight Federation. His talk was entitled: "Commercial Space, Human Spaceflight, the ISS and the U.S. Return to the Moon." Dr. Sirangelo participated

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PRESIDENT'S PAGE, *continued*



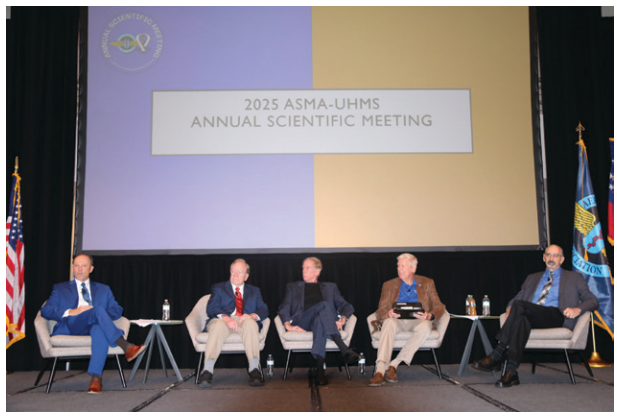
Dr. Orford, 2024–2025 AsMA President, thanks Mark Sirangelo for giving the Reinartz Lecture.

with Elon Musk in the first Space X rocket launch of Falcon 1 from Kwajalein Atoll, releasing their first satellite.

His Sierra Nevada Space Systems developed the "Dream Chaser", a private reusable shuttle-shaped space plane that will be used to transport astronauts and cargo to low Earth orbit. The current one is an unmanned version and its demonstration mission is planned for launch around the third quarter of 2025. He noted the very interesting story that the aircraft was created by copying a model made from a Russian attempt at development from a similar plane that they wanted to use as a match for the U.S. Space Shuttle program. The Russians mothballed the aircraft and ultimately it made its way to the United States.

The UHMS Lambertson Keynote Lecture was a riveting one. It was given by Chris Lemons. Chris is the fellow that a recent movie was made about his diving incident. His talk was entitled "Last Breath: Reasoning with Life and Death at the Bottom of the North Sea." Mr. Lemons was a saturation diver. He was in a team of 12 divers whose job is to spend 28 days at 300 ft below the surface working on oil producing related devices. They eat, sleep, and work during that time, spending 6 hours of their day working on oil machinery. The incident was the 2012 Topaz Incident. His umbilical cable was torn loose when the ship above temporarily lost the Dynamic Positioning System that maintains the ship in a fixed position above their living quarters and diving bell. He fell about 100 m (300 ft) into total darkness at 2 AM that day. He became unconscious and after 29 minutes was rescued with his supplemental oxygen supply gone, and no warm water or electricity from the umbilical cord. Miraculously, he survived with no brain damage or injuries.

The last joint session was the Harry G. Armstrong Lecture that had AsMA Past President Joseph Dervay, M.D., asking a panel of experts about their experiences with undersea, space, and aviation. The panel consisted of Richard Moon, M.D., director of the HBO program at Duke University; Michael Gerhart, Ph.D., astronaut; Jonathan Clark, M.D., Aerospace Neurologist; and Mitch Garber, M.D., MPH, prior NTSB chief physician.



The panel of experts who spoke during the Armstrong Lecture.

There were the usual clinical and research panels presenting excellent topics to fill in the other times. The case presentations by the RAMS and International Flight Surgeons were great as usual.

We had 1,784 total registrants, 316 UHMS, 147 both organizations, 243 students, 153 Residents/Fellows, and 55 countries represented.

The AsMA Council meeting was held on Sunday, June 1st. I would say the major issue that was discussed is the potential sale of the AsMA headquarters at 320 S. Henry St. in Alexandria, VA, to a church across the street. The reason for selling the building at this time is that the association is losing about $30,000 per year on expenses for the building, which would liken to 67 AsMA memberships. The office personnel have been teleworking for years and only come into the building to open and manage the mail. The building is commercial real estate and with the downsizing of the federal government there will be empty properties. Our Council unanimously approved the sale. We are waiting for the church's board to approve the acquisition.

The next AsMA President-Elect is Anthony Wagstaff. He was approved at the Tuesday AsMA Business meeting.

As you should know, our great Executive Director, Jeffrey Sventek, is finally retiring June 30th after 15 years. He will be replaced by John Peters, the current Executive Director of UHMS, who will assume responsibility for both organizations. Gisselle Vargas will become the Deputy Executive Director of AsMA. Please refer any AsMA related questions to her and, if she feels that it is necessary, will involve John Peters. For those that are not fully aware, Mr. Peters has been working with Jeff Sventek for many years now. He has been working with Jeff and the Executive Council to learn more about AsMA's functioning for the past year. He is an exceptional individual and I have no doubt he will do very well.

Remember, AsMA and the UHMS will be hosting joint Annual Scientific Meetings for at least the next 5 years. Our next meeting will be held at the Sheraton in Downtown Denver, CO, from May 17–21, 2026. The theme is "Boundless Frontiers—Relentless Progress."

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2025 Annual AsMA & UHMS Plenary Lectures

70th Louis H. Bauer Lecture

Jeffrey R. Davis, M.D., MS

"Open Innovation at NASA: Good Ideas Can Come from Anywhere"



Dr. Davis has served aviation and space medicine for 20+ years. He is board certified in aerospace medicine and has served in the following roles: Branch Chief of Medical Operations at NASA; Corporate Medical Director of American Airlines; Professor and Residency Director of Aerospace Medicine at the University of Texas Medical Branch; and as Director of Space and Life Sciences at the NASA Johnson Space Center. He has served as the Chair of the American Board of Preventive Medicine. His awards include an Outstanding Leadership Medal and Silver Snoopy at NASA, and the Louis H. Bauer Founders Award from the Aerospace Medical Association.

Eric P. Kindwall Memorial Lecture

Shai Efrati, M.D.

"The Sagol Center for Hyperbaric Medicine: Experience with Treating Israel Defense Forces (IDF) Soldiers"



Dr. Shai Efrati is a professor at Tel Aviv University's Sackler School of Medicine and the Sagol School of Neuroscience. He also serves as the director of the Sagol Center for Hyperbaric Medicine and Research at Shamir Medical Center in Israel, where he leads the world's largest hyperbaric treatment center, treating over 350 patients daily.

11th Eugen G. Reinartz Memorial Lecture

Mark N. Sirangelo, Ph.D.

"Commercial Space, Human Spaceflight, the ISS, and the U.S. Return to the Moon"



Dr. Mark N. Sirangelo currently is the Scholar in Residence for Space, Aerospace and Engineering at University of Colorado. He is also on the Tuskegee University Aerospace Advisory Board and is a visiting professor at Syracuse's Maxwell School of Citizenship and Public Affairs. He has over a two-decade industry executive career. In addition to academia, he provides industry advisory and board services through his company QuanStar Advisors, LLC. He holds Bachelor of Science, Master in Business Administration, and Doctorate degrees and has served as a U.S. Army officer.

In the space industry, Dr. Sirangelo was the founding executive and head of Sierra Nevada Space Systems for over ten years until 2018. Previously, he was the Chairman and Chief Executive Officer of SpaceDev, a publicly traded commercial space company that he grew from an early stage until its merger with Sierra Nevada Corporation. SpaceDev and SNC had many space firsts, including being on the inaugural winning X-Prize team and the design, build, launch, and operation of the first small satellites. He was a founding member and past Chairman of the Commercial Spaceflight Federation, which currently represents more than eighty-five space organizations. He has been inducted as a Fellow of the American Institute of Aeronautics and Astronautics and served on the executive board of the Aerospace Industries Association.

Dr. Sirangelo served for 3 years as the Chief Innovation Officer of the State of Colorado, a cabinet-level position. He is the most recent past Chairman of the U.S. Department of Defense's Defense Innovation Board, which provides advice to the office of the Secretary of Defense, and the founding and past Chair of the DoD's Space Advisory Committee. Previously, he completed an assignment as Special Assistant to the NASA Administrator helping to develop NASA's return to the Moon.

Dr. Sirangelo and his organizations have been recognized with numerous corporate and personal awards. These include being inducted into the Space Foundation's and NASA's Technology Hall of Fame, the World's Top 10 Innovative Space Companies by Fast Company, being named Manufacturer Builder of the Year by *ColoradoBiz* magazine, Best Place to Work by the *Denver Business Journal*, *Inc.* Magazine's top 200 companies, Defense Industry's Fast Track 50, Deloitte's Fast Track 500, and selected as a finalist in Ernst & Young's Entrepreneur of the Year.

Christian J. Lambertsen Memorial Lecture

Chris Lemons

"Last Breath - Reasoning with LIfe and Death at the Bottom of the North Sea"



Chris has been a commercial diver and supervisor for over 18 years, and currently specializes in deep sea saturation diving, operating almost exclusively in the oil and gas industry.

This highly specialized form of diving involves living in the claustrophobic confines of a decompression chamber for up to 28 days at a time, commuting daily to the seabed in a diving bell, and working at depths of up to 900 ft for 6 hours at a time.

In September of 2012, a freak failure of the dynamic positioning system of the vessel he was working under resulted in the umbilical which provides him with breathing gas, light, and heat being severed completely. He was left on the seabed, in complete darkness 300 ft below the surface, with only the 5 minutes of breathing gas he carried in the emergency tanks on his back, and no way to protect himself from the freezing temperatures.

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It took his heroic rescuers over 40 minutes to come back and fetch him, and his miraculous survival story has baffled experts ever since. His extraordinary story was subsequently immortalized in the hit Netflix/BBC documentary 'Last Breath,' a version of which was developed into a Hollywood movie starring Woody Harrelson, Simu Liu, and Finn Cole and was released in February 2025.

Harry G. Armstrong/George B. Hart Memorial Lecture

Joseph Dervay, M.D., MPH, MMS; Richard Moon, M.D., CM, FRCPC, FACP, FCCP; Michael Gernhardt, Ph.D.; Jon Clark, M.D., MPH; and Mitch Garber, M.D., MPH, MSME

Panel: "Pressure Perils from Undersea to Outer Space"

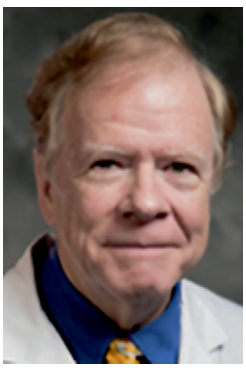


Dr. Joseph Dervay is currently a flight surgeon at the NASA Johnson Space Center, having served there over 27 years. Completing undergraduate studies at Cornell University and a Doctor of Medicine at Syracuse-Upstate Medical Center, he then trained to become a Navy Flight Surgeon, serving aboard the aircraft carrier USS *John F. Kennedy*.

Dr. Dervay has served as crew surgeon for a multitude of missions, encompassing Space Shuttle, long-duration International Space Station, and Commercial Crew, including support of the 2020 NASA/SpaceX Demo-2 test flight as the first Commercial Crew mission. His roles have included work in Russia at the Star City Cosmonaut training center and support of crewmembers during Soyuz launch and landing activities in Kazakhstan.

Dr. Dervay has completed an Emergency Medicine Residency in Washington, DC, at The George Washington University and both a Space Medicine Fellowship and Aerospace Medicine Residency at the University of Texas Medical Branch at Galveston/NASA and Hyperbaric Medicine training at the University of Texas Health Science Center in Houston. He is board certified in Emergency, Aerospace, and Undersea and Hyperbaric Medicine.

In addition to wide-ranging operational duties, Dr. Dervay has contributed to a wide range of research and development efforts in Aerospace Medicine, becoming one of the world experts in EVA physiology and prebreathe protocol development and authoring widely read book chapters and original publications on EVA medicine and physiology. A Fellow of AsMA, he served as President in 2023-2024 and was inducted into the International Academy of Aviation & Space Medicine.



Dr. Richard Moon earned B.Sc. and M.D. degrees at McGill University. He trained in internal medicine and biomedical engineering at the University of Toronto, then in pulmonary and critical care medicine, followed by anesthesiology at Duke University. He joined the Duke University faculty in 1983. He is Professor of Anesthesiology, Professor of Medicine, and Medical Director of the Duke Center for Hyperbaric Medicine & Environmental Physiology. His research has included physiology of immersion and predictors of arterial PCO_2 during underwater exercise. He has been particularly interested in causes and prevention of immersion pulmonary edema, use of an experimental breathing gas (perfluoromethane) to decrease decompression requirements after heliox dives, mechanisms of death during triathlons, causes of perioperative opioid-induced respiratory depression, and improved monitoring techniques for monitoring patients to detect it. His awards include the Mentorship Award from the AMA-Women Physicians Congress Physician Mentor Recognition Program, Leonard Palumbo Jr, M.D., Faculty Achievement Award for compassionate patient care and excellence in the teaching and mentoring of young physicians, Duke awards for Excellence in Medical Student Education, and two awards as Duke Anesthesiology Teacher of the Year.



Dr. Michael Gernhardt is a veteran NASA astronaut, engineer, and scientist with a career spanning ocean engineering, human physiology, and spaceflight systems. He holds a B.S. in Physics from Vanderbilt University and both an M.S. and Ph.D. in Bioengineering from the University of Pennsylvania, where he developed a novel decompression model based on tissue bubble dynamics. While earning his doctorate, he worked as a commercial deep-sea diver and project engineer logging over 700 dives in challenging environments, including saturation and mixed-gas operations. During this time, he contributed to the development of new decompression tables and technologies for subsea applications.

Dr. Gernhardt later became Vice President of Special Projects at Oceaneering International and in 1988 founded Oceaneering Space Systems to transfer subsea technology to the space program. Selected as a NASA astronaut in 1992, he flew four space shuttle missions—STS-69, STS-83, STS-94, and STS-104—logging more than 43 days in space and conducting four spacewalks totaling over 23 hours. He was the first astronaut to perform an EVA from the International Space Station (ISS).

Dr. Gernhardt has led numerous NASA initiatives, including the Prebreathe Reduction Program, which developed safer, more efficient EVA protocols critical to ISS construction. He also contributed to the design of EVA tools, portable life support systems, nitrox diving protocols, and four generations of pressurized rovers as well as serving in technical roles, including Capsule Commander (CAPCOM) at Mission Control, flight software tester, and project lead for the EVA Physiology, Systems, and Performance Project. He conceived and led the NEEMO undersea analog missions and co-led Desert RATS and Pavilion Lake projects simulating planetary exploration. His honors include four NASA Space Flight Medals, two Exceptional Service Medals, the NASA Exceptional Achievement Medal, and the NASA Distinguished Service Medal. Currently he is a senior director at Blue Origin.

Jonathan Clark is an adjunct Associate Professor of Neurology and Space Medicine at Baylor College of Medicine. He served 26 years on active duty with the U.S. Navy, and qualified as a Naval Flight Officer, Naval Flight Surgeon, Navy Diver, U.S. Army parachutist, and Special Forces Military Freefall Parachutist. His as-

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signments included heading a research centrifuge facility and the Neurology and Hyperbaric Medicine divisions at the Naval Aerospace Medical Institute, where he treated diving and altitude decompression sickness and studied divers exposed to high intensity sonar. During Operation Desert Storm he was the 3rd Marine Air Wing Special Projects Officer responsible for Chem/Bio Defense Plan and the Sustained Operations Plan. He flew combat medical evacuation missions and was in the first air element into Kuwait City with the Marine Corps. He ran the aeromedical department at Marine Aviation Weapons & Tactics Squadron One and participated in Marine Recon and ANGLICO team HAHO and HALO jumps.

Dr. Clark worked at NASA from 1997 to 2005, was a Space Shuttle Crew Surgeon on six shuttle missions, Chief of the Medical Operations Branch, and a senior FAA Aeromedical Examiner (AME). He was a Member of the NASA Spacecraft Survival Integrated Investigation Team from 2004 to 2007 and a Member of the NASA Constellation Program EVA Systems Project Office Standing Review Board from 2007 to 2010. He was the Space Medicine Advisor for the National Space Biomedical Research Institute from 2005 to 2017. In 2008 he was an expedition physician supporting the Haughton Mars Project on Devon Island in the high Canadian Arctic. He was Chief Medical Officer for the orbital commercial space company Excalibur Almaz from 2007 to 2012, and Chief Medical Officer for the Inspiration Mars Foundation since 2013. He was Medical Director of the Red Bull Stratos Project, a manned stratospheric balloon freefall parachute flight test program, which on 14 October 2012 successfully accomplished the highest stratospheric freefall parachute jump (highest exit altitude) from 127,852 ft, achieving human supersonic flight (Mach 1.25) without a drogue chute at 843 miles per hour.

In 2012 Dr. Clark joined the StratEx Space Dive project as the lead flight surgeon and medical advisor, and this project culminated in the new high altitude exit freefall record of 135,890 ft and reaching Mach 1.22 at 822 mph in 2014. He currently is a consultant for Virgin Galactic, Heinlein Prize Trust, Paragon Space Development Corp, JAG Human Performance, Space Perspectives, Operator Solutions, and the Foundation for Aerospace Safety and Training. He is board certified in Neurology and Aerospace Medicine and is a Fellow of the Aerospace Medical Association. His professional interests focus on the neurological effects of extreme environments, crew survival, and resilience.

Dr. Mitch Garber is a physician and engineer with over 35 years of military and civilian experience in transportation accident investigation. He was the first (and for 15 years the only) full-time Medical Officer at the U.S. National Transportation Safety Board (NTSB). He has participated in well over 1000 investigations in all transportation modes and has presented testimony to Congress regarding medical issues in transportation accidents. He specializes in the investigation of medical concerns in transportation and other accidents, including the evaluation of pathology, toxicology, human performance, and biomechanics in accident investigation.



Dr. Garber has a B.A. in Psychology/Sociology from Duke University, his M.D. degree from Emory University School of Medicine, an MPH in Occupational and Environmental Medicine from the Harvard University School of Public Health, and an MSME (Master of Science in Mechanical Engineering) from the Georgia Institute of Technology (Georgia Tech).

Dr. Garber has addressed a wide range of medical and human factors issues in all transportation modes, including physical standards, fatigue, perception, medication use, visual impairment, obstructive sleep apnea, substance dependence, injury analysis, egress and evacuation concerns, ergonomics, and the effects of pre-existing disease on transportation operator performance, among others. Additional work specific to aviation has included investigations of hypoxia, spatial disorientation, and visual and vestibular illusions. He has often been called upon to evaluate the potential role of subtle cognitive impairment from a variety of causes in complex transportation accidents. He also has expertise in the optimization of ergonomics for customized office and industrial workstations. He has held a private pilot certification since 1996 and recently retired.

The Bauer Lecture was given on Monday, June 2, at 8:45 a.m. during Opening Ceremonies. Educational Support was provided by KBR.

The Kindwall Lecture was given on Monday, June 2, at 10:00 a.m.

The Reinartz Lecture was given on Tuesday, June 3, at 8:30 a.m. Support was provided by the Eugen Reinartz Memorial Fund.

The Lambertsen Lecture was given on Tuesday, June 3, at 10:30 a.m. Educational support was provided by the Office of Naval Research (ONR).

The Armstrong/Hart Lecture was given on Thursday, June 5, at 8:00 a.m. Eductional support was provided by Environmental Tectonics Corp., the Aerospace Medical Association, and the Undersea and Hyperbaric Medical Society.

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2025 ABSTRACTS OF THE AsMA SCIENTIFIC SESSIONS

95th Annual Scientific Meeting **Hyatt Regency Hotel**
June 1–6, 2025 **Atlanta, GA**

The following are the sessions and abstracts with rooms and presentation times for all presentations accepted after blind peer-review—in workshop, panel, slide, or poster sessions—for the 2025 Annual Scientific Meeting of the Aerospace Medical Association. The numbered abstracts are keyed to both the daily schedule and the author index. The Session numbers are listed as S-1 through S-78 (including workshops). Session chairs are included in the index to participants. The order of some sessions may have changed, so some abstracts may be out of numerical order. Abstracts withdrawn are listed as **WITHDRAWN**. Presenters are underlined in the text.

SLIDES & PANELS: Each slide presentation is scheduled for 15 minutes (10-min talk and 5-min Q&A). We strive to keep slide presentation on time. Panel presentations have more flexibility and may not keep to a strict 15 minutes per presenter format. There will be a discussion period of 15 minutes at the end of each panel.

POSTERS: Posters will be presented digitally this year. Poster authors must be present for the full session in which their poster is scheduled.

EXHIBITS: Exhibits will be open Sunday evening during the Welcome Reception, and 9:30 a.m. to 4:30 p.m. Monday and Tuesday. Please wear your badge and visit every exhibit.

CONFLICT OF INTEREST: All meeting planners and presenters completed financial disclosure forms for this live educational activity. All potential conflicts of interest were resolved before planners and presenters were approved to participate in the educational activity. Any conflicts of interest that could not be resolved resulted in disqualification from any role involved in planning, management, presentation, or evaluation of the educational activity.

TEMPLATES: All Abstracts were submitted according to a certain category and type using provided templates. Not all abstracts submitted fit the mold for Original Research abstracts. We therefore have created an Education category with three additional types: Case Report, Program/Process, and Tutorial. The templates for these are provided for your information.

ORIGINAL RESEARCH TEMPLATE:

This type of abstract describes the results and significance of new research undertaken to address gaps in the current knowledge of aerospace medicine or human performance. It is typically an original analysis of a hypothesis involving data collection and analysis.

INTRODUCTION: *<This section includes the background, including a statement of the problem and why it is important, the status of the current research, and the hypothesis to be tested.>*
METHODS: *<This section includes a brief description of how the study was conducted, the number, type, and gender of the subjects, and how they were selected and grouped. It should also include the metrics collected, how they were measured, and how frequently they were recorded. The types of scales or questionnaires administered should be identified. Environmental condition and administered medications should be described. In addition, a summary of the statistical methods should be provided. A statement concerning ethics approval for studies using human or animal subjects is also required.>*
RESULTS: *<This section includes a summary of the data and metrics of operational and/or statistical significance.* ***"Results will be discussed" is not acceptable.****>*
DISCUSSION: *<This section interprets the meaning of the results in terms of their application to the operational/clinical/scientific community and suggests areas for future research.>*

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EDUCATION: CASE STUDY: CLINICAL OR HUMAN PERFORMANCE TEMPLATE:

This type of abstract describes the analysis of an individual clinical or operational case that is not a research study but provides pertinent information directly applicable to aeromedical practices, safety, or human performance.

INTRODUCTION: *<This section concisely summarizes the case.>*
BACKGROUND: *<This section describes the importance of the case and provides supporting evidence in the form of a literature review.>*
CASE PRESENTATION: *<This section describes the event.>*
DISCUSSION: *<This section explains the applicability and relevance to civilian and military operations.>*

EDUCATION: PROGRAM/PROCESS REVIEW TEMPLATE:

This type of abstract can describe a new Service thrust, e.g., identifying capability gaps, or reviews of critical areas, e.g., safety. It may be a description of a program or process that is used to solve a problem or accomplish a task.

BACKGROUND: *<This section describes why this is important to AsMA attendees and why this needs to be addressed now.>*
OVERVIEW: *<This section concisely describes the effort and how it applies to current or future gaps.>*
DISCUSSION: *<This section describes (1) the operational or clinical significance, (2) how it will this advance aeromedicine/human performance, and (3) address whether it supports cross Service/International/Military – Civilian spheres.>*

EDUCATION: TUTORIAL TEMPLATE:

This type of abstract describes new tools, models, techniques, methodologies pertinent to civilian and military aerospace medicine and human performance.

INTRODUCTION: *<This section summarizes what will be covered, e.g., list of topics or syllabus.>*
TOPIC: *<Description of new technology, procedure, methodology.>*
APPLICATION: *<This section details how the new material will be implemented and how broadly it applies to aerospace medicine and human performance.>*
RESOURCES: *<This is an optional section to provide citations where additional information can be found.>*

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SUNDAY, JUNE 01, 2025

Sunday, 06/01/2025 ***8:00 AM***
Learning Center

[S-1] WORKSHOP: 4TH ANNUAL AVIATION MENTAL HEALTH WORKSHOP - PROGRESS, CHALLENGES, INNOVATION & EVIDENCE – ARE OUR MINDS & SYSTEMS GETTING BETTER? - MORNING SESSSION

Chair: Quay Snyder
Co-Chair: William Hoffman

WORKSHOP OVERVIEW: BACKGROUND: *Mental health is an increasingly visible part of the global aviation system. Efforts are underway globally to optimize the mental health of personnel and the safety of the aerospace system. That said, many open questions remain as to building mental health and wellness in the aviation system of the future.* ***OVERVIEW:*** *This interactive workshop will bring global aviation mental health professionals, operators and regulators to discuss current initiatives, progress, challenges and research efforts to integrate mental wellness support into aviation safety management systems and autonomous programs. The workshop is an initiative of the AsMA Mental Health Working Group. Beginning with a summary of the current state of mental health programs and research in aviation mental health, the program will then highlight current efforts in building mental health awareness and support in all areas of aviation from initial training to career professionals in aviation and air traffic control. Representatives from regional areas around the globe will discussion implantation of peer support programs previously missing structured aviation mental health support systems. Regulators will discuss their initiatives and preliminary data from new policy and regulatory changes. A choice of two breakout session will allow participants to engage in roundtable discussions with colleagues and experts in their area of interest. One breakout will have an operational focus on setting up and revising peer support programs. The second breakout session will focus on the regulatory design concepts and incorporating mental health into aviation Safety management Systems. The workshop will conclude with a summary of research and program development initiatives in the coming years.* ***DISCUSSION:*** *Attendees will have the opportunity to exchange ideas and procedures for advancing mental health support programs for aviation professionals as well as designing systems that reduce barriers to healthcare seeking and positively influence the regulatory design and implementation of research to support a mental health safety management system.*

[1] MENTAL HEALTH AND ITS IMPACT ON AVIATION SAFETY

Johann Magnusson
European Association of Aviation Psychology, Reykjavík, Iceland

(Education - Program / Process Review)

BACKGROUND: While aviation personnel, aeromedical examiners and aviation psychologists all agree that mental health impacts safety there is less consensus on how and to what extent. Having an incomplete view of the different ways mental health can affect safety often leads to an overemphasis on rare, catastrophic events (e.g. the Germanwings accident) rather than the more common slips and mistakes that can occur from poor mental health. **OVERVIEW:** A frequent refrain in aviation medicine is that mental health affects performance and safety, but it becomes more complicated when asked how and to what extent. One reason for that is that aviation is a robust system with multiple safeguards, and therefore very difficult to see the direct linkage between mental health, performance and safety. By looking into research in other fields (e.g. cognitive psychology, psychometrics) we can estimate the type and degree of effects and show how it probably impacts aviation in a more frequent manner. Similarly, research on aviators with specific mental health concerns can be used to better estimate some of the effects that can occur. **DISCUSSION:** Participants will be asked to add specific instances where mental health concerns may have a link to safety performance. Similarly, cases of at-risk behavior, where individuals or workforce, have adapted to compensate for particularly common types of poor mental health concerns will be discussed (e.g. covering for co-workers).

Learning Objectives

1. Understand how mental health can affect performance and safety.
2. Be able to distinguish between performance detriments and compromised decision making.
3. Be aware of the different diagnosable mental health conditions that can have a significant effect on safety measures.

[2] MENTAL HEALTH IN SPACE TOURISM

Duncan Hughes
Chief Medical Officer, Virgin Galactic, Las Cruces, NM, United States

(Education - Program / Process Review)

BACKGROUND: Over the past several years, the explosion of space tourism opportunities has generated significant efforts to define appropriate medical screening of spaceflight participants (SFPs). A paradigm shift from the days of government program absolute exclusion criteria to a commercial 'space for all' approach is underway whereby the decision algorithm is centered on risk mitigation and identification of ways to 'safely get to yes'. But, what about mental health? How is this being screened for in commercial space tourism? Are there exclusion criteria? Are there post flight mental health impacts of layperson spaceflight experiences? If so, are they all positive? **OVERVIEW:** From 2023-2024, Virgin Galactic flew 8 suborbital spaceflights carrying a mixture of employee mission specialists, researchers, and private SFPs to space. These 32 SFPs represent some of the first non-analog data regarding the space tourism suborbital flight experience. The Virgin Galactic approach to mental health screening is reviewed. Observations and lessons learned regarding mental health screening, interpersonal dynamics, observed behaviors, and outcomes are summarized. Additionally, the approach to pre-existing mental health diagnoses, observed interactions, and anticipatory counseling are addressed. **DISCUSSION:** There is no definitive evidence base or consensus regarding how best to screen space tourism participants for mental health issues. Is it really up to each independent service operator to determine how this is best accomplished? Though still few in number, lessons learned from the initial commercial service flights of Virgin Galactic provide important lessons learned in this arena. These lessons provide a window into important considerations for next steps and highlight important research opportunities. The 'overview effect' is amazing; but, is it the only possible response to the spaceflight tourism experience? What is being done to surveil and capture other outcomes?

Learning Objectives

1. Participants will be able to describe the importance of screening for mental health in space tourism participants.
2. Attendees will be able to understand how Virgin Galactic is conducting mental health screening and surveilling for the potential impacts of the space tourism experience.
3. Participants will be able to describe how lessons learned in initial commercial Virgin Galactic flights have resulted in iterative changes to the medical team's approach to screening.

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[3] PROGRESS FOR CABIN CREW MENTAL HEALTH

Heather Healy
Association of Flight Attendants Employee Assistance, Washington, DC, United States

(Education - Program / Process Review)

BACKGROUND: Cabin crew are an essential component of commercial aviation safety operations. In addition to stressors experienced by all individuals, cabin crew are faced unique occupational stressors both while on duty in the aircraft and additional occupation related factors that complicate seeking and obtaining mental health care. **OVERVIEW:** This presentation will highlight recent survey findings of health care avoidance by North American based Cabin Crew. Key considerations that may improve mental health care engagement and satisfaction when designing peer support and intervention programs for Cabin Crew globally will be discussed. **DISCUSSION:** The importance of membership data and survey findings to enhance peer and mental health care utilization will be emphasized.

Learning Objectives

1. Participants will understanding the diverse need and characteristics of Cabin Crew.
2. Participants will recognize a range of factors that may be linked to peer and mental health utilization.
3. Participants will understand the value of utilizing member surveys and feedback for program refinements.

[4] MENTAL WELLNESS CHALLENGES FOR BUSINESS AVIATION

Mark Larsen, Lailla Stein
National Business Aviation Association, Washington, DC, United States

(Education - Program / Process Review)

BACKGROUND: Business aviation organizations often face unique challenges from those of larger airlines when supporting the mental health of their aviation professionals. As a significant segment of operations in the national airspace system, access to mental health support should similarly be available to this industry segment. **OVERVIEW:** Business aviation organizations come in all types and sizes. Most business aviation organizations have one aircraft, and only 1-3 pilots, often depending on the number of pilots legally required for flight and the total annual hours expected to be flown. Larger Part 91 flight departments may have roughly 50 employees, though these organizations often feel resource-constrained for the multiple aircraft they fly. Only a few large business aviation charter management and fractional ownership programs employ numbers of people akin to the airlines with internal peer support programs that are viable. One constant among business aviation organizations is that their pilots, maintainers, flight attendants, schedulers/dispatchers, and managers can all benefit from access to peer support, just as these employee groups within airlines benefit from their own peer support programs. Aggregating the resources of business aviation organizations to provide peer support could be one way to provide this critical mental wellness tool to more business aviation organizations than possible with internal programs. **DISCUSSION:** Business aviation organizations can benefit from peer support programs and it is up to the industry to innovate existing peer support models to normalize mental wellness in aviation, remove barriers to seeking help, and provide for enhanced mental health within the business aviation sector.

Learning Objectives

1. Attendees will learn about organizational differences between common business aviation operations and scheduled airline operators, relative to peer support programs.
2. Attendees will learn about possible ways that business aviation organizations could viably implement peer support programs to support mental wellness among their employees.
3. Attendees will learn about regulatory differences between United States business aviation operators and operators from other countries.

[5] THE NEXT GENERATION IN AVIATION MENTAL HEALTH

Sky Overbo, Zoe Thompson
University of North Dakota, Grand Forks, ND, United States

(Education - Program / Process Review)

BACKGROUND: With a new generation beginning to enter the airspace, understanding the changing perspectives surrounding mental health is vital for aviation medicine, mental health care, and safety. Acknowledging and working with different communication styles, reducing stigma, understanding unique stressors, and encouraging discourse surrounding mental health among the generations can help improve the safety of aviation. Overall, addressing these differences fosters a supportive and responsive environment in the aviation industry. **OVERVIEW:** Aviation is an industry of culture and regulations ensuring safety in the skies with mental health playing a large role in safety. As the workforce continues to change, generational differences surrounding mental health, stigma, and communication methods have not been addressed. These differences, if not addressed, could lead to a decrease in safety and the health of aviation professionals by isolating both the new and old generations. **DISCUSSION:** Medicine, psychology, and aerospace science are all fields that are constantly changing as new research is disseminated. As legislative and regulatory bodies begin acknowledging the importance of mental health, changes in how psychological well-being is promoted and achieved must follow. This presentation not only explores generational differences in mental health perceptions and communication, but also provides more information on practices that have been productive in improving the culture of mental health in aviation.

Learning Objectives

1. Attendees will understand the unique challenges facing aspiring aviator professionals in both disclosing previous and seeking ongoing mental healthcare and the impact on future career opportunities.
2. Attendees will be familiar with evolving communication preferences regarding health care in younger generations.
3. Attendees will be familiar with sources of health care information used by aspirating aviation professionals.

[6] WITHDRAWN

[7] IMPLEMENTATION OF PEER SUPPOORT IN THE MID-EAST: INSIGHTS FROM QATAR AIRWAYS

Stuart Mitchell
Qatar Airways, Doha, Qatar

(Education - Program / Process Review)

INTRODUCTION: In the high-pressure environment of aviation, protection of good mental health is not only critical for pilot's overall well-being but also essential for the flight safety and performance. Recognizing the unique challenges faced by pilots, and the emerging regulations and guidance from around the world, Qatar Airways has prioritized evolving a supportive culture through a tailored Pilot Peer Support Program (PPSP) with the aim of promoting psychological safety and trust in a particularly diverse workforce. **OVERVIEW:** The presentation will provide practice-based reflections on the lessons learnt from the special challenges that were faced in developing a compliant programme that was mindful of the local/regional challenges and offer insights for airlines looking to adopt similar support programs, emphasizing the importance of regional awareness and cultural adaptability in global aviation mental health initiatives. The challenges faced and the insights learnt from the successful implementation of the PPSP at Qatar Airways, will be discussed, with emphasized focus on cultural, regional, and operational considerations. Some of the key factors addressed in the presentation include the integration of mental health support into a dynamic and diverse work culture, where pilots from varied backgrounds must handle not only the

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challenges of flying but also individual, cultural and language differences. **CONCLUSIONS:** We will in particular discuss insights on the role of cultural distinctions in the Gulf region, where stigma surrounding mental health poses an additional barrier to healthcare seeking behaviors. Through the implementation of the PPSP and plans for future expansion to other employee groups, Qatar Airways demonstrates a commitment to building a culture of mental health support and prevention across its diverse workforce.

Learning Objectives

1. The audience will learn about the challenges in addressing mental health issues in a culturally diverse work force.
2. Participants will learn strategies to destigmatize mental health care seeking in cultures traditionally averse to acknowledging disturbances in mental wellness.
3. Participants will understand the safety and operational implications of ignoring mental health challenges in multicultural international airline operations.

[8] MENTAL HEALTH IN SOUTH AMERICAN AVIATION: CHALLENGES AND INITIATIVES

José Aguiar[1], Erica Ermel[2], Audrey Savini[1], Helton Dourado[1], Lia Ribeiro[1], Maria Bertolino[3], Vania Melhado[1]
[1]*Azul Linhas Aéreas, São Paulo, Brazil;* [2]*Latam Airlines, São Paulo, Brazil;* [3]*Latam Airlines, Santiago, Chile*

(Education - Program / Process Review)

BACKGROUND: Mental health in aviation is a critical issue, given its direct impact on personnel safety, performance, and well-being. South America, with its 12 culturally diverse countries and one overseas territory, and distinct civil aviation authorities, lacks a unified regional approach to mental health. Although all countries are ICAO (International Civil Aviation Organization) signatories, the absence of harmonized regional guidelines hinders the development of effective prevention and treatment strategies. The post-pandemic environment, marked by increased operational demands and persistent stigma surrounding mental health, exacerbates these challenges and calls for immediate action. **OVERVIEW:** Current efforts to address mental health in South American aviation focus on two primary areas: general mental health disorders and the misuse of psychoactive substances. Brazil has established comprehensive regulations addressing the misuse of psychoactive substances, which include, but are not limited to, mandatory toxicological testing for safety-critical roles. These programs encompass broader preventive measures aimed at managing substance use within the aviation sector. However, structured mental health promotion and comprehensive psychological support remain largely absent. To fill these gaps, airlines such as Azul and Latam have independently developed programs, including peer support networks and psychiatric services, representing pioneering efforts in supporting the broader mental health needs of aviation personnel. **DISCUSSION:** These initiatives have significant operational implications, as they directly contribute to the safety and performance of flight crews. They offer early support mechanisms that help prevent mental illness and reduce the risk of accidents. Economic instability and post-pandemic labor shortages in the aviation sector further intensify the pressures on personnel, making such programs even more essential. Additionally, the initiatives developed by South American airlines, such as Azul and Latam, which have been carried out for over 10 years, could serve as models for other regions. promoting a more resilient and mentally healthy global aviation workforce and inspiring the adoption of international standards for mental health care in aviation.

Learning Objectives

1. Understand the unique mental health challenges faced by South American aviation, including the lack of harmonized regional guidelines and the impact of post-pandemic operational demands and stigma.
2. Evaluate the role of peer support networks and psychiatric services, as implemented by airlines such as Azul and Latam, in promoting mental health and operational safety in aviation.

[9] CURRENT STATUS OF PEER SUPPORT PROGRAMS AND THE AIR TRAFFIC CONTROL WORKFORCE

Andrew LeBovidge
International Federation of Air Traffic Control Organizations (IFATCA), Washington, DC, United States

(Education - Program / Process Review)

BACKGROUND: Peer Support Programs are gaining traction in the aviation community as an effective method to address the mental wellbeing individuals performing critical safety work. Air Traffic Control Specialists (ATCOs) represent a significant body of that universe and work has just begun to initiative such programs in this community. Critical Incident Stress Management (CISM) programs are only in use by ATCOs in a limited number of countries, and other Peer Support Programs to address generalized mental health issues are only now being considered or implemented for ATCOs. **OVERVIEW:** Participants will learn how Peer Support Programs of all types have been historically used in the international ATCO community and what recent progress that has been made to broaden and deepen the use of such programs in the ATCO sphere. ATCO have a unique position in the industry – as there are various models of Air Navigation Service Providers (ANSPs) which can create a complex web of employment and regulatory barriers to mental health matters. Additionally, the nature of the ATCO 24/7/365 work combined with the global shortage of ATCO creates an environment which is conducive to stress, anxiety, and other mental health conditions. **DISCUSSION:** The participants will discuss the techniques being employed to address the barriers for ATCOs to report mental health matters and hurdles that remain to confront the dearth of mental health support in the ATCO community. The participants will also gain exposure to an oft underrepresented constituency in the aviation industry – the unsung and unseen personnel who bear the burden of ensuring the safety of the airspace while having to preserve their own wellbeing.

Learning Objectives

1. Attendees will be familiar with current limited resources for mental health support among Air Traffic Service Provider (ATSP) organizations.
2. Attendees will be able to state unique mental health challenges to the ANSP organizations and the ATCO workforce.
3. Attendees will be familiar with the role of mental health support in the ATCO workforce as a critical element of aviation safety.

[10] SAFE HAVEN – INITIAL IMPRESSION

Kate Manderson[1], Tim Sprott[2]
[1]*Civil Aviation Safety Authority - Australia, Nowra, Australia;* [2]*Civil Aviation Authority New Zealand, Auckland, New Zealand*

(Education - Program / Process Review)

BACKGROUND: This session will provide attendees with an update on the Safe Haven program being delivered by the National Aviation Authorities of Australia and New Zealand. Safe Haven allows pilots and air traffic control officers to work directly with their trusted peers and aviation medical examiners on assessment of whether their mental health or medical condition poses a hazard to safe air navigation. The intent is to reduce or remove the barriers to help-seeking and disclosure, resulting in a healthier and safer aviation system. **OVERVIEW:** Representatives of the medical sections of the Civil Aviation Safety Authority of Australia and the Civil Aviation Authority of New Zealand will provide an overview of the program framework and governance processes for Safe Haven. Particular attention will be given to the medical and mental health conditions that are eligible for inclusion, including a discussion of the risk assessment processes used to confirm safety and suitability. There will also be a discussion on the content and provision of training for Medical

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Examiner-Safe Haven (MESH) and Peer Support Providers (PSPs) which further provide assurance to CASA and CAA NZ that the Safe Haven program is being implemented safely and effectively by competent providers. The presenters will briefly review the challenges and strategies to implementation to date, and next steps for review and improvement. **DISCUSSION:** the session will raise awareness of opportunities for NAAs to consider a new, risk-based approach to assessment and certification of pilots and ATCOs with mental health and other medical issues. By sharing the experiences to date, the presenters hope to enable other NAAs to begin to consider their own strategies to increase the level of trust within their medical certification system.

Learning Objectives

1. Participants will understand the principles of aviation safety and risk assessment to medical and mental health conditions.
2. Participants will be able to identify required skills and knowledge for aviation medical examiners and peer support provides to perform mental health risk assessments.
3. Participants will be able to explore opportunities to incorporate specialized training and risk assessment tools for safe certification of people with mental health issues.

[11] SAFE HAVEN – REGULATORY DESIGN AND SAFETY MANAGEMENT SYSTEMS

David Powell[1], Kate Maderson[2], Tim Sprott[3], Laurie Shaw[4], Wiliam Hoffman[5]

[1]*Safe Haven Trust, Auckland, New Zealand;* [2]*Civil Aviation Safety Authority, Australia, Canberra, Australia;* [3]*Civil Aviation Authority, New Zealand;* [4]*Airservices, Australia, Brisbane, Australia;* [5]*59th Medical Wing, U.S. Air Force, San Antonio, TX, United States*

(Education - Program / Process Review)

BACKGROUND: This break-out session is part of the 4th Annual Aviation Mental Health Workshop discussing current progress and efforts to integrate mental wellness support into aviation programs. This break-out focuses on Regulatory Design and Safety Management Systems associated with Safe Haven initiatives. **OVERVIEW:** Safe Haven is an initiative proposed in a paper to the 2022 assembly of the International Civil Aviation Authority (ICAO). This is a high trust model aimed specifically at addressing the known reluctance of pilots to report medical problems, and the even greater problem of healthcare avoidance by aviators. In essence Safe Haven involves a National Aviation Authority (regulator) selecting, training, and empowering some of its Aviation Medical Examiners to deal with a wide range of problems in certificate holders (pilots and air traffic controllers) without the usual obligation for the details of those problems to be notified to the regulator. Safe Haven is a medically based program which is separate from peer support groups but sits alongside them with similar aims. There are historical examples of such an approach being successful in military and airline settings. There are also requirements for an appropriate regulatory foundation, safety management, escalation pathways and "guard rails", professional supervision of medical examiners, a degree of independence from the regulator, and audit of performance. Two countries have commenced implementing a Safe Haven system. The breakout session will be convened by facilitators involved in designing such a system and will brainstorm the challenges and requirements. **DISCUSSION:** At the end of the break-out, participants will reconvene to discuss ideas and systems for advancing mental health support for aviation professionals, reducing barriers to healthcare seeking and supporting a mental health safety management system.

Learning Objectives

1. Participants will be able to identify the aims and key features of a Safe Haven program for aviators.
2. Participants will be able to identify the regulatory barriers and foundation for such a program.
3. Participants will understand how Safe Haven can integrate with a safety management system.

Sunday, 06/01/2025 ***12:00 PM***
Learning Center

[S-2] WORKSHOP: 4TH ANNUAL AVIATION MENTAL HEALTH WORKSHOP - PROGRESS, CHALLENGES, INNOVATION & EVIDENCE – ARE OUR MINDS & SYSTEMS GETTING BETTER? -AFTERNOON SESSSION

Chair: Quay Snyder
Co-Chair: Williiam Hoffman

Workshop Overview: BACKGROUND: *Mental health is an increasingly visible part of the global aviation system. Efforts are underway globally to optimize the mental health of personnel and the safety of the aerospace system. That said, many open questions remain as to building mental health and wellness in the aviation system of the future.* ***OVERVIEW:*** *This interactive workshop will bring global aviation mental health professionals, operators and regulators to discuss current initiatives, progress, challenges and research efforts to integrate mental wellness support into aviation safety management systems and autonomous programs. The workshop is an initiative of the AsMA Mental Health Working Group. Beginning with a summary of the current state of mental health programs and research in aviation mental health, the program will then highlight current efforts in building mental health awareness and support in all areas of aviation from initial training to career professionals in aviation and air traffic control. Representatives from regional areas around the globe will discussion implantation of peer support programs previously missing structured aviation mental health support systems. Regulators will discuss their initiatives and preliminary data from new policy and regulatory changes. A choice of two breakout session will allow participants to engage in roundtable discussions with colleagues and experts in their area of interest. One breakout will have an operational focus on setting up and revising peer support programs. The second breakout session will focus on the regulatory design concepts and incorporating mental health into aviation Safety management Systems. The workshop will conclude with a summary of research and program development initiatives in the coming years.* ***DISCUSSION:*** *Attendees will have the opportunity to exchange ideas and procedures for advancing mental health support programs for aviation professionals as well as designing systems that reduce barriers to healthcare seeking and positively influence the regulatory design and implementation of research to support a mental health safety management system.*

[12] IPAAC INITIATIVES - NEW HORIZONS

Dave Fielding

International Peer Aviation Assistance Coalition, Auckland, New Zealand

(Education - Program / Process Review)

BACKGROUND: Accidents such as the 2015 Germanwings crash or the 2022 China Eastern 737 (due to pilot murder suicide), and non-fatal incidents such as Jet Blue (2012) and Horizon Air (2023) which were due to mental breakdown by pilots in the cockpit, represent the 'tip of the iceberg' – the high-profile result of degraded mental health in pilots. But what about deteriorating mental health on a lesser scale which lies hidden beneath the waterline? The Heinrich Triangle theory posits the relationship between accident, incident and near miss / far miss / systemic issues. Focusing on the systemic reasons underlying accidents using this model has improved technical flight safety dramatically in the past 30+ years through data assessment and threat management. Can these techniques be applied in the same way to mental wellbeing and performance in pilots? **OVERVIEW:** Data gathering from aircraft systems is much easier than gathering data from the human mind, but it is possible. Peer-reviewed research into pilot mental health issues is already identifying trends and barriers that result in pilots not seeking help for these issues, thus potentially compromising flight safety. Peer

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Support Programmes are beginning to gather usage data in systematic ways which are highlighting specific wellbeing issues that are affecting pilot performance. Finally, discussions have started with the Air Accident Investigation bodies to try and identify accidents or incidents which have a significant causal factor of distractions as a result of mental health issues. **DISCUSSION:** Data from these differing sources need to be combined into one process which integrates into an operator's Safety Management System. This presentation explores how identifying specific mental health issues amongst pilots can result in: 1. A greater understanding of how undisclosed, untreated and unmonitored mental health issues amongst pilots can represent a significant threat to flight safety 2. The role of PSPs being expanded to raise awareness of the potential impact of these issues as part of a pilot's professional toolkit. 3. The creation of a Mental Wellbeing (MW) competency, similar to other ICAO pilot competencies 4. The training of this competency, and its associated performance indicators, amongst the pilot workforce

Learning Objectives

1. The audience will understand through demonstration that although accidents and deaths by pilot murder suicide are extremely rare, incidents and near/far misses due to mental health issues in pilots are not.
2. Participants will understand that greater data gathering and analysis is required in order to be able to identify early those mental wellbeing and performance issues which have the potential to impact on flight safety if undisclosed, untreated and unmonitored.
3. Participants will learn how this knowledge of mental health support statistical analysis will allow training to be developed which will increase pilot resilience and awareness of the impact of mental wellbeing and performance issues.

[13] AFTER ME SAFE - IMPLEMENTATION CHALLENGES

Janis Vegers, Cristian Panait, Mateja Kotnik-Kerbev, Pedro Caetano, Virgilijus Valentukevicijus
EASA, Cologne, Germany

(Education - Program / Process Review)

BACKGROUND: The "Mental Health for Aviation Safety" (MESAFE) project, conducted over 24 months, aimed to provide evidence and formulate recommendations for enhancing mental health assessments during initial and recurrent aero-medical examinations of pilots and ATCOs. **OVERVIEW:** MESAFE provided evidence regarding the diagnostic tests, prevention and treatments strategies for mental health pathologies and impact on aviation safety of various mental health pathologies. The evidence was transposed into 44 recommendations to enhance aviation safety by preventing mental health problems as well as efficient screening and treatment of mental health pathologies. "It is better to prevent than to treat". Nevertheless, prevention is a concept that involves multiple layers starting from the individual and continuing with the employer, the aero-medical examiner and the regulator working symbiotically. Acknowledgement of mental illness and asking for support with mental wellbeing continues to be the starting point of any preventive work. And here denial, fear of consequences and stigma are major obstacles to overcome by the individual alone before getting to the point of asking for support. Several aviation regulators are taking a best-practice preventive approach with the use of support groups and peer programs to facilitate the management of risk factors, and to prevent their evolution into established mental illness. The screening and treatment of mental health pathologies requires customisation more than in the case of organic disorders. Regulating these aspects presents multiple challenges as it requires sufficient flexibility to be effective while at the same time a proper legal framework to ensure safety. Such regulatory changes require a change of mindset among all stakeholders and that, in turn, requires time, training and willingness to improve. **DISCUSSION:** Regulating the field of mental health for all categories of aeronautical personnel is a challenge in itself. However, we must strive to apply scientific methods in a multi-layered approach to the prevention, assessment and management of mental health issues. Proper assessment and mitigation of mental health issues can only be effective if all stakeholders involved are committed to their part of the puzzle.

Learning Objectives

1. Attendees will understand the multi-layered approach to mental health prevention and the roles of individuals, employers, and regulators in aviation safety.
2. Participants will be able to analyse the challenges of customizing mental health screening and treatment for aeronautical personnel.
3. Attendees will understand the importance of the preventive work including identification and early mitigation of risk factors in maintaining mental health and wellbeing for aviation personnel.

[14] FAA MENTAL HEALTH POLICY UPDATES

Susan Northrup
FAA, Washington, DC, United States

(Education - Program / Process Review)

BACKGROUND: The FAA has made many changes and updates in the past year. The Mental Health and Medical Clearance Aviation Rulemaking Committee accelerated the modifications and enhancements. **OVERVIEW:** This session will review the MH ARC process and recommendations as well as progress on those recommendations. Where possible, the outcomes will be discussed as the policies have been changed. **DISCUSSION:** Recent outreach efforts will also be discussed in the effort to reduce the barriers for seeking care. Finally, the three "Es" – Education, Early Intervention, and Evolution of Standards will be presented.

Learning Objectives

1. Attendees will gain awareness of recent FAA policy changes.
2. Attendees will understanding of the three "Es" of enhancing wellness.
3. Attendees will be familiar with future FAA efforts to enhance mental health in aviation.

[15] MENTAL HEALTH IN AVIATION RESEARCH: BUILDING AN EVIDENCED BASED APPROACH

William Hoffman
59th Medical Wing, U.S. Air Force, San Antonio, TX, United States

(Education - Program / Process Review)

BACKGROUND: Mental health in global aviation is changing at an accelerating rate, driven by novel approaches to new challenges. Stakeholders across aviation are hopeful to drive innovation though data, though questions remain about how to design studies, share data, and build research partnerships. **OVERVIEW:** This presentation will summarize high-impact research studies, programs, and efforts related to mental health global aviation aiming to inform follow-up discussions in the workshop related to mental health. A discussion about efforts to build multi-national research partnerships, fund research, and translating data into policy will follow. The presentation will conclude with a summary of efforts associated with the Aerospace Medical Association Mental Health Working Group including consensus research priorities. **DISCUSSION:** Efforts are underway to optimize mental health and wellness in aviation on a global scale. Quality research and credible data should be a key tool to inform efforts ahead. This session aims to be a high yield review of research related to mental health in global aviation aiming to support the workshop.

Learning Objectives

1. Participants will be able to list two research projects related to mental health in aviation and describe how they can inform future efforts.
2. Participants will be able to describe the objective of the AsMA Mental Health Research Priories effort how this project can support future research.

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Sunday, 06/01/2025 ***8:00 AM***
Hanover A

[S-3] WORKSHOP: AEROSPACE MISHAP EPIDEMIOLOGY - THE SCIENCE OF THE DENOMINATOR

Chair: Peter Mapes

Workshop Overview: INTRODUCTION: *The learning objectives for the Workshop are as follows: Individuals completing this course will be able to:*

1. Understand the language of epidemiology and how it applied to aviation mishap analysis.
2. Identify inadequate statistical analyses.
3. Know about EPI INFO™ and have a rudimentary ability to employ it in the field.
4. Design adequate studies of rudimentary parametric and non-parametric data.
5. Understand the importance of adequate power.
6. Understand the importance of adequate denominator data.
7. Be able to look at displayed data and determine adequacy of analyses.
8. Understand modeling and regression at a fundamental level.
9. Understand the Bradford-Hill criteria for causality.

Note: Previous attendees have noted that this is an excellent Board Review session. ***TOPIC:*** *The Workshop on Aerospace Epidemiology will educate attendees on how the mathematics of epidemiology are applied to aerospace safety and mishap prevention.* ***APPLICATION:*** *The mathematics of epidemiology can be broadly and effectively utilized to conduct meta-analyses of aerospace mishap data. The results of these analyses can be used to focus actions and requirements on data driven conclusions that are currently largely absent from the safety process. The mathematical principles to be covered are well accepted but rarely utilized to analyze aerospace mishap data.* ***RESOURCES:*** *The course will be accompanied by a customized text serving as a reference for the mathematical applications well established in the public domain. The course will also be accompanied by problems for attendees to work through under supervision so that practical experience in aerospace epidemiology can be obtained. Attendees need to bring an adequately charged laptop computer to the course with a copy of the applicable EPI INFO programming loaded from the Centers for Disease Control & Prevention web site.*

[16] AEROSPACE EPIDEMIOLOGY & STATISTICAL ANALYSIS

Peter Mapes
Retired, Oscoda, MI, United States

(Education - Program / Process Review)

TOPIC: The Workshop on Aerospace Epidemiology will educate attendees on how the mathematics of epidemiology are applied to aerospace safety and mishap prevention. **APPLICATION:** The mathematics of epidemiology can be broadly and effectively utilized to conduct meta-analyses of aerospace mishap data. The results of these analyses can be used to focus actions and requirements on data driven conclusions that are currently largely absent from the safety process. The mathematical principles to be covered are well accepted but rarely utilized to analyze aerospace mishap data. **RESOURCES:** The course will be accompanied by a customized text serving as a reference for the mathematical applications well established in the public domain. The course will also be accompanied by problems for attendees to work through under supervision so that practical experience in aerospace epidemiology can be obtained. Attendees need to bring an adequately charged laptop computer to the course with a copy of the applicable EPI INFO programming loaded from the Centers for Disease Control & Prevention web site.

Learning Objectives

1. Individuals completing this course will be able to: understand the language of epidemiology and how it applied to aviation mishap analysis; identify inadequate statistical analyses; and know about EPI INFO™ and have a rudimentary ability to employ it in the field.
2. Individuals in this course will be able to design adequate studies of rudimentary parametric and non-parametric data; understand the importance of adequate power; and understand the importance of adequate denominator data.
3. Attendees will be able to look at displayed data and determine adequacy of analyses; understand modeling and regression at a fundamental level; and understand the Bradford-Hill criteria for causality.

MONDAY, JUNE 02, 2025

Monday, 06/02/2025 ***2:00 PM***
Centennial Ballroom I

[S-4] PANEL: CARDIOVASCULAR SCREENING FOR AIRCREW

Chair: Norbert Guettler
Co-Chair: David Holdsworth

Panel Overview: *Cardiovascular anomalies, abnormalities or frank pathology are the most common causes of medical downgrading or occupational limitation of aircrew. Aircrew are typically asymptomatic and are generally younger than the cardiovascular medicine patient population. As such, cardiovascular screening lies outside the normal remit of clinic and hospital-based medicine. Failure to identify coronary artery disease, valvular heart disease and heart muscle disease in aircrew has potentially fatal consequences. This session reviews the most up to date evidence and data on cardiovascular screening of asymptomatic individuals. We explore the variety of approaches to cardiovascular screening in different national jurisdictions and contrast the use of cardiovascular investigations for asymptomatic aircrew with that among symptomatic patient groups.*

[17] SCREENING FOR CARDIAC ARRHYTHMIA IN MILITARY AIRCREW – DIFFERENCES AND SIMILARITIES IN SEVEN NATIONS

Norbert J. Guettler[1], David Holdsworth[2], Thomas Syburra[3], Olivier Manen[4], Lysette Broekhuizen[5], Denis Bron[6], Gary Gray[7], Eddie Davenport[8]
[1]*German Air Force Centre of Aerospace Medicine, Cologne, North Rhine-Westphalia, Germany;* [2]*Academic Centre of Military Medicine, Birmingham, United Kingdom;* [3]*Fliegerärztliches Institut der Luftwaffe, Dübendorf, Switzerland;* [4]*Percy Military Hospital, Clamart, France;* [5]*University Medical Center Utrecht and Central Military Hospital, Utrecht, Netherlands;* [6]*Aeromedical Centre, Swiss Air Force, Dübendorf, Switzerland;* [7]*Canadian Forces Environmental Medical Establishment, Toronto, Ontario, Canada;* [8]*USAFSAM, Dayton, OH, United States*

(Education - Tutorial / Review)

INTRODUCTION: Cardiac arrhythmia and conduction abnormalities are important causes of denial or loss of aircrew licenses. Screening is therefore crucial and is often performed in a stepwise approach. Abnormalities are age dependent and include atrial fibrillation and atrial flutter in older individuals, whereas channelopathies and ventricular pre-excitation are more often found in young applicants. Ventricular and supraventricular ectopy and tachycardias can be found in all age groups. Abnormal ECG findings in young and sportive individuals with high vagal tone may be acceptable without further evaluation. Due to the challenging working environment, screening for arrhythmia and conduction disturbances is of utmost

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importance in all age groups. **TOPIC:** Screening policies for arrhythmia and conduction abnormalities of the seven nations participating in the working group vary, they will be compared and discussed. The aim of the three-year project ahead will be a harmonization of policies, and the development of international consensus recommendations to foster international cooperation and interoperability. A stepwise screening approach with medical history including family history, physical examination and resting-ECG as basic screening, and more sophisticated examinations including the analysis of underlying diseases and risk factors on a second and third level has already been recommended by a former NATO working group. Meanwhile, novel screening devices including wearables (smartphones, watches, patches, belts etc.) emerge in the general population. They may be based on electrocardiography, photoplethysmography, mechanocardiography, or oscillometry. Different mechanisms, their use for cardiac screening in military aircrew, guideline recommendations, and legal aspects will be discussed and illustrated. **APPLICATION:** National screening policies for arrhythmia and conduction abnormalities are different and may be age dependent. The aim of the current NATO working group is the evidence-based development of international consensus recommendations for arrhythmia screening with a focus on military aircrew applicants. Results could be adapted for other high-hazard occupations within and outside the military.

Learning Objectives

1. Understand differences in international screening policies and the use of harmonization.
2. Learn examples for a stepwise screening for arrhythmia and conduction abnormalities.
3. Learn different mechanisms of wearables for arrhythmia screening, and their applicability for the screening of military aircrew.

[18] INTERNATIONAL APPROACHES TO SCREENING FOR CORONARY ARTERY DISEASE IN AIRCREW - CAN WE AGREE TO DISAGREE

Eddie Davenport[1], Lysette Broekhuizen[2], David Holdsworth[3], Norbert Guettler[4], Thomas Syburra[5], Denis Bron[6], Oliver Manen[7], Gary Gray[8]

[1]*USAFSAM, Wright-Patterson AFB, OH, United States;* [2]*Central Military Hospital, Ultrecht, Netherlands;* [3]*Academic Department of Military Medicine, Oxford, United Kingdom;* [4]*German Air Force Centre of Aerospace Medicine, Cologne, Germany;* [5]*Fliegerarzliches Institut der Luftwaffe, Dubendorf, Switzerland;* [6]*Aeromedical Centre Swiss Air Force, Duebendorf, Switzerland;* [7]*Percy National Military Hospital Military Aeromedical Centre, Clamart, France;* [8]*Canadian Forces Environmental Medical Establishment, Toronto, Canada*

(Education - Program / Process Review)

BACKGROUND: Coronary artery disease (CAD) is the leading cause of death globally and is attributed to over 18 million deaths a year. More concerning is the most common presenting symptom of severe CAD is sudden cardiac death. However, there is no international consensus on how to screen our aircrew for CAD. Optimal screening for CAD is very controversial and must be evidence-based. **OVERVIEW:** Screening ECG and echocardiogram and exercise stress testing with or without imaging are very poor predictors of CAD with a positive predictive value of 16%. A global cardiac risk score is a better predictor of risk for major adverse cardiovascular events (MACE); however, it is also limited in an asymptomatic population with a false positive and false negative rate that exceeds true positives. Coronary artery calcium scoring (CACS) has emerged to further characterize cardiac risk with a sensitivity and specificity of over 90% for MACE over 10 years. However, CACS is still a limited assessment of the coronary artery anatomy and can miss significant coronary artery disease. CT coronary angiography (CTCA) provides a complete assessment of the degree of CAD and, thus, perhaps the best screening modality for aircrew. However, CTCA concerns include availability, cost, radiation, and IV contrast exposure. **DISCUSSION:** CAD is a leading cause of disqualification or denial of licensure in both civilian and military pilots. A thorough investigation, including aircrew data on the sensitivity, specificity, and positive and negative predictive values of various modalities of screening for coronary artery disease, will be presented. Although data is limited, mounting evidence can likely change how the world screens for heart disease in aircrew. An international, NATO-supported occupational cardiology working group has recently been established to provide international consensus on screening processes for aircrew.

Learning Objectives

1. Understand the strengths and weaknesses of various screening modalities for coronary artery disease in aircrew.
2. Appreciate the differences in how 7 different countries screen for coronary artery disease.
3. Learn a path forward for an international, evidence-based approach to screening for coronary artery disease in asymptomatic aircrew.

[19] SCREENING FOR AORTIC AND VALVULAR HEART DISEASES IN AIRCREW APPLICANTS

Thomas Syburra[1], David Holdsworth[2], Olivier Manen[3], Denis Bron[4], Lysette Broekhuizen[5], Eddie Davenport[6], Gary Gray[7], Norbert Guettler[8]

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(Education - Tutorial / Review)

INTRODUCTION: Epidemiology of aortic disease (AD) is poorly studied. AD and valvular heart disease (VHD) are relevant during aircrew screening, both conditions later potentially leading to sudden incapacitation. The lack of symptoms at early stage challenges the screening process. AD may later lead to acute aortic dissection. VHD, such as mitral valve prolapse causing atrial fibrillation, aortic stenosis or regurgitation, may later interfere with optimal cardiac output under high +Gz conditions. We emphasize the value of rigorous chest auscultation for VHD detection and of in-depth family history exploration for AD detection prior to imaging investigations. Our NATO group compares the recommendations of 7 nations to develop an international consensus for the aeromedical community. **TOPIC:** Aortic dilation of the root and ascending aorta is defined as diameters 40–45 mm. Aortic aneurysm is defined as >45mm for the root and ascending aorta. Thoracic aortic aneurysm incidence ranges from 5 to 10 per 100 000 person-years. The incidence rate per 100 000 patient-years at risk is 15 for aortic dissection, 27 for abdominal aortic aneurysm and 9 for thoracic aortic aneurysm. Most VHD in Western countries are degenerative, rheumatic is rare. Prevalence of degenerative VHD increases with age and affects about 1% of adults under 55 years. Congenital VHD like bicuspid aortic valve is expected in about 1-2% of the population. Advanced surgical techniques such as robotic mitral valve repair, valve sparing root repair and complex aortic surgery including frozen elephant trunk arch repair are widely available. New autologous valve prostheses allow Ross procedures without homograft and for autologous tricuspid valve replacement. Next-generation mechanical heart valves without oral anticoagulation have reached advanced stage animal testing and are today at the edge of clinical approval. **APPLICATION:** Detection of AD and VHD is challenging during screening and requires thorough examination. In applicants with AD or VHD, appropriate surgical repair techniques are crucial for medical licensing. Therefore, international consensus recommendations are necessary and liaison with cardiac surgeons understanding the effects of high-performance military aviation is advised. Under the right circumstances, an applicant who has had surgical correction may be considered for initial pilot training.

Learning Objectives

1. Understand differences in international screening policies and the usefulness of consensus recommendations.
2. Learn the surgical methods to treat aortic diseases and valvular heart diseases with their impact on medical licensing.

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[20] THE USE OF NEW ARTIFICIAL INTELLIGENCE RISK SCORE IN AVIATION CARDIOLOGY ENVIRONMENT

Denis Bron[1], Norbert Guetler[2], David Holdsworth[3], Thomas Syburra[1], Lysette Broekhuizen[4], Olivier Manen[5], Gary Gray[6], Eddie Davenport[7]

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(Original Research)

The field of cardiology has seen rapid advancements in the application of artificial intelligence (AI) to risk assessment and clinical decision-making. One such innovation is the development of new AI-powered risk scoring systems that aim to improve patient outcomes by more accurately predicting cardiovascular events. This literature research explores the implementation and performance of a novel AI risk score in a real-world cardiology in aviation environment. The AI model was trained on a large, diverse dataset of electronic health records and validated against independent patient cohorts. Key features of the model include the ability to incorporate a wide range of clinical, demographic, and laboratory variables to generate personalized risk profiles. Compared to traditional risk scoring methods, the AI model seems to demonstrated superior accuracy in predicting myocardial infarction, stroke, and all-cause mortality over 5-year follow-up periods. Additionally, the model was able to identify high-risk patients who may benefit from more intensive monitoring or aggressive treatment interventions. The implementation of this AI-powered risk score within a cardiology clinic workflow is discussed, including strategies for data integration, clinician education, and patient engagement. Preliminary results indicate that the risk score has been well-received by providers and has positively impacted clinical decision-making and patient outcomes. The findings from literature research highlight the potential for AI to enhance risk assessment and guide personalized management in cardiology in aviation environment. Further research is warranted to evaluate the long-term impacts and generalizability of this approach across diverse healthcare settings.

Learning Objectives

1. The learning objectives focus on providing attendees with an understanding of the AI risk scoring model and its clinical implications in aviation.
2. The learning objectives focus on providing attendees with an understanding of the AI risk scoring model, its performance and its implementation considerations in aviation.

[21] THE ROLE OF EXERCISE TESTING IN CARDIOVASCULAR SCREENING OF AIRCREW

David Holdsworth[1], Thomas Syburra[2], Lysette Broekhuizen[3], Olivier Manen[4], Denis Bron[5], Gary Gray[6], Eddie Davenport[7], Norbert Guettler[8]

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(Education - Tutorial / Review)

INTRODUCTION: Cardiovascular conditions can lead to sudden incapacitation of aircrew, with potentially fatal consequences. There is a variety of approaches to applicant screening across different jurisdictions globally. Within the NATO screening panel this presentation will review the prognostic and diagnostic potential of clinical exercise testing for aircrew. **TOPIC:** The use of exercise ECG as an initial test to rule in/rule out flow-limiting coronary disease has fallen out of favour in recognition of its poor diagnostic sensitivity and specificity. As part of this change in strategy, in many settings the huge prognostic significance of peak exercise capacity has also been forgotten. In the CASS registry there was no 7-year survival difference for all patients who could complete ≥3 stages of the Bruce protocol between those who underwent medical therapy versus medical therapy. Peak exercise capacity was a more powerful prognostic indicator than any conventional cardiovascular risk factor, including the presence of 3 vessel coronary disease. It is common practice at aircrew screening/review to record the medical history, perform a cardiovascular examination and review a 12-lead ECG. Given the huge metabolic scope from rest to peak exertion, such an assessment is relatively insensitive to detect even quite significant abnormalities of the coronary arteries, heart muscle or valvular heart disease. The use of objective cardiovascular risk scores (Framingham, SCORE, Q-RISK etc) in the appropriate population is a useful adjunct to estimate 10-year cardiovascular risk. However, these tests are population-based tools and so provide a relatively crude estimate for each individual. The addition of a symptom-limited peak exercise test can provide individual-specific data, with direct prognostic relevance to a particular pilot or aircrew. Cardiopulmonary exercise testing is not superior to a treadmill based peak exercise test in terms of the prognostic value of peak exercise capacity. However, in cases of objective limitation of functional capacity it is invaluable to partition the cause of limitation between ventilatory, circulatory, peripheral or breathing-pattern problems. **APPLICATION:** In the context of sophisticated imaging and anatomical assessment, it is important not to overlook the enormous prognostic power of peak exercise capacity in the rule-out of significant cardiovascular anomalies.

Learning Objectives

1. To understand the prognostic significance of peak exercise capacity.
2. To appreciate the negative predictive value for acute coronary syndrome events of exceeding certain peak exercise capacity thresholds.
3. To understand the additional diagnostic utility of cardiopulmonary exercise testing in cases of objective functional limitation.

Monday, 06/02/2025 ***2:00 PM***
Centennial Ballroom II

[S-5] PANEL: INTRINSICALLY PHOTOSENSITIVE RETINAL GANGLION CELLS (IPRGC): WHAT ARE THEY? SHOULD WE CARE? AND IF SO, WHY?

Chair: Leonard Temme

Panel Overview: INTRODUCTION: *By 2000, it was clear that rods and cones were not the only retinal photoreceptors and that the newly identified photoreceptors are vastly different from the legacy ones. For example, their photopigment, which resembles that of the insect, is inserted in the cell membrane of retinal ganglion cells, making the ganglion cell itself photosensitive, bypassing the whole anterior retinal circuitry. These are the intrinsically photosensitive retinal ganglion cells (ipRGC) that had gone unnoticed, but now have us rewriting what we think we know about vision.* ***TOPIC:*** *The present panel assembles five presentations to discuss different aspects of the ipRGC. The presentations will describe the function, anatomy, and physiology, as well as the vision these ipRGC support. After a brief introduction, CDR Erica Poole, OD, PhD, and Jeff Rabin OD, PhD will provide an overview of ipRGC retinal anatomy, the various subtypes of these strange photoreceptors, their sensitivity, and, since they are ganglion cells, their axonal projections to the central nervous system. These projections provide clues about the kinds of visual information the ipRGC support and its functional significance. MAJ Toan Trinh, OD, Ph.D. will discuss clinical aspects of the ipRGC, including his research on their impact on photophobia in civilian and military populations with a history of mild traumatic brain injury, migraine, and other clinical entities. Sergei Turovets, Ph.D. will lead a discussion of the spectral sensitivity of the ipRGC, including issues of measuring them radiometrically as well as photometrically, which poses unique technical and procedural challenges. This discussion will address the calibrations of the green and the white night*

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vision goggle phosphors as an example of using the recent international CIE melanopsin standards. CPT Mathew D'Alessandro, Ph.D. will discuss the intricate interactions between the ipRGC and sleep, circadian rhythms, and external environmental cues commonly classified as zeitgebers that act as synchronizers to ensure that the body's circadian clocks remain in sync with the 24-hour day/night cycle. ***DISCUSSION:*** *The outstanding discussion topic is the operational significance, if any, of ipRGC. Is this new chapter in vision science relevant to aerospace and military medicine, and if so, how?*

[22] INTRODUCING THE INTRINSICALLY PHOTOSENSITIVE RETINAL GANGLION CELLS (IPRGC)

Leonard Temme
U. S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Education - Tutorial / Review)

INTRODUCTION: This presentation provides a brief historical context for the ongoing extraordinary discoveries about the intrinsically photosensitive Retinal Ganglion Cells (ipRGC), a set of retinal photoreceptors that are profoundly different from the well-known, legacy cones and rods of the vertebrate retina. A preeminent goal of 19th century vision science was to identify the retinal elements that respond to light and that initiate the neural activity we experience as vision. By 1855, two independent lines of evidence converged to identify the anatomically distinct cones and rods as the retina photoreceptors in the human eye. This discovery seemed to settle the question. Subsequent vision research, for the most part, elaborated the two types of vision the cones and rods supported, characterized as photopic and scotopic, or day and night vision, respectively. Von Kries is credited with coining the term Duplicity Theory to characterize the differences between these two types of vision. **TOPIC:** However, reports of some visual phenomena remained difficult to reconcile with this classical view and thus remained puzzling at best. For example, reports of individuals who were completely blind yet evidenced light-induced circadian entrainment, or even more perplexing were those with so-called 'blindsight,' who demonstrated visual discriminations while asserting that they had no appreciable visual experience. Explanations were mostly post hoc and unconvincing. With the new millennium, around 2000, nearly 150 years after identifying the retinal photoreceptors, the identification of the ipRGC made sense of these anomalous findings. The photoreceptors that transduce light stimuli for circadian regulation, seasonal cycles, neuroendocrine responses, light therapy, etc. were now known. Furthermore, the origin of the retinal information of light and dark cycles projected via the extra-geniculate, superchiasmatic nucleus to the pineal gland to influence the rhythmic secretion of melatonin was clarified. It was clear, however, that neither rod nor cone signals participated in this light-induced melatonin response. Essentially, a previously unknow, functioning visual system was discovered in the retina with unique photoreceptors that project to different parts of the brain. **APPLICATION:** This presentation sets the stage for the panel discussion of ipRGCs, their anatomy, physiology, function, and operational significance.

Learning Objectives

1. To provide a historical context for the discovery of the ipRGC.
2. To provide a historical context to appreciate how extraordinary the discovery of these unique retinal photoreceptors really is.

[23] THRESHOLD SENSITIVITY AND VISUAL CONTRIBUTIONS OF THE HUMAN INTRINSICALLY PHOTOSENSITIVE GANGLION CELL PATHWAY

Erica Poole[1], Jeff Rabin[2]
[1]*Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States;* [2]*University of the Incarnate Word Rosenberg School of Optometry, San Antonio, TX, United States*

(Original Research)

INTRODUCTION: Over the past two decades, intrinsically photosensitive retinal ganglion cells (ipRGCs) have been identified as the fifth type of human photoreceptor. Although not yet fully understood, ipRGCs are known to mediate myriad crucial human functions across both visual and non-visual domains, including pupil size, circadian rhythms, mood, and aspects of visual perception. Notably, several studies have shown that certain ipRGC-mediated functions persist even after acquired blindness, highlighting not only the unique resilience of this pathway but also its critical importance to the regulation of a wide array of essential human processes. Herein, we describe two studies that advance our understanding of the contributions of these cells. **METHOD:** 39 participants were exposed to 200 ms blue (460 nm) flashes on an amber (590 nm) background (desensitized rods, L-, and M-cones). Using an adaptive staircase method, stimuli were presented monocularly and binocularly, with and without a short-wavelength blocking filter. Parametric analyses revealed normally distributed ipRGC thresholds. Next, 30 healthy participants fixated on an X with their right eye while a blue oval stimulus (dominant wavelength = 480 nm, melanopsin peak) was presented three times, located 15° temporal to the fixation point. A series of adjustments ensured the stimulus projected precisely onto the anatomical blind spot (ABS) before threshold measurements were recorded (method of limits). **RESULTS:** We determined that the mean monocular threshold (0.13 log cd/m2) was higher than the binocular threshold (-0.01 log cd/m2), and the difference was highly significant (mean difference = 0.14 log cd/m2, 95% CI: 0.04 – 0.22, $P < .004$). The 0.14 log improvement in sensitivity when binocular represents a 38% improvement. Second, we demonstrated that the mean ± 2SD ipRGC threshold was 32 ± 12.6 cd/m2 (log: 1.5 ± 0.2 log cd/m2) in the ABS. The coefficient of repeatability was 0.16 log cd/m2. **DISCUSSION:** The enhancement noted with two eyes is suspected to be a form of physiological summation suggesting cortical involvement, and a possible terminus for the ipRGC pathway. Additionally, we demonstrated that vision occurs within the ABS, enabling rapid assessment of melanopsin pathway function. These combined findings have important applications in assessing various conditions that impact the ipRGC pathway.

Learning Objectives

1. Understand the systems that the ipRGC provides input to.
2. Understand the implications of knowing threshold values for the ipRGC pathway.

[24] SENSITIVITY AND LIGHT ADAPTATION CHARACTERISTICS OF IPRGC DRIVEN PLR IN PATIENTS WITH MTBI

Toan Trinh
U. S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: The pupillary light reflex (PLR) is evoked by change in retinal illuminance and is routinely assessed in the clinic and studied in clinical research as an objective, noninvasive measure of retinal and optic nerve function. The ipRGCs have been shown to be affected in optic nerve and retinal disease such as glaucoma and retinitis pigmentosa. **METHODS:** Direct PLR to blue light (peak $\lambda = 440$ nm) was measured from the dominant eye, the other eye was fully occluded, of 12 control adult subjects) and 12 chronic mTBI patients using LiveTrack pupilometer module and an infrared camera (30 Hz) inside an LED-driven Ganzfeld system (Espion V6 ColorDome, Diagnosys LLC, Lowell, MA). The study consisted of two protocols: (1) The intensity series included 19 steps of increasing intensity ranging from 0.001 to 198 cd/m2, was completed first in sequence after 5 minutes of initial dark adaptation, and 2 minutes between test flashes. A test blue flash stimulus with a duration of 1 second was used, and the pupil responses were recorded for 7.5 seconds; (2) The background intensity series consisted of seven steps, ranging from 0 to 10 cd/m2, was completed thereafter with test flash of 120 cd/m2 on top of the background. Pupil diameter measurements were made following 5 minutes of initial dark-adaptation, and first on a dark background with a 120 cd/m2 test flash for a duration of 1 second. **RESULTS:** The post-illumination pupillary response (PIPR) was significantly reduced in mTBI patients relative to controls through both the intensity and background series, indicating a reduction in luminance gain of ipRGCs. The baseline pupil

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diameter following 2 or 5 minutes of dark adaptation and at the end of 2 minutes of light adaptation over a 5-log unit range of background was larger (i.e., less constriction) for mTBI patients. **DISCUSSION:** The reduction in the PIPR and the larger baseline pupil responses in patients with mTBI insinuates an underlying pathophysiology that may reflect a dysfunction of ipRGC and its luminance gain control mechanism.

Learning Objectives

1. Understand how the pupillary light responses act as an indirect measure of intrinsic-photosensitive retinal ganglion cells function.
2. Evaluate the light adaptation characteristics of ipRGCs in patients in mTBI.

[25] THE GREEN AND THE WHITE NIGHT VISION GOGGLE PHOSPHORS SPECTRAL CHARACTERISTICS AND THEIR IMPACT ON CIRCADIAN RHYTHMS: EXPERIMENTAL AND MODELING STUDY

Sergei Turovets, Toan Trinh, William McLean, Leonard Temme
U. S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: Night vision goggles (NVGs) are widely used in military aviation. NVGs amplify low ambient light and present it to the human eye as a monochrome image using two types of phosphor screens P43 (green) and P45 (white). The comparative studies of these screens concerning visual performance suggest that there is no significant difference between them. However, the projection of the blue parts of spectra (essential in P45) to the brain centers regulating circadian rhythms by the recently discovered intrinsically photosensitive Retina Ganglia Cells (ipRGC) raised the new questions on NVG's impact on pilot's awakeness and quality of sleep. **METHODS:** We have analyzed the extensive data base of the spectral characteristics for P43 and P45 NVG eyepiece outputs in luminance collected in the recent years at USAARL and made necessary calibration measurements to rescale and transform the data appropriately to account for illuminance at a human eye cornea at the 25 mm relief and 40 degrees Field of View. Then we used the spectral data as inputs for predictive calculations in a modeling toolbox supporting the International Commission on Illumination (CIE) System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light. **RESULTS:** The overall circadian phase shift for both green and white screens is small, 8 and 17 minutes respectively for exposures of 6 hours with the maximum NVG eyepiece output of 5 fl (above a quarter moon and greater). These numbers linearly scale to zero when the output brightness is reduced to the starlight conditions 0.5fl or the exposure time is decreased to 2 hours (a typical night flight duration). **DISCUSSION:** The studies of the ipRGC spectral sensitivity to NVG light poses unique technical and procedural challenges. We will discuss the calibrations of the extensive NVG spectral data at USAARL in the context of using them as inputs in the recent international CIE melanopsin modeling standards to predict a resulting impact on circadian rhythms. Given the preliminary results obtained with selected spectral data the impact of the NVG light exposure on circadian rhythms is deemed as not significant in both cases of the green and white phosphors luminophores.

Learning Objectives

1. Understand the impact of NVG's spectral characteristics and exposure on pilot's circadian rhythms, quality of sleep and ultimate performance.
2. Compare quantitatively the normalized spectral characteristics of green and white phosphor luminophores in the ipRGCs sensitive range.

[26] THE IMPORTANCE OF ASSESSING CIRCADIAN ENTRAINMENT IN HUMAN SLEEP RESEARCH

Matthew D'Alessandro
U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Education - Tutorial / Review)

INTRODUCTION: Properly regulated wake/sleep cycles, governed by intrinsic and extrinsic processes, are imperative for homeostasis. Intrinsically, the retinohypothalamic tract (RHT), connecting intrinsically photosensitive retinal ganglion cells (ipRGCs) to the suprachiasmatic nucleus (SCN), forms the anatomical basis of circadian entrainment. This process allows for extrinsic modifiers such as light cues, acting as zeitgebers, to synchronize the body's internal clock with the 24-hour day/night cycle. ipRGCs, containing the blue light-sensitive photopigment melanopsin, play a crucial role in regulating circadian rhythms and wake/sleep cycles. When stimulated, they transmit signals to the SCN, the master circadian pacemaker, which coordinates rhythms throughout the body via a network of clock genes and proteins. **TOPIC:** In human sleep research, particularly when studying how artificial light sources impact wake/sleep cycles, accounting for individual differences in circadian rhythms is imperative. The spectral characteristics and timing of light exposure to external devices such as NVGs can induce phase shifts in the circadian system, as described by phase response curves (PRCs). PRCs illustrate how light exposure at different circadian phases can advance or delay the internal clock and provide valuable insight to the impact on wake/sleep patterns and circadian entrainment. **APPLICATION:** Researchers should assess variables such as circadian phase, chronotype, and entrainment status using methods like dim light melatonin onset (DLMO) and core body temperature rhythms. By establishing baseline circadian profiles and considering PRCs, sleep responses can be contextualized within each participant's unique biological rhythm. This approach enhances the accuracy of sleep research findings, which may lead to an improved understanding of the complex interactions between sleep, circadian processes, ipRGCs, and external factors like NVG use. Precise, methodological approaches may pave the way for more effective interventions and personalized sleep management strategies in populations exposed to irregular light patterns, contributing to better health outcomes and performance in various fields, including military and shift work environments. This presentation strongly complements the panel by connecting to Dr. Turovets' technical focus on spectral sensitivity and NVG calibration. This presentation emphasizes measuring circadian entrainment and understanding light exposure timing which provides practical context for the panel's military applications.

Learning Objectives

1. Understand the role of the retinohypothalamic tract in circadian entrainment and its relevance to sleep research.
2. Recognize the importance of assessing individual circadian profiles in studies that have extrinsic light sources.
3. Apply knowledge of phase response curves (PRCs) and individual differences to understand the effects of light exposure on circadian rhythms.

Monday, 06/02/2025 ***2:00 PM***
Centennial Ballroom III

[S-6] PANEL: NASA'S MEDICAL CAPABILITY AND TECHNOLOGY DEVELOPMENT ACTIVITIES FOR MISSIONS TO MARS

Chair: Moriah Thompson
Co-Chairs: Jay Lemery, Rahul Suresh

Panel Overview: *As NASA seeks to conduct missions beyond low Earth orbit to the Moon and eventually to Mars the medical operations model both in-flight and terrestrially need to evolve to support more Earth-independent operations. The objective of the Exploration Medical Integrated Product Team (XMIPT) of NASA's Mars Campaign Office is to develop technologies and capabilities that enable provision of medical care in this challenging new environment so that crews can execute their mission and return home safely. In this panel, the XMIPT will describe the new challenges this transition brings, explain the gaps between current medical operations and future exploration missions, and describe the activities and projects seeking to close those gaps. The team uses a comprehensive roadmap to visualize these gaps and their associated gap-closing activities which encompasses not only XMIPT work but also work being performed by others both inside and outside of NASA. The first presentation will provide an overview of the medical challenges of*

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exploration missions, the gaps in technology and capabilities, and XMIPT projects that contribute to gap closure. The subsequent presentations offer a more in-depth review of specific XMIPT projects that are contributing to enabling earth-independent medical operations and include: The Crew Health and Performance Integrated Data System Platform which ingests data from disparate sources to reduce time and resources to manage data, improve crew access to data, and offer inflight advanced analytics; the Mini X-ray and Multifunctional Integrated Medical Device projects which advance medical diagnostics and imaging by providing diagnostic and treatment capabilities in a mass/volume-friendly package; and lastly, the medications at vacuum pharmacy pilot study which seeks to address key questions about medication stability after exposure to alternobaric environments expected during exploration missions.

[27] EXPLORATION MEDICAL INTEGRATED PRODUCT TEAM (XMIPT) STRATEGIC ROADMAP AND PROJECT PORTFOLIO OVERVIEW

Moriah Thompson[1], Rahul Suresh[1], Justin Yang[2], Phyllis Friello[3], Courtney Schkurko[4]
[1]*NASA, Houston, TX, United States;* [2]*Aegis Aerospace, Houston, TX, United States;* [3]*Leidos, Houston, TX, United States;* [4]*NASA, Cleveland, OH, United States*

(Education - Program / Process Review)

BACKGROUND: A diverse set of NASA subject matter experts identified ten high-level medical capability gaps that would need to be addressed for humans to safely conduct exploration-class missions, including those to the Moon or Mars. The medical challenges associated with exploration missions stem from their increased duration and distance from Earth complicating communication, evacuation, and resources. The Exploration Medical Integrated Product Team (XMIPT) works to overcome these challenges and provide crew a medical system capable of Earth-independent care. The team has active projects in nine of the ten gaps and tracks closure of all gaps in their exploration medical roadmap. This roadmap is updated annually with inputs from teams inside and outside of NASA on progress towards gap closure. **OVERVIEW:** This presentation will briefly discuss medical challenges posed by exploration missions, gaps in medical capabilities and technology required to safely execute future exploration missions, and benefits of a strategic roadmap for tracking gaps and gap closure. It will review XMIPT accomplishments from the past year and how each contributes to gap closure. In the medical informatics domain, the XMIPT is working on an exploration electronic health record, a clinical decision support tool, and just-in-time-training tools & procedures. The goal of these projects is to provide crew access to the resources they need to successfully manage inflight medical issues when ground support is unavailable due to comm-delays or blackouts. In the medical diagnostics domain, the team aims to provide crew with increased diagnostic, imaging, and treatment capabilities to overcome limited shelf-life of medications and consumables, reliance on ground medical support, limited resupply, mass and volume constraints, and lack of medical evacuation capability. Lastly, the presentation will emphasize the integrated nature of the exploration medical roadmap and how that has fostered collaboration within NASA, with other government agencies, international & commercial partners, and with students across the country. **DISCUSSION:** The XMIPT will continue work to close exploration medical gaps, update the roadmap, and collaborate with the aerospace medicine community in order to provide an exploration medical system capable of mitigating the risks of long duration, deep space travel. This work is of interest to medical professionals working in resource or communication-limited settings and remote environments.

Learning Objectives

1. The participant will be able to describe the XMIPT's roadmap and how gaps are tracked.
2. The participant will be able to understand how current ISS medical operations will need to change for exploration missions.

[28] CREW HEALTH AND PERFORMANCE INTEGRATED DATA SYSTEM PLATFORM PROJECT UPDATES

Amanda Smith[1], Dennis Beaugrand[2], Steve Duran[3], Melissa Lyons[2], Michele Beaugrand[2], Braeden Conrad[3], Cornelya Howard[1], Darrius Garrett[1]
[1]*KBR, Houston, TX, United States;* [2]*Alidyne, Mountain View, CA, United States;* [3]*NASA, Houston, TX, United States*

(Education - Program / Process Review)

BACKGROUND: Future Human Exploration missions introduce a new paradigm as crews move further from the resupply and near real-time ground support typical of Low Earth Orbit missions today. Without immediate support from ground-based personnel, exploration crews will be more reliant on inflight data and technology to respond to emergencies and anomalies. A data architecture to support a new generation of technologies, employing advanced analytical and predictive modeling techniques, is needed to enable crew autonomy. **DESCRIPTION:** The Crew Health and Performance Integrated Data System Platform (CHP-IDSP) project, funded both by NASA's Exploration Medical Integrated Product Team (XMIPT) and Human Research Program (HRP), is laying a foundation for future in-flight informatics by providing a back-end architecture for collecting, storing, and integrating multiple sources of data generated by and around the crew. CHP-IDSP provides a platform that supports common data models and Application Programming Interfaces to access, integrate, process, and display CHP data (e.g., environmental, exercise, medical, sleep, performance, etc.). This will facilitate the increased situation awareness and decision support required by the crew and remote support of exploration missions. This presentation will describe the ongoing development effort of the path-to-flight CHP-IDSP software and the demonstration of its core capabilities. This includes the human-centered process used to identify data needs and workflows that feed development of scenarios and requirements, and current subsystem development status. Current integrations, including the Chiron exploration electronic health record application, will be discussed. Future work includes collaboration with additional CHP domains and a flight technology demonstration. **DISCUSSION:** Today,
in-flight data is often siloed, unsynchronized, and largely inaccessible in real time. Many data sets require manual entry and/or data transfer between vehicles and the ground. These issues contribute to risks in supporting exploration medical capabilities. The CHP-IDSP is a back-end data platform providing core capabilities needed for timely and meaningful data insights across CHP domains to crew and remote personnel to enable increased crew autonomy. Future work includes collaboration with additional CHP domains, new technology integrations, expanding test bed capabilities, and a flight demonstration.

Learning Objectives

1. The audience will understand that the CHP-IDSP is a back-end system, providing a platform to facilitate access, promote decision tools, and provide meaningful insights to crew and to remote stakeholders during exploration missions.
2. The audience will understand current CHP-IDSP core capabilities, how these subsystems support specific scenarios, and plans to expand integrations and analog demonstrations as the project progresses toward enabling flight technology.

[29] LONGITUDINAL ANALYSIS OF PHARMACEUTICAL STABILITY AFTER EXPOSURE TO 120,000 FEET OF ALTIDUDE: DOES A SIMULATED NEAR-VACUUM EXPOSURE CHANGE LONG TERM MEDICATION STABILITY?

Craig Nowadly[1], Khaled Shennara[1], Lyle Babcock[1], Dennis Lovett[1], Hayley Brawley[1], Phyllis Friello[2], Justin Yang[3], Moriah Thompson[4], Rahul Suresh[4], Tina Bayuse[5], Sincy Mathew[6]
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(Original Research)

INTRODUCTION: Vehicles supporting the Artemis missions will have dedicated, vehicle-specific medical kits as well as crew medical accessory kits. Although most of the kits will be stored in a pressurized, climate-controlled volume, there are scenarios in which they may become exposed to vacuum, such as the vehicle being brought to vacuum to enable clearance of atmospheric contaminants or in the airlock (in which kits may be stored) during extravehicular activities. Given weight and volume restrictions on launch, pharmaceuticals flown in space are often repackaged using non-manufacturers packaging prior to flight. This study aims to investigate the longitudinal impact of extreme vacuum on pharmaceuticals relevant to the Artemis missions. **METHODS:** 19 medications relevant to the Artemis missions were exposed to a vacuum equivalent to 120,000 feet via altitude chambers for 8 hours. Tablets and capsules were removed from their manufacturers packaging and placed in a weigh boat prior to exposure. Liquid medications (i.e. moxifloxacin, tetracaine) and epinephrine autoinjectors remained in manufacturer's packaging. A lot-matched control group remained a one atmosphere (692 feet above sea level). After exposure, the active pharmaceutical ingredients were extracted tested utilizing ultra-high-performance liquid chromatography with tandem mass spectrometry. Experimental and controlled medications were compared against commercial standards for each medication. Testing occurred within 2 weeks of exposure (T = 0 months, n = 10 for each group) and again at 3 months post exposure (T = 3 months, n = 10 for each group). Follow-up testing will occur at T = 6 and 9 months. **RESULTS:** At Time = 0, the concentrations of the undegraded active compound had decreased by more than 5% compared to controls in Moxifloxacin (-5.2%), Ibuprofen (-5.4%), Ondansetron (-20.9%), Oxymetazoline (-10.6%), and Pseudoephedrine (-5.5%) out of 19 drugs included. However, further degradation was not seen at T3; only Ondansetron had concentrations greater than 5% less than controls (-5.4%) at T3. **DISCUSSION:** Spaceflight has been shown to accelerate the degradation of certain pharmaceuticals; however, the specific factors driving this phenomenon remain unclear. Pharmaceuticals sent into space are subject to various environmental stressors, including altered air pressure, elevated carbon dioxide levels, cosmic radiation, and microgravity. This is the first study to isolate an individual aspect of spaceflight to better understand how spaceflight affects pharmaceuticals. Results indicate that 8 hours of exposure to a simulated altitude of 120,000ft (vacuum) has minimal effect on the potency of most drugs at 3 months post exposure. Confirmatory testing is planned at T = 6 and 9 months. Disclaimer: The views expressed are those of the presenters and do not reflect the official views or policy of the National Aeronautics and Space Administration, the Department of Defense or its Components. The views of the manufacturers are not necessarily the official views of, or endorsed by, the U.S. Government, the Department of Defense, or the Department of the Air Force. No federal endorsement or any manufacturer is intended.

Learning Objectives

1. Understand the scenarios in which medications could be exposed to vacuum.
2. Understand how and why the medications were chosen for the study.

[30] CRITERIA-BASED SELECTION OF A HANDHELD COMMERCIAL X-RAY SYSTEM FOR SPACEFLIGHT, CHARTING NEW TERRITORY IN SPACE MEDICINE AND MULTI-FUNCTIONAL CAPABILITIES

Cy Peverill[1], Chase Haddix[2], Justin Yang[3], Ariel Tokarz[4], Russell Valentine[5], Courtney Schkurko[4], Beth Lewandowski[4]

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(Education - Tutorial / Review)

INTRODUCTION: NASA has identified x-ray imaging capability as a valuable diagnostic tool to mitigate medical risks posed by long duration spaceflight. To date, conventional medical radiography has never been performed in a spaceflight environment. A comprehensive, standardized process consisting of relevant criteria must be defined to allow for the optimal selection of an x-ray system for spaceflight. **TOPIC:** The extensive variety of commercial medical devices for treating similar conditions provides numerous options. However, the spaceflight necessitates specific design requirements to ensure the medical device functions effectively in space. When beginning the down select process for spaceflight medical systems, the scope begins as inclusive as possible. Given strict limits on payload size, it becomes increasingly important to consider cross-disciplinary applications. Assembling a team of subject matter experts (SMEs) aids in defining spaceflight relevant requirements or benchmarks for success that are difficult to specify a priori. A weighted matrix approach can be used to quantitatively assess each medical device's fit for the specific mission and thus inform a down select. This approach should consist of multiple criteria with values reflecting the product of a stakeholder-provided weighting and scores based on a criterion-specific scale, normalized between 0 and 1. Each criterion should be carefully defined after consultation with mission requirements, stakeholders, and SMEs. This creates a system catered to the precise needs of a mission while offering the flexibility to change based on evolving constraints and device capabilities. **APPLICATION:** Regarding x-ray imaging capability, a set of criteria should be developed to address a system's physical footprint, durability and operability, ability to obtain images across all areas of the body, and utility outside of medical diagnostics. Another important element is the development of design requirements based on imaging standards spanning both medical and non-medical domains. This element is critical and challenging because it requires extensive collaboration with SMEs and achieving consensus on the requirements to include in the weighted matrix. Lastly, interoperability should be considered for a variety of spaceflight vehicles and habitats in terms of software interface requirements, data integration architectures, and design reference missions.

Learning Objectives

1. A thorough explanation of a down select process for evaluating commercial medical devices is described.
2. Insights into how to gather evidence for selecting a medical device never used in a spaceflight environment is detailed.

[31] INSIGHTS AND TAKEAWAYS FROM TESTING MULTI-FUNCTIONAL INTEGRATED MEDICAL DEVICES: RESULTS FROM GROUND AND LOW EARTH ORBIT DEMONSTRATIONS

Chase Haddix[1], Rachael Miller[2], Courtney Schkurko[3], Ashley Nelson[3], Beth Lewandowski[3]

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(Original Research)

INTRODUCTION: Recently, the Human Research Program and the Mars Campaign Office's Exploration Medical Integrated Product Team (XMIPT) conducted a series of evaluations on two commercial Multi-functional Integrated Medical (MIM) devices. These devices combine vital sign monitoring, medical scopes, and ultrasound imaging into a single compact unit. Their potential to enhance efficiency and functionality for spaceflight medical systems is significant, as they could replace the current suite of individual, manual-entry medical tools. The aim of this effort was to gather evidence to inform decisions about including a MIM device into future spaceflight medical systems. **METHODS:** To assess viability for spaceflight use, the MIM devices were demonstrated with human participants on multiple test platforms. These included the 20ft Hypobaric Chamber at NASA Johnson Space Center (n=11), the exploration medical testbed at NASA Glenn Research Center (n=6), and as part of the SpaceX Polaris Dawn mission (n=2). The IRB approved the human research testing activities and primary data collected included pre- and post-session surveys. Tasks using the devices included obtaining medical data from oneself or another posing as a patient, with some of the obtained data (EKG and ultrasound images)

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evaluated by board-licensed physicians for diagnostic utility. Quantitative analyses such as time to complete task and device usability were also performed. **RESULTS:** Both devices quickly display user data when peripherals are connected and their ability to store patient records offline makes them beneficial for multi-crew missions. While vital signs were generally easy to collect, cable management was an issue. One device's large screen for ultrasound and vital signs was well received, but at a cost of significantly shorter battery life. Both devices require improvements in touchscreen responsiveness and neither provide all necessary functions for a standalone spaceflight system. Limitations in ultrasound use by non-experts highlight areas for future improvement. **DISCUSSION:** This in-depth characterization of MIM devices enhances our understanding of how to maintain human health during future space exploration missions. MIM device's plug-and-play features for vital sign collection are intuitive for non-expert users, but more assistance is needed for skill-based tasks such as ultrasonography and data interpretation, especially for Earth-independent medical operation.

Learning Objectives

1. This work detailed a first-of-its-kind holistic approach for evaluating multi-functional integrated medical devices for spaceflight applications.
2. The need for user-friendly interfaces with on-board clinical support was emphasized in these demonstrations.

Monday, 06/02/2025 ***2:00 PM***
Centennial Ballroom IV

[S-7] PANEL: BRINGING A RESEARCH PROJECT TO FRUITION: FROM CONCEPT TO JOURNAL PUBLICATION

Chair: Douglas Boyd
Co-Chair: Frederick Bonato

Panel Overview: INTRODUCTION: *In an academic setting, published research represents one of the benchmarks commonly used for peer recognition and career advancement. However, bringing a research project to fruition (i.e. a published manuscript) represents a complex multi-step process. While researchers schooled in this sphere receive training in this respect, this is less frequent for aerospace medicine professionals who have transitioned to a research path later in their career.* ***TOPIC:*** *Herein, this Panel, sponsored by the Education and Training Committee, will discuss the multiple steps involved in taking a research project from a novel concept through to publication.* ***APPLICATION:*** *Research starts with an idea/concept posed by the investigator. The first presentation will address how to determine if the idea is novel via a literature search and designing an appropriate experimental approach, data acquisition and analysis towards answering the question. In the second presentation, the issue of whether the research represents human subjects research and navigating the required approval process will be covered. In the third presentation, the past editor of the "Aerospace Medicine and Human Performance" journal will discuss statistical methods and statistical packages commonly used in aeromedical research projects. The following session, journal selection manuscript preparation, reference managers and the Editorial process for submitted papers will be discussed. In the final presentation, the manuscript review process will be addressed. Since, by far, the majority of manuscripts require at least one round of revision how best to respond to critiques towards getting a manuscript accepted will be addressed.*

[32] THE NUTS AND BOLTS OF A RESEARCH PROJECT FROM CONCEPT THROUGH TO EXPERIMENTAL DESIGN

Douglas Boyd
Embry-Riddle Aeronautical University, Daytona Beach, FL, United States

(Education - Tutorial / Review)

INTRODUCTION: In an academic setting, published research represents one of the benchmarks commonly used for peer recognition and career advancement. However, bringing a research project to fruition (i.e. a published manuscript) represents a complex multi-step process. While researchers schooled in this sphere receive training in this respect, this is less frequent for aerospace medicine professionals who have transitioned to a research path later in their career. **TOPIC:** Herein, the author will discuss the steps involved in a research project from the germinating seed of an idea to data acquisition. **APPLICATION:** Research starts with an idea/concept posed by the investigator. One of the first steps is to determine whether this question has been addressed previously-this is important as priority in research is accorded more to novelty than a confirmation of older findings. Towards answering this question, various literature search platforms (e.g. PubMed, Google Scholar) will be discussed and how to bypass the fee required by some journals for non-subscribers. Consequently, selection of research methods which most directly answer the question posed will be addressed as well as data collection and analysis. Will research funding be required? Does the research lend itself to multiple experiment approaches to corroborate each other? What factors affect the population size needed? Importantly, is the allotted experimental time frame (including approvals for human subjects' research, research fund acquisition) within that achievable by the investigator? This presentation will segue to the next two where human subject research approval and statistical analyses are addressed.

Learning Objectives

1. Coming up with a novel research question which advances scientific knowledge.
2. Literature searches: has similar work been done previously or does yours differ in a specific way?
3. What experimental design/methods are appropriate for the research question posed?

[33] NAVIGATING INSTITUTIONAL REVIEW BOARDS AND SURVIVING THE JOURNEY.

Michael Wiggins
Embry-Riddle Aeronautical University, Daytona Beach, FL, United States

(Education - Tutorial / Review)

INTRODUCTION: Research involving human subjects is required by law to be reviewed and approved by an institutional review board (IRB). Understanding the requirements and ensuring your application contains the necessary information are the keys to success. **TOPIC:** Any research involving human subjects is required by law to be reviewed and approved by a qualified IRB to ensure that the rights and welfare of participants who volunteer in research activities are protected. IRBs are federally mandated by the Department of Health and Human Services to regulate this protection by the respective institution. This presentation will firstly define what constitutes human subjects research. Thereafter, the key components of the regulations governing human subjects research encapsulated in Title 45 of the Code of Federal Regulations (CFR) Part 46 (and based on the "Common Rule" and 45 CFR Part 46) will be described. These components set the basis for the review process. Noteworthy is that each institution has a unique process flow based on these components. Understanding both the regulatory requirements and navigating the institutions' specific process flow will minimize the applicant's effort/time in preparing/revising an application towards an expedient approval. **APPLICATION:** Attendees will learn how best to follow their institution's process for gaining approval in an expedient manner but at the same time protecting the rights, dignity, and safety of participants. **RESOURCES:** Office of Human Research Protections, U.S. Department of Health and Human Services, https://www.hhs.gov/ohrp/regulations-and-policy/regulations/45-cfr-46/index.html

Learning Objectives

1. What research constitutes human subjects research?
2. Definition of the "Common Rule".
3. How best to navigate the IRB application process.

[34] AEROSPACE MEDICINE STATISTICS

Frederick Bonato
Manhattan University, Bronx, NY, United States

(Education - Tutorial / Review)

INTRODUCTION: In most research projects scientific rigor requires statistical testing of the data to draw any conclusion as to whether an endpoint has changed. Unfortunately, statistics is commonly given short

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shrift in in aerospace medical training. **TOPIC:** Herein, the author will give an overview of the types of data commonly generated in aerospace medicine studies, appropriate statistical tests and interpretation of their output. Exemplars drawn from published studies will be used for illustrative purpose. **APPLICATION:** Typically any research project will generate volumes of data requiring statistical analysis to determine whether a perceived change is real or anomalous. The type of statistical test used will be predicated partly on the question posed and whether data are parametric (normally distributed) or non-parametric. The following common research data scenarios are discussed (1) Do two/multiple populations differ in their average/median values for a particular parameter? Such differences can be tested using Students T test/ANOVA (parametric) or Mann-Whitney U (non-parametric) tests. (2) Is a population over-represented for a particular trait/parameter? This can be answered using proportion analyses (e.g. Chi-Square or logistic regression (for multiple variables)). Interpretation of statistical outputs to determine the strength of an association, confidence intervals and significance levels will be discussed. Finally, the suitability of various statistical packages for the non-statistician, aerospace medicine professional in context of ease-of-use will be addressed

Learning Objectives

1. Statistical test depends on the type of data.
2. Difference between parametric and non-parametric data.
3. Interpretation of statistical outputs.

[35] PREPARING AND SUBMITTING A MANUSCRIPT TO A SCIENTIFIC JOURNAL

Frederick Bonato
Manhattan University, Bronx, NY, United States

(Education - Tutorial / Review)

PROBLEM STATEMENT: Publication in a scientific journal (such as Aerospace Medicine and Human Performance) has potential benefits to one's career and can also provide valuable information to others in one's field/specialty. Choosing the right journal is important—a decision that can depend on journal indexing, impact factor (or other metrics), 'fit', whether or not the journal offers Open Access, and turnaround time. How does one maximize the chances of getting successfully published? Also, how can requests for revised manuscripts best be handled? **TOPIC:** This talk will address the following: 1) Appropriate journal(s) your work should be submitted to, 2) Writing and formatting a submission, 3) Ethics committee approval (e.g., Institutional Review Board or Institutional Animal Care and Use Committee) 4) The editorial process—including peer-review, 5) Turnaround times, 6) Corresponding with the journal office/editor. **APPLICATIONS:** Careful preparation prior to submitting a manuscript for consideration by a scientific journal is essential. After selecting a journal to submit to, following simple steps in preparing, submitting, and revising manuscripts can maximize the probability that a given manuscript will be accepted and published. These guidelines are broadly applicable to many scientific journals.

Learning Objectives

1. Provide authors with a systematic approach to writing and submitting a manuscript for publication.
2. Acquaint authors with the editorial review process.

[36] A BEHIND THE SCENES LOOK AT THE MANUSCRIPT REVIEW PROCESS-HOW BEST TO HANDLE REVISIONS (AND REJECTIONS)

Douglas Boyd
Embry-Riddle Aeronautical University, Daytona Beach, FL, United States

(Education - Tutorial / Review)

INTRODUCTION: In academia, peer-reviewed published papers represent one of the benchmarks used for peer recognition/career advancement. After submission, a research manuscript is subjected to at least one round of reviews by subject matter experts/reviewers/referees and rarely accepted "as is." **TOPIC:** In this presentation, the author, (a reviewer for over 30 journals in as many years), will discuss the various elements that reviewers scan for and how best to deal with referee critiques. **APPLICATION:** A manuscript Introduction should be concise, state the gap in knowledge and the research question posed. Too often, Introductions read like a graduate thesis and/or contain irrelevant material (red herrings). In the Results, how consistent are the data with each other? For example, if data from 200 and 230 subjects were presented in two separate tables/graphs, the discrepancy warrants explanation. In the Discussion, were the conclusions drawn by the author(s) supported by the data? Did this section represent a regurgitation of the Results - suggesting a poorly read author out of touch with the literature? Also in the Discussion, did the author address how the new research fits in with the bigger picture and importantly other work? Were the limitations of the research clearly stated? Commonly, authors are invited to revise/resubmit a manuscript after addressing a reviewer's concerns. Shortcomings highlighted by the referee should be addressed via new data acquisition/analysis/experiments. Finally, responding to the reviewer in a non-confrontational manner will improve one's chances of final acceptance.

Learning Objectives

1. pertinent elements to include in a manuscript Introduction.
2. importance of highlighting the "take home" message in the Discussion.
3. strategies for revising and resubmitting a manuscript.

Monday, 06/02/2025 ***2:00 PM***
Regency V

[S-8] SLIDE : AEROSPACE MEDICINE POTPOURRI

Chair: Warren Silberman
Co-Chair: Roy Allen Hoffman

[37] REVIEWING MEDICATIONS IN CONTEXT OF A PILOT'S FLYING ACTIVITIES

Turan Kayagil
NTSB, Washington, DC, United States

(Education - Case Study)

INTRODUCTION: On September 18, 2022, an Aero Vodochody L-29 Delfín military jet trainer airplane crashed during the Jet Gold race at the Reno Air Racing Association's annual National Championship Air Races in Reno, Nevada. On November 12, 2022, a Bell P-63F Kingcobra historic fighter airplane and a Boeing B-17G Flying Fortress historic bomber airplane collided in midair during the Wings Over Dallas Airshow in Dallas, TX. Findings from the National Transportation Safety Board (NTSB) investigations of these accidents illustrate why physicians may wish to consider pilots' individual flying activities when reviewing their medication use. **BACKGROUND:** Physician review of pilot medications is a routine component of the aeromedical examination. The examiner assesses whether reported medications are safe for flight and acceptable for certification. The examiner may also consider how a pilot's flying activities and medication use relate. Some pilots might use unacceptable medications in association with particular activities; for example, motion sickness medication used before an airshow performance. Some pilots might use medications that, while generally safe, warrant caution if combined with particular activities; for example, vasodilator medication used before an air race. **CASE PRESENTATION:** The pilot in the 2022 Reno air race crash had used amlodipine as part of hypertension treatment approved under Federal Aviation Administration (FAA) protocol. Amlodipine is a vasodilating drug that may increase risk of G-induced loss of consciousness. While this risk increase is theoretical, it is the basis for prohibitions on amlodipine use by high-performance US military aviators. In the Wings Over Dallas Airshow crash, meclizine was detected in postmortem specimens from the B-17G pilot and flight engineer, neither of whom had reported medication use at their last aviation medical examinations. Despite its common marketing as a "less drowsy" motion sickness medication, meclizine is a sedating antihistamine and is on the FAA's list of "no go" over-the-counter drugs. **DISCUSSION:** Physicians who examine pilots have an opportunity to educate them about potential safety concerns related to medication use in

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context of their individual flying activities. Case examples are presented by the investigating NTSB medical officer.

Learning Objectives

1. Understand how physicians who examine pilots can increase the safety benefit of medication review by considering each individual pilot's particular flying activities, and how those activities might lead to situational use of hazardous medications or situationally hazardous effects of otherwise safe medications.
2. Learn about potential safety concerns regarding pilots' use of over-the-counter medications for motion sickness, and high-performance pilots' use of otherwise acceptable vasodilating medications.

[38] MARINE CORPS FIGHTER PILOT RETURN TO HIGH-G FLIGHT FOLLOWING EJECTION AND SEVERE BURNS: A CASE REPORT

Michael Rizzo
U.S. Navy, Pensacola, FL, United States

(Education - Case Study)

INTRODUCTION: This case report describes the clinical course, aeromedical management, and return to high-G flight of a US Marine Corps Student Naval Aviator following life-threatening burns sustained after ejection from a T-45C Goshawk. **BACKGROUND:** US Navy and Marine Corps aviators are held to a high medical standard for aviation duty. Naval Flight Surgeons are tasked with assessing the aeromedical fitness of aviators, and also with guiding them back to the level of health required to safely execute their mission when injuries and diseases occur. This case illustrates the robust, thorough approach to medical, aeromedical, and administrative care required to return an aviator to flight after critical injury. **CASE PRESENTATION:** On 19 September 2021, a healthy 25-year old USMC Student Naval Aviator ejected from a T-45C at 300 feet after his jet ingested a large vulture over Fort Worth, TX. Due to the low-altitude nature of ejection, he was unable to steer his parachute and became entangled in high-voltage power lines, resulting in full-thickness burns to 30% total body surface area. Burns involved the bilateral legs, buttocks, back, and upper arms. Burn etiology was thermal due to superheating of aluminum ejection seat pan caused by electrical arcing from power lines, resulting in combustion of flight gear. He was transported to Parkland Hospital and spent 37 days in the Burn ICU, undergoing extensive surgical debridement and skin grafting. He transitioned to intensive outpatient rehabilitation and underwent extensive testing before ultimately being cleared for return to full duty as a tactical jet aviator seven months later. He went on to earn wings of gold and was selected to fly the F-35C Lightning. **DISCUSSION:** This case highlights the high degree of multimodal medical care, interprofessional coordination, and administrative oversight required to return a critically injured aviator to the level of fitness required for tactical aviation. Flight Surgeons should be empowered and educated to navigate the many obstacles that stand in the way of achieving aeromedical clearance in severe cases that at first glance seem insurmountable for return to flight.

Learning Objectives

1. The audience will understand the importance of Flight Surgeons adopting a global view of patient care and stance of complete patient ownership in complex aeromedical cases. This is essential in guiding patients through the gauntlet of specialist consults and aviation-specific testing required to achieve full aeromedical clearance.
2. The audience will gain insight into the significant administrative challenges faced by Flight Surgeons and their critically injured/ill aviators working towards a return to flight. This often involves aggressive patient advocacy, involvement of higher echelons of command, and creative solutions to "get to a yes."
3. The audience will understand the viability of return to high-G tactical aviation following severe thermal burns and skin grafting. They will also see the huge importance of a positive attitude and open mind when dealing with novel cases that are not guided by existing aeromedical literature.

[39] USE OF MOBILE PHONE DETECTION AND LOCATION SYSTEM (MPDLS) IN THE ROYAL NORWEGIAN AIR FORCE (RNOAF) SAR HELICOPTER SERVICE

Geir Ingvar Berg
Norwegian Armed Forces, Oslo, Norway

(Education - Case Study)

INTRODUCTION: In 2020, the Royal Norwegian Air Force (RNoAF) became one of the first to implement the Mobile Phone Detection and Location System within its fleet of AW101-612 SAR Queen Search and Rescue (SAR) Helicopters. MPDLS represents a novel technology in SAR operations, aimed at enhancing mission safety, reliability, and efficiency. This presentation will examine two case studies that illustrate the impact of MPDLS on the success of SAR operations. **BACKGROUND:** Since the adoption of MPDLS, the system has demonstrated significant value in over 220 SAR missions across Norway. MPDLS enables improved accuracy and efficiency in locating victims through their mobile phones, making it an invaluable tool in challenging SAR conditions. This technology not only contributes to mission success but also positively affects the SAR crew's performance by reducing workload, fatigue, and stress. **CASE PRESENTATION:** Two cases demonstrate the effectiveness of MPDLS in enhancing SAR operations. In the first case, MPDLS significantly reduced the time required to locate the victim, minimizing crew workload and lowering the risks of fatigue and stress associated with prolonged search operations. The second case underscores the life-saving impact of MPDLS on the victim in this instance, the rapid location enabled by the technology was crucial and likely prevented a fatal outcome. Together, these cases highlight MPDLS as a pivotal advancement, improving both crew performance and mission success. **DISCUSSION:** Norwegian SAR operations face unique challenges, as much of Norway lies north of the Arctic Circle. Extended darkness, extreme cold, mountainous terrain, a lengthy coastline, and rapidly changing weather create difficult rescue conditions. MPDLS has proven to be a game-changer, enhancing mission effectiveness and crew performance, as well as increasing the likelihood of successful rescues under these harsh environmental conditions.

Learning Objectives

1. Participants will gain an introduction to the Mobile Phone Detection and Location System (MPDLS) used onboard the Royal Norwegian Air Force SAR helicopters.
2. The audience will learn about the operational benefits of MPDLS and its impact on crew performance in SAR missions.

[40] WINGS OVER HOUSTON MEDICAL SUPPORT: A THREE-YEAR DATA REVIEW AND LESSONS LEARNED

Samantha King[1], Ethan Stephens[1], Rebecca Mendelsohn[1], David Alexander[2]
[1]*UTMB, Galveston, TX, United States;* [2]*NASA, Houston, TX, United States*

(Original Research)

INTRODUCTION: The University of Texas Medical Branch Division of Aerospace Medicine has provided medical support to the Wings Over Houston (WOH) Airshow for over a decade. In the last three years of support, since the COVID-19 pandemic, medical operations have become more innovative, integrative, and standardized. Each year, the medical team has collected data on patient care and the supplies utilized to provide feedback and insights into future medical planning. **METHODS:** Medical support at WOH is provided by coordinated mobile walking medical teams and stationary tent teams. Medical care is focused on first aid and basic life support care; pre-arranged partnerships with local Emergency Medical Service agencies enable the transfer of patients to higher levels of care. For each team and tent, patient encounter information is collected in a deidentified manner. Information including age, gender, chief complaint, care rendered, and disposition are collected. This data is then collated and reviewed to evaluate trends and plan for future support. **RESULTS:** Each of the last three years has seen a different variety of common patient encounters. In 2022 and 2023, 80 and 95 patients,

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respectively, were treated in the medical tents. During these years, the most common medical conditions treated included abrasions, headaches, and lightheadedness/dizziness. In 2024, over 200 patients were treated in the tents, with a marked increase in heat-related illnesses. Each year, the majority of treated patients are adults, but up to 40% are children. Most patients (>80%) are discharged back to the show or discharged to home. In 2024, there was an increase in the number of patients transferred to the hospital (11 patients). **DISCUSSION:** Each year, the medical support teams at WOH are able to care for over 100 patients across the three-day event. Weather appears to significantly impact the types of ailments treated. Minors represent a sizable proportion of patients, thus, appropriately staffing the airshow requires the participation of some medical providers with a baseline comfort with acute pediatric care. Data collected from reviews like this allow for improved medical support staffing for this event, and provide insight for medical support for similar mass gathering events.

Learning Objectives

1. After this presentation, learners will understand the complexities of providing medical care for spectators at large, mass-gathering events, such as the Wings Over Houston Airshow.
2. After this presentation, learners will gain insight into appropriately staffing medical providers with a wide variety of experience to provide the most appropriate care to patients in a dynamic out-of-hospital environment.

[41] TIME COURSE OF EFFECTS OF CO2 EXPOSURE ON PHYSICAL AND COGNITIVE PERFORMANCE IN A SIMULATED SURFACE EXTRAVEHICULAR ACTIVITY CONTINGENCY SCENARIO

Nathan Keller[1], Robert Scully[1], Ben Levine[2], Tony Babb[2], James Pawelczyk[3], Alex Baughman[1], Mathias Basner[4], Karina Marshall-Goebel[5], Alejandro Garbino[6]

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(Original Research)

INTRODUCTION: Carbon dioxide (CO2) is a metabolic byproduct produced by humans that must be scrubbed from the atmosphere by environmental control and life support systems in space vehicles and spacesuits to prevent buildup. Current nominal CO2 limits are set by NASA Standard 3001; however, limits during contingency situations are not specified. The purpose of this study was to characterize and quantify the physiological, cognitive, and self-assessed symptom and performance metrics as a function of inspired CO2 (PICO2) during a simulated 1-hour contingency lunar EVA scenario in virtual reality (VR). **METHODS:** Fifteen healthy subjects completed seven simulated EVA scenarios walking on a passive treadmill for one hour, breathing dry, ambient air mixed with added CO2 in a blind, counterbalanced manner (PICO2: 0, 5, 10, 15, 20, 25, 30 mmHg), simulating a 2.0 km contingency EVA walkback to a habitat on the lunar surface in the event of a CO2 scrubber malfunction. Subjects were immersed in a Lunar VR environment and asked to maintain their walking speed between 2.1 km/h and an upper limit individually calibrated to a fixed metabolic workload of 1.3 L/min of O2 consumption and performed periodic cognitive tasks and continuous cardiopulmonary measurements. Self-assessments of symptoms and task performance were measured via verbal Likert-scale survey at the onset of the walkback and at 10-minute intervals thereafter. Mixed models were employed to detect effects of CO2. **RESULTS:** The time course of cardiopulmonary, cognitive, and self-reported responses at each level of PICO2 will be presented. All 15 subjects were able to complete the 1-hr walkback task at all CO2 levels. Physiological responses were rapid, typically within 1 to 5 min. No effects of time were detected for cognitive measures. Symptomatic ratings of headache, shortness of breath, and fatigue demonstrated a time-course development, reaching asymptote after 40 min of CO2 exposure. **DISCUSSION:** These findings will inform the posture of risk associated with CO2 exposure on human health and performance during microgravity and planetary surface operations, which will—in turn—help inform decisions related to space suit and environmental life support hardware requirements and EVA operational limits for contingency extravehicular activity (EVA) scenarios.

Learning Objectives

1. The audience will learn about the time course development of physiological, cognitive, symptomatic, and performance affects of acute carbon dioxide exposure up to 30 mmHg in the context of a spaceflight contingency.
2. The audience will learn about spaceflight-related operational contingencies and how they can inform evidence-based hardware requirements that lead to innovations in risk reduction during human exploration of space environments.

[42] REVIEWING THE IMPACT OF INSULIN CHANGES ON LONG-DURATION SPACEFLIGHT

Alexander Lee[1], Richard Whittle[2]

[1]*David Grant Medical Center, Travis AFB, CA, United States;* [2]*UC Davis, Davis, CA, United States*

(Original Research)

INTRODUCTION: As we expand our capabilities and embark on longer duration missions, understanding physiologic changes brought on by space flight becomes increasingly important. There is evidence to suggest the challenges of microgravity exposure has the potential to significantly disrupt glucose metabolism, with particular implications for insulin secretion and responsiveness. Such disruptions can set the stage for a cascade of pathologic changes that manifest within the spectrum of clinical diabetes. Tobin et al. last explored this association in 2002, though a multitude of studies have since been published with new evidence and insight on possible mechanisms driving the pathophysiology. **METHODS:** A literature review involving keyword and MeSH term searches in PubMed and EMBASE was conducted. A populations, intervention, comparison, outcomes, and study (PICOS) framework was used to assess outcomes on insulin sensitivity and resistance in the setting of exposures to microgravity/ground-based analogs. **RESULTS:** Of 139 studies, a total of 73 studies met the inclusion criteria and were included in the review. Upon reviewing abstracts, full texts, and removal of duplicates, a total of 39 peer-reviewed studies were included in our analysis. 31 articles from PubMed and 8 from EMBASE. 22 of the studies employed an experimental design. 4 of the studies were observational in nature. 13 of the studies were review articles. Studies primarily used plasma levels of insulin, glucose, and physiologic biomarkers as outcome measures. **DISCUSSION:** Notably, 24 of the 26 non-review studies included have continued to demonstrate a positive association between serum insulin concentrations, fasting blood glucose, among other measures, and microgravity and its analogs. This suggests an increase in insulin resistance, resulting in a subclinical diabetic state, even with brief exposures. Multiple studies elucidated novel mechanisms contributing to their results. Though the data does not suggest we start sending antiglycemic agents along with our astronauts, given the deleterious health impacts of clinical diabetes, a greater understanding of this pathologic association is imperative. Longer duration studies are needed to elucidate any dose-response relationships and to shed light on the pathophysiology of the diabetogenic effect. With this information, we will be able to develop more effective countermeasures to optimize the health of the growing number of space travelers.

Learning Objectives

1. The audience will learn about the impact of microgravity and ground-based analogs on glucose metabolism with particular focus on insulin secretion and responsiveness.
2. The audience will understand implications of spaceflight-induced insulin changes for exploratory spaceflight.
3. The audience will learn about the proposed mechanisms underlying insulin resistance in microgravity, including the roles of muscle atrophy, liver function disruption, and inflammatory cytokines.

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Monday, 06/02/2025 ***2:00 PM***
Regency VII

[S-9] SLIDE : BIOMECHANICS AND PHYSIOLOGY

Chair: Peter Hodkinson
Co-Chair: Robert Slater

[43] INCREASE IN PREVALENCE OF NECK AND BACK PAIN IN F-35 PILOTS: CAUSES AND POTENTIAL INTERVENTIONS

Gracia den Bult - van Wieren[1], Aline van Rijswijk[2], Maybritt Kuypers[3], Yuval Steinman[4], Thijs Wingelaar[5]
[1]*Center for Man in Aviation, Soesterberg, Netherlands;* [2]*Leiden University Medical Center, Leiden, Netherlands;* [3]*European Space Agency, Cologne, Germany;* [4]*Royal Netherlands Air Force, Soesterberg, Netherlands;* [5]*Royal Netherlands Navy, Den Helder, Netherlands*

(Original Research)

INTRODUCTION: Fighter pilots face unique occupational challenges, including exposure to G-forces, suboptimal seating postures, and cumbersome flight gear. These factors contribute to a high prevalence of neck and back complaints, which can impair flight performance and reduce productivity. **METHODS:** This cross-sectional study assessed the self-reported prevalence of neck and back pain among F-16 and F-35 pilots of the Royal Netherlands Air Force (RNLAF). A total of 121 pilots were invited to participate, of which 50.4% (n=61) responded. Data were collected using a questionnaire based on prior research and adapted for military pilots. **RESULTS:** Results indicated a higher prevalence of back pain among F-35 pilots (46.3%) compared to F-16 pilots (8.3%, p=0.001), while neck pain prevalence was not statistically different between the two groups (51.1% vs 37.5%, respectively, p=0.278). Contributing factors included seat angle, heavy (helmet mounted) equipment and specific flight maneuvers (e.g., check-six). A majority (83.3%) reported a negative impact on flight performance, with 37.5% stating it affected flight safety. Thirteen pilots (22.8%) were at least one time unable to perform flying duties due to neck and/or back pain. Preventive strategies suggested by pilots included a multidisciplinary approach including physiotherapy and physical training, as well as adjustments to equipment. **DISCUSSION:** This study represents one of the first investigation into neck and back pain amongst F-35 pilots and shows a significant presence in back pain. Equipment and seat angle appear to be the main contributing factors. Targeted interventions may prevent pain or potential injury and improve performance and productivity.

Learning Objectives

1. The participant will gain insights into the prevalence of neck and back pain among fighter pilots in the Royal Netherlands Air Force (RNLAF), specifically concerning the F-35 platform.
2. The participant will explore the contributing factors to neck and back pain in fighter pilots and understand how these factors differ between F-16 and F-35 pilots.
3. Possible effective preventive strategies for reducing neck and back pain in fighter pilots, including physiotherapy, physical training, and equipment adjustments will be discussed.

[44] DIFFERENCES IN CERVICAL AND LUMBAR SPINE DEGENERATION BETWEEN FIGHTER PILOTS, MILITARY HELICOPTER PILOTS, AND CIVILIAN CONTROLS

Rachel Cutlan[1], Clarissa Strother[1], L. Tugan Muftuler[1], Narayan Yoganandan[1], Aditya Vedantam[1], James B. Sheehy[2], Daniel P. Nicolella[3], Peter Le[4], Chris Dooley[4], Timothy Bentley[5], Brian D. Stemper[1]
[1]*Medical College of Wisconsin, Milwaukee, WI, United States;* [2]*Naval Air Warfare Center Aircraft Division, Patuxent River, MD, United States;* [3]*Southwest Research Institute, San Antonio, TX, United States;* [4]*Air Force Research Lab, Dayton, OH, United States;* [5]*Office of Naval Research, Arlington, VA, United States*

(Original Research)

INTRODUCTION: The military environment includes many unique loading scenarios not experienced by civilians. Fighter pilots (FP) are exposed to high-g accelerations during flight, wear headbourne equipment, and frequently move their head to extreme viewing positions (e.g., "check six") during high-g exposure to maintain visibility of the airspace. Military rotary wing aircrew (helicopter - HA) are exposed to whole-body vibrations, wear headbourne equipment, and adopt a 'helo-hunch' (forward leaning) position during flight. Since structural spinal degeneration is due, at least in part, to the mechanical environment, the unique loading environments experienced by military pilots may change their spinal degeneration profile. **METHODS:** FP and HA from the Wisconsin National Guard and age-matched civilian controls provided informed consent and participated in cervical and lumbar spine MRI scans. Clinical reads, intervertebral disc degeneration (IVDD) grading (Grade I-V; Pfirrmann Spine 2001), and identification of Schmorl's Nodes were completed. **RESULTS:** Eighteen FP (16M/2F; avg±SD age: 38±6 years), 14 HA (12 pilots/2 crew chiefs; 14M; 36±7 years), and 17 civilian controls (12M/5F; 35±7 years) participated. FP had more subjects (83%) with at least one instance of IVDD (Pfirrmann Grade 2+) in the upper cervical spine (C2/3-C3/4) compared to HA (p=0.04, 43%) and civilians (p<0.001, 18%). FP also exhibited a higher incidence of cervical foraminal stenosis (avg: 2.4 levels) compared to HA (p=0.01, 1.1 levels). HA exhibited a higher incidence of lumbar IVDD (avg: 2.9 levels) compared to FP (p=0.15, 1.8 levels) and civilians (p=0.08, 1.2 levels). Three HA exhibited atypical (rectangular/multiple; Samartzis Osteoarthritis Cartilage 2016) lumbar spine Schmorl's Nodes, while FP and controls exhibited only typical (indent) Schmorl's Nodes. **DISCUSSION:** FP and HA exhibited unique spine degeneration compared to controls. FP exhibited upper cervical spine degeneration, which may relate to rotation of the head/neck during high-g flight maneuvers. HA exhibited lumbar spine degeneration, which may relate to whole-body vibrations during long duration flights, along with abnormal Schmorl's Nodes possibly due to the occasional hard landing. DISCLAIMER: Views expressed are those of the authors and do not reflect the official views of the USAF, nor the DOD. Mention of trade names, commercial products, or organizations do not imply endorsement by the USG.

Learning Objectives

1. Fighter pilots exhibit accelerated cervical spine degeneration, specifically in the upper cervical spine.
2. Helicopter aircrew exhibit accelerated lumbar spine degeneration, specifically in the upper lumbar spine.

[45] APPLICATION OF A NECK COACTIVATION INDEX TO EVALUATE COMPLEX MOVEMENTS WITH HEAD SUPPORTED MASS

Peter Le[1], Therese Parr[1,2], Charles Weisenbach[3]
[1]*U.S. Air Force Aeromedical Research Lab, Wright-Patterson AFB, OH, United States;* [2]*Oak Ridge Institute for Science and Education (ORISE), Oak Ridge, TN, United States;* [3]*Naval Medical Research Unit Dayton (NAMRU-D), Wright-Patterson AFB, OH, United States*

(Original Research)

INTRODUCTION: Head supported mass (HSM) and poor cockpit ergonomics are physical risk factors for neck pain (NP). Given the high prevalence of NP among military aviators from such factors, objective measures are needed to understand, evaluate, and track the neck response which provides insight into fatigue, feedback control errors, and subsequent injury/NP. A neck coactivation index (CoA) was employed to classify multi-muscle agonist/antagonist activity and describe it as a system for complex dynamic head movements. With a scale of 0 to 1 (low to high), it provides insight into the level of activation necessary to satisfy the neuromuscular intent for a task, where higher values may indicate inefficiency, fatigue, or guarding. The objective was to demonstrate the feasibility of the CoA across a series of head motions with HSM. It was hypothesized that the CoA would be higher with complex movements such as a check-six maneuver

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and higher with HSM compared to an independent dataset without HSM. **METHODS:** Sixty-two subjects performed uniaxial head (flexion/extension, axial rotation, lateral bending) and multiaxial (check-six) movements in a simulated helicopter environment while wearing a comfortably fitted helmet (HGU-56/P). Full body kinematics were collected through optical motion capture and electromyography (EMG) data were collected on the bilateral sternocleidomastoids, levator scapulae, cervical extensors, and trapezius muscles. Head/trunk kinematics and EMG data were used as inputs into the CoA and peak CoA (unitless) were compared through a one-way ANOVA. These data were compared to an independent dataset of head motion data without an HSM. **RESULTS:** With HSM, the check-six maneuver had the highest CoA (0.155±0.073), followed by axial rotation (0.112±0.058), flexion/extension (0.070±0.060), and lateral bending (0.066±0.052) ($p<0.001$). These values were higher than neck CoA from an independent dataset without HSM for the uniaxial movements. **DISCUSSION:** The CoA confirmed its feasibility as an approach to evaluate neck muscle response as a system across complex dynamic motions with HSM. Its utility demonstrates the capability to evaluate neuromuscular response to modifications in HSM design, long endurance operations, and prehabilitation effectiveness. Efforts are underway to further develop the capability for personalized muscle morphometry, open-source usability, and viability under sustained-G exposure.

Learning Objectives

1. This work demonstrates a capability to reduce the complexity of multi-muscle neck activity into a time-series index to describe neuromuscular effort as a system.
2. The CoA is scalable for tasks beyond the reported use case of HSM as it captures the response to physical environmental exposures.

[46] PARACHUTE OPENING SHOCK IN MILITARY TANDEM TETHERED BUNDLE OPERATIONS

Tyler Rooks, Haley French Krahn
U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: Military free-fall (MFF) and tandem tethered bundle (MTTB) operations are used to insert Service Members into combat. There is limited research investigating the biomechanics and health hazard effects of MFF and MTTB operations. Previous research focused on recreational skydiving and military static line injury incidence and associated injuries. The objective of the present study was to quantify the health hazard effects of MTTB operations associated with parachute opening shock exposure. **METHODS:** The study was conducted with experienced free-fall jumpers during prescheduled events. Volunteers completed multiple jump types (solo, tandem-passenger, tandem-equipment, and tandem-bundle) under high-altitude low opening (HALO) and high opening (HAHO) profiles. Prior to each jump, participants were instrumented with seven inertial measurement units (IMUs) to record jump severity and opening kinematics. At the start of the event, volunteers completed a survey and baseline physiological assessments, including neck range of motion (ROM), shoulder ROM, and neck strength. Assessments were repeated at the end of each day. **RESULTS:** Data were collected from 26 subjects conducting a total of 176 instrumented jumps. Subjects jumped an average of 6.7 (±4.4) times with a range of 1 to 17 jumps per subject. Jump types included tandem-bundle (n=115), tandem-equipment (n=8), tandem-passenger (n=31), and solo (n=22) jumps. Canopy types included standard military free-fall (n=8), military tandem parachutes (n=50), and next-generation tandem parachutes (n=118). Jump profiles included HALO (n=137) and HAHO (n=39) jumps. Significant reductions were also found in neck strength and neck ROM from baseline to the end of the event period (approximately one week). Significant reductions in neck strength and neck ROM were observed on days with high jump severity (i.e., hard openings). High jump severity was defined as the upper 75th percentile of all openings as measured by the IMUs (peak acceleration) or self-reported opening shock severity. **DISCUSSION:** Data collected in the present study are a first step toward understanding the effects of parachute opening shock during MTTB operations. While reduced neck strength or neck ROM may not necessarily be associated with injury, repeated exposures without recovery time may develop into chronic damage or injury.

Learning Objectives

1. The audience will learn about military free-fall and parachute opening shock effects on the human body.
2. The audience will learn about the novel use of wearable sensor-based motion capture systems to capture human kinematics in military training environments.

[47] PROGRESSIVE LENS USE IN HIGH PERFORMANCE AIRCRAFT

Bonnie Posselt, Guy Hunter, Malcolm Woodcock, Alaistair Bushby, Scott McClellan, Nicholas Green
RAF Centre of Aerospace Medicine, Henlow, United Kingdom

(Education - Program / Process Review)

BACKGROUND: There are several presbyopic aircrew in the UK military, many of whom prefer using progressive lenses outside the cockpit and find the sharp demarcation line in bifocal lenses problematic. Progressive lenses have not previously been authorised for use in flight by aircrew of high-performance military aircraft in the UK, but they have been permitted for use in other fixed wing, rotary wing and multi-engine aircraft. Progressive lenses are transitional with increasing power on inferior gaze and there is no demarcation line as there is with bifocal lenses. However, there may be optical compromise in the lateral areas of progressive lenses and some individuals report visual illusionary movement requiring a period of adaptation. **DESCRIPTION:** A flight trial previously conducted in a Hawk T1 aircraft in 2015 to investigate the use of progressive lenses in experienced pilots showed that progressive lenses were rated higher by participants than bifocals, with a significant improvement during defensive air combat ($p=0.038$). No adverse effects on flight safety were reported. In 2018, a progressive lens trial conducted in a Tornado simulator found no issues when using the Head Up Display. More recently, feedback has been gathered from 7 aircrew who have flown in the RAF in high performance aircraft with progressive lenses, either inadvertently or with a waiver. These aircrew collectively have more than 30 years' experience of using progressive lenses in-flight and reported no associated adverse incidents. Of note, Canadian and German military pilots have been permitted to use progressive lenses in high performance aircraft for some time, without report of issues. The successful use of progressive lenses in the challenging rotary wing environment also provides evidence that this form of visual correction is likely to be safe in this aviation setting. **DISCUSSION:** Based on the evidence, the UK military has elected to permit progressive lens use in high performance aircraft. For progressive lenses to be authorised in an individual, focal distances must be set in relation to the specific cockpit layout; a four-week adaptation period is needed, followed by a functional assessment both on the ground and in flight, in a non-safety-critical role.

Learning Objectives

1. The audience will learn about the different types of optical correction that can be used for presbyopia and specifically in the aviation environment.

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2. The audience will learn about the evidence required to permit use of progressive lenses in aircrew – in-flight and simulator trials, literature review, gathering experience from aircrew and other international partners.

[48] NEUROLOGICAL BIOMARKER PROFILES INDICATE EARLY NEURODEGENERATIVE PROCESSES IN HIGH-PERFORMANCE AVIATORS - RESULTS FROM THE CANADIAN WMH STUDY

Joan Saary[1], Shawn Rhind[2], Alex Di Battista[2], Maria Shiu[3], Oshin Vartanian[4], Joel Ramirez[5], Christopher Scott[5], Gary Gray[6], Shamus Allen[7], Miriam Palmer[6], Sandra Black[8]

[1]*Canadian Forces Environmental Medicine Establishment, and University of Toronto, Toronto, Canada;* [2]*Defence Research and Development and University of Toronto, Toronto, Canada;* [3]*Defence Research and Development, Toronto, Canada;* [4]*Defence Research and Development Canada and University of Toronto, Toronto, Canada;* [5]*Sunnybrook Research Institute, Toronto, Canada;* [6]*Canadian Forces Environmental Medicine Establishment, Toronto, Canada;* [7]*Canadian Forces Environmental Medicine Establishment and University of Calgary, Toronto, Canada;* [8]*Sunnybrook Research Institute and University of Toronto, Toronto, Canada*

(Original Research)

INTRODUCTION: Military aviators routinely operate in environments exposing them to various physiological stressors. Repeated exposure to these conditions can result in neuroinflammation, oxidative stress, and axonal damage, which may then lead to cognitive impairments and risk of neurodegenerative disease. Despite concerns, the cumulative neurobiological effects of such exposures remain poorly understood, with limited research on brain injury biomarkers in this population. This study addresses this gap by analyzing a panel of 8 blood-based neuroproteomic biomarkers, hypothesizing elevated levels of brain injury markers in aviators compared to non-aviators. **METHODS:** This all-male, cross-sectional cohort study compared plasma samples from 48 Canadian Armed Forces (CAF) aircrew (age: 39.0±11.9 y) with flight exposure to 48 non-aviator CAF controls (34.1±6.3 y). Eight biomarkers were analyzed using ultra-sensitive multiplex immunoassays: S100b, glial fibrillary acidic protein (GFAP), neuron-specific enolase (NSE), ubiquitin carboxyl-terminal hydrolase (UCH-L1), neurofilament light (NF-L), phosphorylated neurofilament heavy (pNF-H), peroxiredoxin-6 (PRDX-6), and total tau (T-tau). Statistical comparisons used the Mann-Whitney U-test with FDR correction. The study received ethical approval. **RESULTS:** Aviators exhibited significant elevations in GFAP ($p<0.001$), NF-L ($p<0.001$), and PRDX-6 ($p<0.001$), indicating astrocyte activation, axonal damage, and oxidative stress. Tau levels were modestly higher in aviators ($p=0.005$), suggesting potential early neurodegenerative processes. Trends toward elevated S100b and NSE were noted but were not statistically significant ($p>0.1$). **DISCUSSION:** This study provides the first evidence of elevated GFAP, NF-L, PRDX-6, and T-tau in military aviators, suggesting cumulative neurological damage/dysfunction from repeated exposure to stressors of flight. These biomarkers indicate probable astrocytic and axonal injury, alongside increased oxidative stress, which may heighten the long-term risk of cognitive impairment and neurodegenerative diseases. The findings highlight the need for preventive measures and further research into the progressive effects of such exposures on brain health to enhance understanding of neurobiological risks faced by aviators and underscore the importance of monitoring to safeguard long-term cognitive function and operational readiness.

Learning Objectives

1. Understand the impact of high-altitude flight on biomarkers of brain injury in military aviators.
2. Recognize the potential long-term neurological risks associated with repetitive exposure to stressors of flight.

Monday, 06/02/2025 ***2:00 PM***
Hanover F/G

[S-10] SLIDE : AEROMEDICAL CAPABILITY AND PERFORMANCE

Chair: Carol Ramsey
Co-Chair: Leanne Baggott

[49] U.S. NAVY 2025 AEROMEDICAL TOP 10

Adam Preston[1], Sarah Beadle[1], Micah Kinney[2], Richard Arnold[3], T. Chris Foster[1], Bethany Shivers[1]

[1]*U.S. Naval Air Warfare Center Aircraft Division, Patuxent River, MD, United States;* [2]*U.S. Naval Research Unit EURAFCENT, FPO, Armed Forces - Europe, Canada, Middle East, Africa, United States;* [3]*U.S. Navy Research Unit Dayton, Wright-Patterson AFB, OH, United States*

(Education - Program / Process Review)

BACKGROUND: The U.S. Naval Air Warfare Center Aircraft Division Human Systems Engineering Department and Naval Aeromedical Research Laboratory conduct an annual U.S. Navy (USN) and U.S. Marine Corps (USMC) aircrew survey to identify the most pressing aeromedical priorities and capability gaps across platform/community. Survey data are used to produce an Aeromedical Top 10 List to inform and prioritize research, development, test, and evaluation (RDT&E) and acquisition program support. **OVERVIEW:** The 2024 survey received a total of 988 responses (49 fixed-wing ejection, 282 fixed-wing non-ejection, and 424 rotary/tiltrotor). The 2024 USN/USMC Aeromedical Top 10 Priorities were (in order): (1) post-flight neck and back pain, (2) long-term health impacts of flight, (3) hearing protection, (4) physical fatigue and sleep health, (5) implementing an aircrew conditioning system, (6) personnel recovery/extended survival, (7) workload management, (8) dehydration mitigation, (9) oxygen mask design, and (10) spatial disorientation and degraded visual environments. When broken out by community, hearing protection, neck & back pain, and long-term health effects of flight were the highest rated overall. Fixed-wing ejection aircrew had more concerns about oxygen masks, respiratory dynamics, and cockpit pressure. Fixed-wing non-ejection had more concerns about fatigue. Rotary wing/tiltrotor had additional concerns about spatial disorientation and dehydration mitigation. Survey results from previous years are analyzed for trends and used to inform survey question development. The 2025 survey is in process and updated data will be presented. **DISCUSSION:** Aircrew-level input is critical to focus RDT&E efforts, within fiscal and time constraints, requiring an interdisciplinary approach to include clinical, materiel, technological, and process-oriented solutions. The USN/USMC Aeromedical Top 10 survey results drive collaboration with civilian and military services and with international partners.

Learning Objectives

1. The participant will be able to understand the most pressing aeromedical concerns relayed directly from U.S. Navy and U.S. Marine Corps aircrew.
2. The participant will understand how aeromedical priorities may differ depending on platform type.

[50] IMMEDIATE EFFECTS OF SCREEN USE ON SLEEP QUALITY & MENTAL FATIGUE IN HEALTHY ADULTS

Anubhav Upadhyay[1], Stuti Mishra[2], Sudhanshu Mohapatra[1], Gaurab Ghosh[1]

[1]*Institute of Aerospace Medicine, Bengaluru, India;* [2]*Indian Air Force, Pathankot, India*

(Original Research)

INTRODUCTION: In the contemporary digital age, screen-based devices are omnipresent, serving functions such as communication, work, education, and entertainment. The widespread use of these devices around bed time, raises concerns about its impact on sleep quality & mental fatigue. This study aims to investigate the immediate effects of screen time

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on sleep quality and mental fatigue in healthy adults. It seeks to understand how screen time influences sleep efficiency, cognitive performance and mental fatigue, with implications for individuals in safety-critical roles. **METHODS:** This study involved 30 healthy adult volunteers aged 20-40 years with an average screen time exceeding 05 hours daily. Participants underwent three test conditions: baseline (BL), extended wakefulness with continuous screen time (SDST), and extended wakefulness without screen time (NOST). The study used validated tools i.e., GSQS, CFS and an indigenous cognitive test battery PSUMEDHA. Cognitive performance was evaluated using tasks measuring vigilance (MCT), tracking and psychomotor coordination (DTT). Statistical analyses was performed using repeated measures ANOVA for normally distributed data and Friedman's test for non-normal data. Pairwise comparisons was done using Bonferroni post-hoc analysis. **RESULTS:** The study revealed a significant decline in sleep efficiency in the SDST condition compared to the BL and NOST conditions, as measured by actigraphy ($p<0.001$). Participants exposed to continuous screen time reported high mental fatigue (CFS, $p<0.05$). Cognitive performance on DTT (Dual task test) was impaired in the SDST condition, with slow reaction times post-sleep ($p<0.05$) and increased lag error observed pre-sleep ($p<0.001$). These results underscore the impact of screen time on sleep quality and cognitive function. **DISCUSSION:** The study indicate that continuous screen time before sleep impairs sleep efficiency and exacerbates mental fatigue. Screen time management particularly in the hours leading up to bedtime, is crucial for restorative sleep, cognitive function, and optimum human performance in safety critical scenarios. The study highlights the need for further research specifically targeting aircrew population to assess the unique challenges they face regarding screen time and sleep. Implementing screen time management strategies and promoting good sleep hygiene practices are essential, to enhance both operational effectiveness & public safety.

Learning Objectives

1. The audience will learn about the detrimental effects of continuous screen use near bed time and its impact on sleep quality.
2. The audience will learn the implications of digital media use on mental fatigue, thereby educating them about the importance of screen time management especially near bed time.
3. The audience will be able to appreciate the operational implications of reduced human performance in aviation due to the widespread screen use near bed time leading to extended wakefulness.

[51] IMPLEMENTING A PEER SUPPORT PROGRAM IN A BRAZILIAN AIRLINE: A COLLABORATIVE APPROACH

Audrey Savini[1], Jose Eliezio Rodrigues de Aguiar[1], Vania Elizabeth Ramos Melhado[1], Augusto Duro Froner Dalazen[2], Helton Rubem Campos Dourado[4], Anna Clara Cybele Heliodora Coelho Cunha[1], Leonardo Eduardo Martins Santos[1]

[1]*Azul Linhas Aéreas Brasileiras, São Paulo, Brazil;* [2]*Azul Linhas Aéreas Brasileiras, Porto Alegre, Brazil;* [4]*Azul Linhas Aéreas Brasileiras, Recife, Brazil*

(Education - Program / Process Review)

BACKGROUND: In the high-pressure environment of aviation, mental health and operational safety are closely intertwined. Recognizing this, a peer support initiative was launched one year ago in Brazil, drawing on best practices from global models and adapting them to the Latin American culture. This project was spearheaded by the Operational Safety Department, in collaboration with the Mental Health Department, ensuring that both safety and wellbeing were integral to the program's design and implementation. **OVERVIEW:** This presentation examines the creation of the peer support program, adapted to the unique cultural and geographical realities of the region, and highlights the lessons learned during its first year of operation. It also underscores the importance of collaboration between the Mental Health and Operational Safety Departments. **DISCUSSION:** By integrating mental health expertise with operational safety protocols, the program addresses not only psychological wellbeing but also enhances overall safety outcomes. This collaboration can significantly enrich peer support programs in airlines. Additionally, while established peer support program models serve as a foundation, they must be adapted to reflect local cultural nuances.

Learning Objectives

1. The participant will be able to understand the integration of mental health and operational safety in peer support programs, learning how collaboration between the Mental Health and Operational Safety Departments enhances both psychological wellbeing and safety outcomes in the aviation industry.
2. The participant will be able to identify key cultural adaptations necessary for effective peer support, recognizing the importance of tailoring global program models to align with local cultural nuances and geographical realities, particularly in Latin America.
3. The participant will be able to better understand the implementation of a Peer Support in Latin America program and the challenges faced.

[52] QUANTIFYING THE GENDER DATA GAP WITHIN AEROSPACE MEDICINE RESEARCH

Jemma Austin[1], Camille Bilger[2], Erica Jackson[3], Bonnie Posselt[3], Peter Hodkinson[1]

[1]*King's College London Department of Aerospace Medicine, London, United Kingdom;* [2]*Martin-Baker Aircraft LTD, Upper Denham, United Kingdom;* [3]*RAF Centre of Aviation Medicine, Henlow, United Kingdom*

(Original Research)

INTRODUCTION: A gender data gap (GDG) has been identified within the academic literature of medicine, sports, performance, science, and physiology that has not previously been assessed in aerospace medicine (ASM).This study aimed to investigate whether a GDG exists within ASM through examination of the ration of male and female participants in recent ASM publications. **METHODS:** Research publications involving humans were examined in all editions of the Journal of Aerospace Medicine and Human Performance from January 2018 to December 2022. The title, topic, number of participants (male and female) and which sections of the paper identified the gender were recorded. Data were expressed in frequencies and percentages with Chi-square analyses performed to assess the statistical relevance of any differences seen between frequencies. **RESULTS:** In total, 260 research papers (which included 152,636 participants) were reviewed. Of these papers, 16.5% did not record participant sex, 48.8% of papers incorporated data from both sexes, 33.4% from male only participants and 1.2% female only ($p<.0001$). Of those papers that reported the gender of participants, 87.9% were male and 12.1% were female ($p<.0001$). The inclusion of gender in the title was more common in papers where females were the sole participant (75%) than males (1%).Females were less likely to be represented in research focused on spatial disorientation, anthropometry, altitude, acceleration and medical standards/licencing. Conversely, females were more likely to be represented in research on airline health, space physiology and medicine, cardiovascular physiology and hypoxia. **DISCUSSION:** Females are significantly underrepresented within ASM research. The implication is that gender specific differences in physiology or protection requirements may not have been identified. Consequently, conclusions from aerospace medicine research that inform evidence based operational practice might not be applicable to females in the aerospace environment. It is imperative ASM researchers are aware of the existing GDG within the literature and are encouraged to address the GDG through targeted research on female-centric issues, subgroup analyses by gender and promotion of increased female research participation. This will contribute to wider ongoing dialogue around creating equitable working environments and optimizing the health, safety, and performance of all aircrew.

Learning Objectives

1. Understand the concept of a gender data gap and the risks it may present to current evidence in aerospace medicine and the accurate informing of operational practice and guidance.
2. Describe examples of how gender data gaps in allied research fields may be relevant to ASM.
3. Understand how research protocols and publications could be improved to address gender-based knowledge gaps.

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[53] EMBRACING DIVERSITY FOR THE FUTURE OF HUMAN SPACEFLIGHT

Irene Di Giulio[1], Camille Bilger[2], Jemma Austin[1]
[1]*King's College London, London, United Kingdom;* [2]*Martin-Baker Aircraft Ltd, Denham, United Kingdom*

(Education - Tutorial / Review)

INTRODUCTION: New missions the Moon and Mars are opening a new era for human spaceflight. In this context, the value of diversity is being recognised across national space agencies, private companies and society at large. So far, no woman, person of colour or individual with physical impairments has set foot on the Moon. Addressing these gaps in representation is now essential to foster a more inclusive future in space exploration.**TOPIC:** Inclusivity is not only a legal and moral imperative but also a driver of progress in space exploration. Expanding access to space will require innovative medical and engineering solutions to accommodate a more diverse group of professional and commercial astronauts. Applying the "all-human-in-the-loop" design approach is essential to address human physiological and physical variability. This approach not only identifies individual needs, risks, and safety considerations but also highlights unique advantages that diverse astronauts bring to successful missions. For example, motion sickness is an important problem in aerospace, yet it is unknown why women and some ethnicities are more susceptible to it. Interestingly, individuals with vestibular impairments may experience less motion sickness and could potentially be well-suited for space careers, though they are rarely considered in this field.Aerospace medicine research participation remains male-dominated, and examples from gender-based analyses of relevant physiological, medical and scientific research suggests applying male-centric data to females is inadequate. Our work focuses on new approaches to ensure future spaceflight equipment and environments support diverse populations to thrive. These approaches include the establishment of the 'Space 4 All' community in partnership with people with a lived experience of disability. Community workshops have identified physiological, medical and technical factors that can inform the development of solutions for safe and inclusive space missions. **APPLICATION:** Involving a broader range of expertise and experiences in discussions about the future of human spaceflight is essential, especially as new spacesuits, habitats, and space stations are being developed. The Spacesuit Physiology Lab aims to support these efforts and by including considerations on biological sex, race, and disability, so that the new era of human spaceflight can benefit from solutions that include everyone.

Learning Objectives

1. To identify the adjustments for new astronauts, including those with a physical impairment.
2. To discuss the new challenges posed by space tourism in terms of human variability.

[54] CLOSING THE WELL-BEING GAP FOR PILOTS: A NEW APPROACH TO HEALTH AND SAFETY

Reyne O'Shaughnessy
Duquesne University, Pittsburgh, PA, United States

(Education - Program / Process Review)

BACKGROUND: At the UND Mental Health Symposium in November 2022, a conversation with an aviation student, "Eddy," highlighted common sleep disturbances among aviation students. After a brief assessment, we introduced lifestyle adjustments, such as reducing caffeine intake and modifying dietary habits, to improve sleep hygiene. Over four weeks, Eddy reported notable improvements in sleep quality and well-being, reflecting a larger trend: many aviation students face physical, mental, and emotional challenges without fully understanding causes. Research shows that 60% of collegiate aviation students report sleep issues, nearly 50% experience dietary challenges, and 70% face high stress and anxiety. In collaboration with Southern Illinois University, this study addresses these health challenges through targeted interventions to improve student resilience as they prepare for aviation careers. **OVERVIEW:** This IRB-approved study examines the effect of masterclass education on sleep, nutrition, exercise, and mindfulness on aviation students' health and behavior. We hypothesize that non-technical, aviation-specific well-being tools can positively impact health, performance, and safety. Twenty-five students participated, with behavioral changes measured through pre- and post-training surveys. Preliminary findings indicate modest improvements across wellness areas—sleep, nutrition, exercise, and relaxation—though statistical significance has not yet been achieved. Nonetheless, these initial outcomes suggest that structured education may have meaningful long-term benefits. Conducted with Southern Illinois University, this study addresses critical well-being challenges, equipping future professionals with resilience tools suited for high-stress environments. **DISCUSSION:** This study underscores the operational importance of continuous health education in aviation, particularly through masterclasses tailored to students. Small lifestyle adjustments show potential for significant health benefits, emphasizing the need for further research to validate findings and refine interventions. Expanding collaboration with faculty and students will improve data quality and broaden the research scope.Non-Technical Skills (NTS) training may also enhance operational safety across aviation sectors, with potential benefits for teamwork and performance in unpredictable situations. Future research could explore outcomes related to performance, cost savings from reduced burnout, and overall health promotion

Learning Objectives

1. Recognize the Relationship Between Lifestyle Adjustments and Well-Being in Collegiate Aviation Students • Objective: Participants will identify how targeted lifestyle changes, such as improved sleep hygiene, nutrition, and mindfulness, can positively impact the well-being and performance of aviation students.
2. Evaluate the Role of Non-Technical Skills (NTS) in Enhancing Aviation Safety • Objective: Attendees will understand how Non-Technical Skills training, particularly in wellness and resilience, contributes to operational safety and efficiency within civilian, international, and military aviation sectors.
3. Analyze the Potential Benefits of Masterclass Education on Aviation Health and Performance •Objective: Participants will assess preliminary outcomes of masterclass education on sleep, nutrition, exercise, and mindfulness in enhancing health and resilience among aviation students, with a focus on the long-term benefits of structured education.

Monday, 06/02/2025 ***4:00 PM***
Centennial Ballroom I

[S-11] PANEL: BANISH NEUROPHOBIA – AEROSPACE NEUROLOGY FOR THE BUSY AME

Chair: Willliam Hoffman
Co-Chair: Roger Hesselbrock

Panel Overview: BACKGROUND: *The field of clinical neurology is advancing at an accelerating rate, bringing new options for patients facing a range of neurological conditions. Innovation brings new optimism for patients and clinicians, but novel challenges for aeromedical certification. AMEs are uniquely positioned to assist applicants with neurologic disorders navigating aeromedical assessment processes, but key actions and information are needed to enable a timely and accurate certification decision.* ***OVERVIEW:*** *This panel aims to provide an aeromedically focused review of five commonly encountered neurological conditions intended for the busy AME in clinical practice. Each presentation will include the following for each condition: (1) a clinicopathological review, (2) update on approved medications, (3) updates on certification processes and standards, and (4) recommendations by aerospace neurologists. Five conditions will be reviewed including (1) Headache (2) First Time Seizure and Epilepsy, (3) Multiple Sclerosis, (4) Parkinson's Disease, and (5) Cerebrovascular Disorder. Discussions will be scoped for the busy AME in clinical practice.* ***DISCUSSION:*** *This panel is intended to enable AMEs to best care for pilot patients with neurologic conditions with ease. Content will be clinically focused and allow for time for questions from the audience.*

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[55] TREATMENT OF HEADACHE NEUROPHOBIA - TAKE 2 ASA AND CALL IN THE MORNING?

Roger Hesselbrock
FAA, Dayton, OH, United States

(Education - Program / Process Review)

BACKGROUND: Headaches occur in all population segments and age groups, estimated to affect about 40% of the world's population. They are in the top three most common neurologic disorders and are the third highest world-wide cause of disability-adjusted life years. The wide variability in presentation and management of headache disorders is challenging for aeromedical assessment and disposition. This presentation on aeromedical assessment of headache disorders is applicable to Aviation Medical Examiners and Flight Surgeons, and audience participation is encouraged. **OVERVIEW:** Headaches have a variety of clinical manifestations ranging from minimal to incapacitating. Often, headaches have no definitively identifiable underlying cause. Unfortunately, future recurrence risk in headache disorders is generally imprecisely-predictable. **DISCUSSION:** Aeromedical concerns in headache disorders primarily involve potential for unexpected functional distraction or incapacitation, and secondarily involve potential for aeromedically-adverse effects from treatment modalities. Aeromedically-significant symptoms may occur not only during the actual headache episode but also in prodrome, aura and post-headache phases. An aeromedical approach to headache assessment will be presented and discussed, focusing on compatibility and incompatibility factors for medical certification/waiver. A simple algorithm for aeromedical assessment of headaches that can be used by the Aviation Medical Examiner or Flight Surgeon will be presented and discussed.

Learning Objectives

1. Recognize the aeromedical implications of headache disorders.
2. Discuss aeromedical assessment of aviators with headache disorders.
3. Note resources available for headache disorder evaluation and management.

[56] PARKINSONS DISEASE AND AEROMEDICAL NEUROLOGICAL CONSIDERATIONS

William Hoffman
Brooke Army Medical Center, San Antonio, TX, United States

(Education - Program / Process Review)

BACKGROUND: Parkinson's Disease is a complex and progressive neurodegenerative disorder commonly encouraged in clinical practice. Symptoms are unique to individual patients but can include impaired movement and gait, autonomic dysfunction with constipation and orthostatic hypotension, mood disorders, and REM sleep behavior disorder. In advanced cases, patients can develop cognitive impairment and psychosis. While no disease modifying medications currently exist, certain medications can effectively control symptoms and permit occupational and social function. **OVERVIEW:** The current presentation aims to provide a brief review of Parkinson's Disease intended for the busy AME in clinical practice. The presentation will begin with a clinicopathology review of the disease including symptoms, course, and diagnosis. Next, the presentation will review medications employed to manage symptoms along with potential side effects and drug interactions. We will then review aeromedical certification standards, approved medications, and monitoring considerations. Special considerations including when to involve a movement disorders specialist, diagnostic pitfalls, and a brief review of deep brain stimulation will be reviewed. **DISCUSSION:** Parkinson's Disease is the number two neurogenerative disorders in the world, but the incidence is growing at an accelerating rate. For this reason, AMEs are likely to encounter applicants with this condition in practice. Medications can control symptoms and permit certification in the appropriate patient. This presentation aims to provide AMEs with a brief review of the condition and tools to assist applicants seeking certification.

Learning Objectives

1. Describe the pathophysiology, clinical symptoms, and course of Parkinsons Disease.
2. Describe medications used in the treatment of Parkinsons Disease symptoms.
3. Describe considerations for aeromedical certification of a pilot with Parkinsons Disease.

[57] AEROMEDICAL EVALUATION OF UNPROVOKED SEIZURES AND EPILEPSY

Eilis Boudreau
Affiliations VA Portland Health Care System, Oregon Health & Science University, Portland, OR, United States

(Education - Program / Process Review)

BACKGROUND: Seizures are one of the most common neurologic disorders and a frequent cause of referral for special aeromedical certification. Therefore, the goal of this tutorial is to update the aerospace medical practitioner on the epidemiology of first-time seizures and epilepsy, common clinicopathology, latest certification and aeromedical standards, and the practical approach to evaluating an individual presenting with a possible remote or recent history of seizures. **OVERVIEW:** The presentation will review seizure management and aeromedical considerations. 8% - 10% of the population will have a seizure in their lifetime with the risk for a second seizure in an adult being about 40%. While most seizures, if they reoccur, will do so within two years, the risk remains elevated for up to 5 – 10 years. As use of anti-seizure medications are forbidden in aviators, individuals with a history of one or more seizures must be seizure-free and off medication for a significant period of time before most jurisdictions will consider special issuance. Minimal evaluation for Special Issuance certification to be considered by the FAA includes a thorough history, MRI obtained after the first seizure, sleep-deprived EEG within the past 12 months with provoking maneuvers such as photic stimulation and hyperventilation, and completion by the pilot of a FAA airman seizure questionnaire. For a single unprovoked seizure, the FAA requires a waiting time of at least 4 years with the last 2 years being off anti-seizure medications, and for epilepsy (generally two or more seizures or single seizure with high risk for subsequent seizures) then the waiting period is 10 years with the last 3 years being off anti-seizure medication. **DISCUSSION:** Obtaining a thorough history is the single most important part of evaluating an individual for medical certification if a history of seizures is suspected. A thorough description of the seizure should be obtained from the aviator and if possible, an eyewitness to the event(s) as well as obtaining medical records associated with the initial presentation, evaluation, and follow-up care so that an appropriate disposition can be formulated.

Learning Objectives

1. The attendee will understand the epidemiology of first-time seizures and risk for reoccurrence, and the epidemiology of epilepsy.
2. The attendee will be updated on the latest standards for aviators with regard to seizures.
3. The attendee will become more comfortable with the initial evaluation and referral of aviators presenting with a history of possible seizures.

[58] AEROMEDICAL EVALUATION OF AVIATORS WITH KNOWN OR POTENTIAL CERBROVASCULAR DISEASE

Christopher Skinner[1], Joseph Connolly[2]
[1]*Ottawa, Canada;* [2]*No institution, Beavercreek, OH, United States*

(Education - Program / Process Review)

INTRODUCTION: The aging pilot population makes the problem of cerebrovascular disease more prevalent and therefore it is important that aeromedical medical practitioners be aware of the epidemiology, clinical pathology, and latest certification in aeromedical standards. This presentation will provide a practical approach to the evaluation of aviators at risk and those who have had definite cerebrovascular episodes. **OVERVIEW:** The

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presentation will cover the care and aeromedical considerations for pilots with cerebrovascular disease. Out of the 180,738 airline pilots in the US in 2023, the average age of airline pilots is 51 years of age with an average risk for a cerebrovascular event of 0.7 per thousand patient-years. Although, the probability of an occurrence of an initial cerebrovascular event during critical phases of flight is low, however the consequences of having brain injury from either hemorrhagic or ischemic stroke has profound implications in terms of cognitive, psychomotor function and risk of seizures after recovery which can make the process of recertification complex. **DISCUSSION:** Aviation examiners play a vital role in obtaining critical clinical information including vascular risk factors, family history and lifestyle that a given individual is at risk for a cerebrovascular event and ensuring that these individuals at high risk are being managed in order to ensure maximal preventative measures. In the event of that an aviator has definitely suffered a TIA or stroke either hemorrhagic or ischemic, aviation medical examiners play a vital role in terms of coordinating the immediate disposition of the pilot and providing the appropriate documentation to regulators in order to make decisions about aeromedical disposition.

Learning Objectives

1. The attendee will understand the epidemiology of the most common types of stroke and their impact on aviation safety.
2. The attendee will be updated on the latest international standards for aviators with respect to the disposition of pilots with cerebrovascular disease.
3. The attendee will be provided with some tools to aid with the initial evaluation and referral of aviators other at risk of or who have had a cerebrovascular event.

[59] AEROMEDICAL CERTIFICATION OF PILOTS WITH MULTIPLE SCLEROSIS (MS); ALIGHNING AEROMEDICAL DECISION MAKING WITH CURRENT CLINICAL PRACTICE AND CONTROVERSIES IN TREATMENT

Ronan Murphy
FAA, Oklahoma City, OK, United States

(Education - Program / Process Review)

INTRODUCTION: Treatment options for Multiple Sclerosis (MS) have dramatically increased in recent years. Clinical knowledge and practice in selecting optimal treatment and reducing long term and subtle sequelae such as cognitive decline is still evolving. It is hoped that improving treatment will reduce the risk of sudden or subtle impairment in pilots with MS, however frequent and comprehensive surveillance remains a lynchpin for the assurance of safety in these pilots. **TOPIC:** Multiple sclerosis (MS) is an immune-mediated inflammatory disease that attacks myelinated axons in the central nervous system causing episodic or progressive neurological impairment. There is a wide variation in the severity and frequency of disease expression, ranging from apparent quiescent disease to rapid progression. Without treatment, 30% of patients will have significant physical disability within 20–25 years. Options for disease modifying therapy (DMT) with immunotherapy have expanded over the last few decades, have been shown to reduce risk of disease relapse, and shown promise for reducing disability progression over time. The risk for subtle cognitive decline in MS has long been known, but there is increasing recognition that it may occur independently of observable disease relapse activity. Certification under Special issuance is possible if it can be assured that the pilot can safely perform the required duties without endangering the public. Pilots with MS requesting medical certification are often at the milder end of the clinical scale. **DISCUSSION:** The FAA has developed protocols for pilots with treated MS and stable disease course to screen for deficits that may pose a risk to aviation safety, and to monitor for disease progression. This includes testing for subtle cognitive decline, performing regular frequent clinical neurological evaluations, obtaining eye and vision evaluations, and requiring intermittent neuroimaging. Controversies have arisen in reconciling current developments in clinical practice with the goals of aeromedical certification.

Learning Objectives

1. Attendees with learn about the expanding treatment options for Multiple Sclerosis (MS) Disease Modifying Therapy (DMT).
2. Attendees will identify the concerns for aviation safety in pilots with MS, including subtle cognitive and visual effects of the disease.
3. Attendees will understand how DMT may reduce disease relapse and progression, including subtle cognitive decline.

Monday, 06/02/2025 ***4:00 PM***
Centennial Ballroom II

[S-12] PANEL: THE NECESSITY OF AN AVIATION PSYCHOLOGY SPECIALTY

Chair: Forest Pavel

Panel Overview: *This panel presents the argument necessitating the creation of an aviation psychology specialty. The American Psychological Association Code of Ethics dictates that for ethical practice of psychology "psychologists provide services… only within the boundaries of their competence based on their education, training, supervised experience, consultation, study or professional practice." Individuals who operate in the aviation environment often have unique mental health needs which differ from the normal population due to many factors, including that they are beholden to medical certification with standards differing from the DSM and ICD. Mental health issues of aviation personnel also have the potential to negatively impact the safety of aviators themselves, as well as the public, if left untreated and unevaluated, as certain mental health symptoms and/or conditions may decrease an individual's ability to safely operate in the aviation environment. However, there are very few treating and/or evaluating psychologists who have the formal training to provide ethically informed psychological services to aviation personnel. There are no formal academic programs focused on aviation psychology, and few opportunities to gain formalized training/experience in the field outside of the military. Individual military branches in the United States differ in how they train aviation psychologists, and the military differs from how the FAA goes about vetting psychologists and neuropsychologists for the evaluation of civilian aviation personnel. Both the military and the FAA generally focus their aviation psychology training on evaluation-only, seeking to ascertain whether aviation personnel meet aeromedical certification criteria. There are no formalized training programs at the doctoral level on how to provide aeromedically informed mental health treatment to aviation personnel, and only limited brief trainings at the master's level. Until a specialty in aviation psychology is created, standardized, and taught, most work in this field will remain ad hoc, and the risk to aviation safety remains. This panel brings civilian and military stakeholders together (including both pilots and psychologists) to discuss the need for an aviation psychology specialty from their unique viewpoints, and how standardizing the approach to aviation psychology may increase aviation safety.*

[60] A BRIEF HISTORY OF AVIATION PSYCHOLOGY

Raymond King
ESi, Dayton, OH, United States

(Education - Program / Process Review)

BACKGROUND: What is Aviation Clinical Psychology? Or is it Aeromedical Psychology? Or Aerospace Psychology? In the United States psychologists are increasingly working in aviation-related operational settings, despite there being a lack of standardized training and professional organizations (in fact, there is not even consensus on a name for this field) devoted to the application of psychological principles applied to occupational demands. This presentation provides an overview of the history of Aviation Psychology thus establishing a framework for understanding why a psychological specialty field must be developed. **OVERVIEW:** How did Aviation Psychology develop? Psychologists were pressed into service during the World Wars to aid in personnel

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selection. While the field of clinical psychology expanded greatly in the Veterans' Administration after World War II, psychologists are now seen as a resource in performance optimization and not just a mental health resource. Psychologists perform applied research in military and civil aviation, both in the U.S. and internationally. The European Association for Aviation Psychology (EAAP) provides a model of integrating psychologists into aviation. Clinical psychologists/neuropsychologists are integral in assessing aviators for return to flying status after psychiatric illness and neurological insult, to include substance dependence. **DISCUSSION:** What does the future hold as resources become scarcer and the margin of disaster potentially grows more tenuous? There is clearly a need to train more clinical psychologists on how to work with aviation personnel and to establish professional organizations to nurture development. The Aerospace Human Factors Association (AsHFA) provides a home within the Aerospace Medical Association (AsMA), but the representation of psychologists has been negligible. How can that be increased? Is there a need for other organizations to provide a professional home? Is there role for the American Psychological Association (APA) and its affiliate Divisions? If so, which affiliate should be the host and would fellowship status be afforded to professionals who have excelled in the field? Finally, what training should be offered, at the undergraduate, graduate, and post graduate levels? Audience members will be able to articulate the evolution of aviation psychology and appreciate the current lack of standardization for training and practice in this field.

Learning Objectives

1. Audience members will appreciate the lack of standards of training and practice in aerospace/aeromedical psychology.
2. Audience members will be able to articulate the evolution of aerospace/aeromedical psychology.

[61] THE EUROPEAN VIEW ON AVIATION PSYCHOLOGY VIS A VIS THE EUROPEAN ASSOCIATION FOR AVIATION PSYCHOLOGY (EAAP)

Robert Bor[1], Jóhann Petur Wium Magnusson[2], Gunnar Steinhardt[3]

[1]*European Association for Aviation Psychology, London, United Kingdom;* [2]*European Association for Aviation Psychology, Reykjavík, Iceland;* [3]*European Association for Aviation Psychology, Trier, Germany*

(Education - Program / Process Review)

BACKGROUND: Aviation and aerospace psychology in Europe can trace its roots to the establishment of EAAP in the Netherlands in 1956; the Association will mark it's 70th year anniversary in 2026 (in the Hague, NL). The Association provides a forum for professionals working in the various domains of aviation psychology, human factors and flight safety. It now has more than 600 members from within Europe as well as many others worldwide and is recognised as a leading professional association furthering all branches of psychology, human factors and human performance, in pursuit of improving flight safety. **OVERVIEW:** The objective of EAAP is to promote the study of psychology and the scientific pursuit of applied psychology in the field of aviation. EAAP aims to achieve this objective by: (a) Providing a network for professionals working in aviation psychology; (b) Organising conferences and workshops; (c) Facilitating education and training, and approving suitable courses, and professional recognition in aviation psychology; (d) Publishing a leading peer-reviewed journal with a distinguished international panel of editors, 'Aviation Psychology and Applied Human Factors', and periodical newsletters and information news flashes; (e) Making recommendations for scientific research and for the practical application of aviation psychology; (f) Co-operating and consulting with institutions active in related fields; (g) Giving guidance and support to national and international aviation regulators, bodies, associations and authorities; and (h) being open and receptive to new directions of research and professional endeavour. **DISCUSSION:** EAAP is an example of a professional aviation association which can reflect and promote common themes and interests within aviation psychology, doing so across international boundaries. The Association considers variances in psychology and human factors registrations between states, and developed a comprehensive list of competencies against which members and prospective members can benchmark their professional development and 'calibrate' their membership grade. Recently, EAAP has been at the forefront of developing practice and standards for mental health professionals working within aviation psychology. We attribute some of the vibrancy and success of EAAP to it representing all relevant branches of psychology, human factors and flight safety, as well as promoting specialist sub-groups within our membership.

Learning Objectives

1. Participants become aware of what EAAP stands for, what is its main area of focus, and size of membership.
2. Participants understand how EAAP aims to achieve its objective of promoting the study of psychology and the scientific pursuit of applied psychology in the field of aviation.

[62] NEUROPSYCHOLOGY'S IMPERATIVE ROLE IN AVIATION: DEVELOPING MILITARY, CIVILIAN, AND INTERNATIONAL REGULATIONS/STANDARDS (INCLUDING AN AVIATION PSYCHOLOGY SPECIALTY)

Ryan Green

Aerospace Neuropsychology Services, LLC, Layton, UT, United States

(Education - Program / Process Review)

BACKGROUND: Neuropsychology is the study of brain-behavior relationships and the clinical/operational application of the associated sciences. Human factors account for 70% of aviation accidents, mishaps, and close calls. Measurable neuropsychological phenomena are the human factors that account for the largest number of these aviation incidences. Therefore, an aviation asset's neuropsychological fitness to fly or control air traffic is of paramount importance. Many seeking to work in aviation do not have the right neuropsychological stuff required to maintain aviation safety. Given the large pool of individuals seeking aeromedical certification, it may be reckless or negligent to be unaware of an aviation asset's neuropsychological fitness. Although individuals with medical, neurologic, neurodevelopmental, and psychological histories often get flagged for evaluation, regulations and standards of practice across stakeholders should continue to be developed with specific regard to brain-behavior relationships and therefore with specific regard to the role of the neuropsychologist. **OVERVIEW:** Neurocognitive and psychological assessments are critical to help determine an aviation asset's fitness to perform safely. An individual with ADHD may have a limited capacity to sustain attention, be impulsive, or prone to taking risks. An individual who experienced a stroke, brain injury, or other neurologic insult may lack neurocognitive abilities or psychological stability. An individual with a history of panic may experience suddenly incapacitating symptoms. A rather long list of medical issues and treatments cause brain-behavior-related risks to aviation safety (e.g., HIV, cancer, hypothyroidism, sleep apnea). The goal of the aviation neuropsychologist is to measure an aviation asset's risk to safety so adjudicators can make risk management decisions. **DISCUSSION:** Although regulations/standards do exist to help neuropsychologists identify human-factor liabilities, they are frequently woefully inadequate or outdated and have not been adapted to suit the overlapping military, civilian, and international aviation communities. Many standards are contradicted within and between milieus making risk identification and management more difficult and confusing for aeromedical providers and aviation assets. Additional regulatory clarity and practice standards should be developed based on improved empirical evidence (e.g., tests used, normative data, virtual interviews, defining aeromedical significance) to best serve these overlapping communities and ensure operational, clinical, and public safety in all speres. To this end, aviation psychology needs a defined subspeciality with training and practice guidelines to better inform the aviation community.

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Learning Objectives

1. The participant will understand how regulations/standards exist to help neuropsychologists identify human-factor liabilities but appreciate that they are frequently inadequate or outdated and have not been adapted to suit the overlap between military, civilian, and international aviation communities.
2. The participant will understand how an aviation asset's neuropsychological fitness to fly or control air traffic is of paramount importance, and the specific role that neuropsychology plays in assessing that fitness.

[63] NECESSITY OF AN AVIATION PSYCHOLOGY SPECIALTY: PERSPECTIVE OF A TREATING PSYCHOLOGIST

Sky Overbo
University of North Dakota, Grand Forks, ND, United States

(Education - Program / Process Review)

BACKGROUND: Few mental health training programs include modules on aviation psychology which reduces exposure to this population. Furthermore, even for experienced clinicians, opportunities for continuing education in aviation psychology are severely limited, making it challenging to work effectively with aviators and other aviation personnel, such as air traffic control specialists. This lack of training and education is detrimental to not only the mental health of our aviation personnel, but also the speed of the medical certification process, inadequacies of screening tools, difficulties in diagnostic clarity, and the overall safety of the airspace. **OVERVIEW:** Aviation is an industry of regulations and culture which holds safety with the utmost importance. We have now begun to recognize that mental health plays a large role in keeping the skies safe. This increased awareness on mental health has also shed light on the paucity of mental health clinicians' training in the field of aviation psychology. With the creation of an aviation psychology specialty, problems with limited understanding of aviation-specific stressors, assessment, diagnosis, certification, and barriers in mental health will be reduced. Additionally, with specific training in aviation, new treatment approaches and strategies tailored to aviation personnel can be created, not only improving care but improving the speed of recovery as well. **DISCUSSION:** Utilizing shared experiences of clinicians entering the aviation sector, current challenges with insufficient training and knowledge of aviation challenges will be highlighted. Further, evidence for the necessity of creating a specialization in aviation psychology tailored to treating civilian aviation professionals would involve several key components to ensure psychologists can effectively address the unique challenges faced by aviators. Creating an aviation specialty within the psychological community will affect all sectors of aviation and is a necessity to keep the skies safe and our aviators healthy. With greater knowledge and training, clinical care for aviation professionals will improve.

Learning Objectives

1. Recognize the need for specialized training in aviation psychology: Understand the current limitations in mental health training for clinicians working with civilian aviation professionals, including gaps in exposure to aviation-specific challenges and stressors.
2. Explain the impact of limited aviation psychology training on clinical care and aviation safety: Attendees will be able to identify how the lack of training affects diagnostic clarity, medical certification processes, assessment tools, and the overall mental health of aviation personnel.
3. Propose strategies for developing a specialized aviation psychology curriculum: Participants will learn about key components necessary for establishing an aviation psychology specialty, including tailored assessment techniques, certification processes, and treatment approaches for civilian aviation professionals.

[64] THOUGHTS ON AVIATION MENTAL HEALTH FROM THE COCKPIT: A PILOT'S PERSPECTIVE ON THE NEED FOR A SPECIALTY FIELD IN AVIATION PSYCHOLOGY

Reyné O'Shaughnessy
Piloting 2 Wellbeing, Sewickley, PA, United States

(Education - Program / Process Review)

BACKGROUND: As a pilot, the responsibility to perform at the highest level involves both physical and mental health. Pilots are constantly making decision-making and critical judgment calls, whether for the safety of cargo or lives, often under intense pressure. Every decision, whether routine or complex, can have serious consequences, and maintaining sharp judgment is crucial for flight safety. Poor mental health can weaken a pilot's ability to make sound decisions, which can jeopardize safety. As the World Health Organization states, "There is no health without mental health." However, mental well-being remains under-addressed in aviation. Many pilots avoid seeking help due to fear of losing their aeromedical certification, creating a culture of silence. The creation of a specialized field in aviation psychology is necessary to safeguard both pilots and the public. **OVERVIEW:** To address this gap, we propose the creation of a specialized field in aviation psychology dedicated to the mental well-being of aviation professionals. The lack of standardized psychological support leaves pilots vulnerable to issues that can compromise safety. A USAF study of 3,700 pilots showed 56% avoid healthcare due to fear of losing certification, 46% seek informal care, and 27% withhold medical information. These findings highlight real risks for both pilots and public safety. A standardized aviation psychology specialty would ensure pilots can access mental health support without fearing professional consequences. This proactive approach would create a framework to prioritize both pilot and public safety. **DISCUSSION:** There is operational significance to the establishment of a specialty field of Aviation Psychology. Mental health is as crucial as physical fitness for flight safety. A specialized field would normalize care, reduce stigma, and encourage early intervention, improving decision-making under pressure. Furthermore, integrating aviation psychology into aerospace medicine would address the specific psychological demands on pilots, enhancing performance and safety. Lastly, the cross-sector relevance of such a field would support both civilian and military aviation sectors, fostering collaboration and improving global safety.

Learning Objectives

1. Learners will recognize how mental health influences decision-making abilities, situational awareness, and overall safety in aviation. Learners should understand that mental health equally essential to physical health in aviation and will understand the risks associated with poor mental health that can compromise both pilot and public safety.
2. Learners will understand why an aviation psychology specialty is critical to flight safety; how its creation may alleviate problems with gaps in mental health support for pilots, the benefits of aviation psychology in normalizing mental health care/early intervention, and its role in reducing fear of disclosing mental health conditions.
3. Participants will understand the impacts of an aviation psychology specialty in military/civilian aviation, understanding how standardized practices could foster cross-sector collaboration, support consistent psychological assessments, increase global safety improvements in aviation, and how a proactive approach improves pilot mental health thus enhancing overall resilience/aviation safety.

[65] PERSPECTIVES ON AVIATION PSYCHOLOGY FROM THE MILITARY AVIATOR AND RESEARCH PSYCHOLOGY STAKEHOLDER VIEWPOINT

Aric Raus
Army University, Fort Leavenworth, KS, United States

(Education - Program / Process Review)

BACKGROUND: Military and civilian aviation personnel operate in demanding environments with unique stressors when compared

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to the general population. These stressors have the potential to cause mental health symptoms, some of which can negatively affect not only the wellbeing of the aviation members, but also the safety of aviation operations and the general public utilizing them. While those in high-risk aviation-related career fields must undergo periodic medical evaluation to ensure they are physically and mentally fit for duty, few aviation medical professionals have received specialized training to evaluate the effects of psychological symptoms on aviation duty requirements. **OVERVIEW:** Currently, the US military provides the only formalized program to train and certify aviation-focused psychologists. Yet, there are differences among the military branches regarding how these professionals are trained to determine the impact of mental health on aviation suitability, and the determining factors often differ from those developed by the FAA for civilian aviation personnel. The lack of a standardized training curriculum can lead to differing fitness assessments for those with similar symptoms. Concern about diagnoses that could jeopardize medical certification is the leading barrier to care and cause for healthcare avoidance among military aviation personnel. **DISCUSSION:** Aviation personnel and aerospace medical professionals need a cadre of psychologists with a thorough knowledge of aerospace operational, safety, and regulatory factors to ensure proper mental health evaluation, treatment, and research. Under current conditions, there is not a method to determine the aviation knowledge of mental health practitioners providing fitness evaluations or treatment services. Additionally, individuals who have undergone a Department of Defense aviation psychology program may be unfamiliar with the differences between military and civilian operations and safety considerations. Military aviation professionals often feel caught between seeking help for mental wellness or performance concerns and losing their medical certification and possibly careers, even for conditions ultimately considered acceptable. Therefore, a formalized certification program could provide increased safety by not only ensuring aviation members are fit for their unique aviation duties, but also that aviation professionals can receive treatment and advice appropriate for both their symptoms and aerospace-specific safety limitations.

Learning Objectives

1. The audience will be able to understand the impact of differing standards between military service on providing a consistent understanding of aviation mental health fitness.
2. Attendees will understand the concerns military aviation members experience due to the separation of military and civilian aviation mental health evaluations.
3. The audience will understand the benefits on safety and aviation mental wellness from a formal, standardized aviation psychology training and certification program.

Monday, 06/02/2025 ***4:00 PM***
Centennial Ballroom III

[S-13] SLIDE : TOOLED FOR SPACE MEDICINE

Chair: Kris Lehnhardt
Co-Chair: Zach Campbell

[66] OPTIMIZATION OF 3D PRINTED SURGICAL TOOLS FOR SPACE MISSIONS IN ZERO GRAVITY: AN FEA-BASED MODELING APPROACH

Sergio Navarro[1], Eren Demir[2]
[1]*Mayo Clinic, Rochester, MN, United States;* [2]*Mizar Analytics Research Institute, Izmir, Türkiye*

(Original Research)

INTRODUCTION: This project outlines the enhancement of 3D printed surgical tools tailored for operations in the demanding conditions of space environments. Utilizing Finite Element Analysis (FEA) and optimization techniques, we aimed to develop a tool enabling surgical tools to be manufactured on space stations, addressing the unique operational challenges of space. Our primary objective is to assess and refine the structural integrity and functionality of various 3D printed surgical tools through advanced simulations, experimenting with different materials and design geometries to ascertain configurations that minimize the risk of tool failure during critical space missions. **METHODS:** The project employed Solidworks for the initial designs of several surgical tools, including the Army-Navy retractor, scalpel, tweezers, and forceps. These designs underwent stress analysis using Matlab's FEA tools to replicate zero-gravity conditions and other specific space-induced stresses. Various materials were evaluated, including PLA, PP, and PLGA, with safety factors then applied. Iterative design and material modifications resulted in enhanced tool durability and performance, based on repeated FEA testing. **RESULTS:** Optimization of the instruments, including the 3D printed Army-Navy retractor, were applied (Figure 1). Initial FEA highlighted stress concentrations at the hinge; subsequent redesigns effectively redistributed these stresses, leading to a 20% increase in projected tool longevity under simulated space conditions at a specific stress point for a PLA printed instrument. Safety factors were then applied and tested. **DISCUSSION:** We developed and applied robust, optimized surgical tool designs with improved reliability, such as the enhanced Army-Navy retractor, surgical scalpel, tweezers, and Debakey, critical for conducting medical procedures on space missions. This project holds potential for advancing the field of space medicine by developing surgical tools that enhance the safety and operational capabilities of astronauts. By ensuring the reliability of these essential tools, the project supports the feasibility of extended space missions and contributes to the advancement of human space exploration via space medicine innovation.

Learning Objectives

1. The participant will learn and understand the application of FEA in evaluating the structural integrity of 3D printed surgical tools in space.
2. The audience will learn how stress analysis using advanced tools can assist in selecting materials to meet safety requirements necessary for space missions.

[67] PROCESSING SURGICAL FLUIDS IN REDUCED GRAVITY

George Pantalos[1], Elvis Joseph[1], Ishita Jain[1], Jordan Sobert[2], Marsh Cuttino[3], Steven Collicott[2]
[1]*University of Louisville, Louisville, KY, United States;* [2]*Purdue University, West Lafayette, IN, United States;* [3]*Orbital Medicine, Inc, Midlothian, VA, United States*

(Original Research)

INTRODUCTION: Surgical treatment in reduced gravity requires wound fluid management. Chest drain or surgical site fluids can be collected and processed to recover blood for transfusion therapy or fluid processed by the Water Recovery System (WRS) creating potable water. We investigated three processes: (a) separating fluids from air introduced while suctioning, (b) filtering fluid to remove debris to create fluid for transfusion, or (c) adsorbent filtering of fluid to lower protein content for processing by the WRS. **METHODS:** A bleeding wound model was infused with analog blood (40% glycerin, 59.5% red food coloring, with 0.5% wetting solution (Kodak Photo-Flo 200)) mimicking the wetting, surface tension, density, and viscosity of blood. Blood was suctioned by a "surgeon" from the wound to a 2-phase separator with vanes arranged to maximize capillary flow separation of liquids and gas, a concept used in liquid rocket motor fuel management. This approach takes advantage of dominant surface tension forces during 0-g created by parabolic flight. Also in parabolic flight, a solution of simulated wound waste solution (212.5mL normal saline, 12.5mL packed human RBCs, 12.5 mL packed human RBCs pre-mixed with 12.5mL of water to induce hemolysis), and surgical debris (surgical clips, suture, tissue) was prepared in a 250 mL

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reservoir connected to a pump. In 0-g, the mixture was pumped through a 20-µm cardiopulmonary bypass filter, then through a resin adsorbent filter at 30ml/min before collection in a reservoir for post-flight analysis. Pressure readings and samples before and after each filter were collected and analyzed for residual particulate, plasma free hemoglobin (PFHb), and total organic carbon (TOC). **RESULTS:** Suctioning blood away from the wound consistently contained and controlled the bleeding; reliable air/fluid separation was demonstrated. The two-stage filtration system operated effectively. Up to 77% of PFHb and 93% of TOC was removed. The hematocrit and PFHb were lowest following the adsorbent filter with all particulates captured by the 20-µm filter. **DISCUSSION:** Separation of air from physiological fluid was achieved in 0-g permitting recovery of fluids for autotransfusion or additional processing of fluid that could be introduced to the WRS. An integrated separator/filtering unit for surgical fluid processing could be created for use in reduced gravity. [NASA 80NSSC21K0358, Payload T0285-P, NASA Flight Opportunities Payload T0049-P]

Learning Objectives

1. Understand that in exploration spaceflight, conserving supplies and materials can include the recovery and processing of surgical waste fluids that can be processed into useful fluids rather than discarded with other waste material.
2. Taking advantage of the observation that surface tension is a dominant force for fluids in reduced and microgravity, fluid and air can be separated from each other using an array of flowstream vanes to maximize the effect of surface tension to attach fluid to the vanes separating it from air.
3. Physical selective porous filtering can be used to remove debris from recovered surgical waste fluids and resin adsorbent filtering can be used to remove undesired biochemicals from recovered surgical waste fluids to be sent to the Water Recovery System to produce potable water for crew use.

[68] STREAMLINED TELEPRESENCE PROJECT (STP): CLINICAL EFFECTIVENESS STUDY OF A VIDEO PROCESSING ALGORITHM

Jeremy Beer[1], Patrick C. Ng[2], Dan C. Wlodarski[3], Jenny Tompkins[3], Jeffrey Mock[1], Andrew Mojica[4], Melissa Clemons[5], Bianca Cerqueira[3]
[1]*KBR Aerospace Environment Protection Laboratory, San Antonio, TX, United States;* [2]*University of Texas Health Science Center San Antonio, San Antonio, TX, United States;* [3]*KBR, Beavercreek, OH, United States;* [4]*Aerospace Environment Protection Laboratory, San Antonio, TX, United States;* [5]*USAF 59th Medical Wing, San Antonio, TX, United States*

(Original Research)

INTRODUCTION: Improved video transmission is needed for triage and telemedicine in austere aerospace environments. A prototype compression algorithm named "V-CRAMMIT" (patent pending) streamlines medical images, yielding improved bandwidth efficiency. This study evaluated the new technology by measuring accuracy, speed, and confidence with which physicians made diagnostic designations using V-CRAMMIT-streamlined video compared to uncompressed video. **METHODS:** An inventory of videos was selected from point-of-care ultrasound (POCUS) pulmonary scans archived at Brooke Army Medical Center. Recordings were scanned from patients, de-identified, and retained in MP4 format. Investigators selected recordings showing four lung pathology conditions: "Pneumothorax," "Pneumonia," "Pleural Effusion," and "No Pathology." Four videos were selected for each condition, yielding 16 sequences streamlined using V-CRAMMIT. Average file size reduction was 80%. Twenty physicians evaluated each video and selected the best response to classify the pathology condition shown. Both "Uncompressed" and "Streamlined" formats were presented in a randomized 32-trial sequence. After each video, the physician selected one of the four pathology designations or an "Inconclusive" designation. Trials were presented using a mouse interface and virtual dashboard, which displayed the video in large format, the anatomic location of each scan, a "Replay" button, and five response buttons corresponding to the above designations. Performance measures, including accuracy, response time, and replay frequency were analyzed using a two-way repeated-measures ANOVA incorporating Video Format (Uncompressed vs. Streamlined) and Pathology (four levels) as independent factors. **RESULTS:** Physicians' performance did not differ significantly between Video conditions: Uncompressed vs. Streamlined trials showed no significant difference in accuracy ($p=.15$), response times ($p=.96$) or replay counts ($p=.85$). Pathology imposed significant ($p<.001$) effects for all measures, with physicians making more accurate, faster, and more confident determinations in "Pleural Effusion" and "No Pathology" cases. No interaction was identified. **DISCUSSION:** In this paradigm, V-CRAMMIT afforded performance equivalent to standard video: no overall decline was observed in accuracy, speed, or confidence for trials employing streamlined video. This could enable advances in bandwidth efficiency to enhance telemedicine in remote environments.

Learning Objectives

1. The participant will better understand the challenges of telemedicine triage and remote diagnosis in remote, austere, bandwidth-constrained aerospace environments.
2. The participant will gain familiarity with a proposed video compression algorithm designed to improve bandwidth efficiency in support of telemedicine for remote and austere environments including space.

[69] CELL-FREE BIOPRODUCTION FUEL CELL FOR LIFE SUPPORT AND SPACE MEDICINE

Gil Stamm
University of Washington, Seattle, WA, United States

(Original Research)

INTRODUCTION: Cell-free bioproduction uses microorganisms' transcription and translation machinery to produce products such as pharmaceuticals, nutrients, plastics, building materials, biofuels etc. An advantage of cell-free is that the systems can be freeze-dried and reconstituted. This makes on demand bioproduction in outer space possible. Also, cell-free reactions can remove carbon dioxide from the atmosphere. The problem with cell-free is its high cost and one of its highest costs is providing the energy required to drive the reactions. This energy is mainly in the form of adenosine triphosphate (ATP). My research is a cell-free fuel cell that produces ATP. **METHODS:** A membrane was created to separate an H-type electrochemistry cell. Layer by layer technique was used to coat a cation exchange membrane with polycations and polyanions followed by a lipid membrane with cell-free expressed ATP synthase embedded. Two buffers, one acidic and one basic were loaded into the H-type cell. The basic buffer contained adenosine diphosphate (ADP) and phosphate. The protons from the acidic buffer flowed across the membrane into the basic buffer. The amount of ADP converted to ATP in the basic buffer was measured using a luciferin-luciferase assay. **RESULTS:** Luminescence increased over time in the luciferin-luciferase assay. This demonstrated the conversion of ADP to ATP. **DISCUSSION:** This research demonstrates that ATP can be produced using a H-type electrochemical cell, a membrane with cell-free expressed ATP synthase and a proton gradient. This research will lower the cost of cell-free bioproduction by supplying the energy needed. It will reduce the barriers to using cell-free bioproduction in outer space and can be used to decrease the atmosphere's carbon dioxide concentration. This will help enable long duration manned missions by being able to produce needed products on demand and help with life support systems.

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Learning Objectives
1. Understand how cell-free bioproduction can be used to support manned space travel.
2. Learn a method of creating energy in the form of adenosine triphosphate (ATP) to drive cell-free reactions.

[70] INNOVATIVE DEVELOPMENT OF A COMPACT, POINT OF CARE, LOW COST OSMOMETER TO MEASURE URINE OSMOLALITY IN SPACE

Shankar Subramanian
Indian Air Force, Shillong, India

(Original Research)

INTRODUCTION: Fluid redistribution in space affects osmoregulation and Sodium homeostasis and is assessed by urine osmolality. Conventional osmometers use freezing point depression technology to measure the same. The equipment is usually bulky, requires electricity and costs about $ 7000 in India. Limited storage space and sample handling (due to microgravity) presents a challenge in space. There is a thus felt need for a compact, lightweight, battery operated, point of care osmometer.Our Insight and Innovation. Urine is composed of organic (60-70%) and inorganic (30-40%) particles and it's osmolality is determined by the total number of particles. Electrical conductivity (EC; dependent on inorganic content) and Specific gravity (SG; dependent on total mass) correlate with Osmolality (r=0.75) independently, but estimate different dimensions. We aimed to exploit the discordance between the two measurements and estimate the Osmolality. **METHODS:** The experiments were conducted in two stages, Initially on healthy volunteers and later among patients of hyponatremia. Following tests were done on anonymized urine samples: (a) Osmolality using FISKE 210 Osmometer (gold standard); (b) Specific gravity (SG) using Milwaukee Digital Brix Refractometer MA871; (c) Electrical conductivity (EC) using HM Digital COM-80- EC/TDS Hydrotester. In both experiments, data was randomly divided into Test set (80%) and Validation set (20%). Pearson's correlation coefficient was estimated between the gold standard (GS) Vs EC & GS Vs SG respectively. Algorithm & Instrument development Suitable mathematical transformation was applied to EC and SG values and algorithm derived to predict osmolality. The predicted value from the test set was tested on the validation set.A patent has been applied for the current technology. Prototyping is in progress and the final product will weigh under 800 gms. **RESULTS:** The 2 experiments were done among 397 healthy volunteers and 402 patients with hyponatremia. The correlation coefficient between gold standard Osmolality and predicted osmolality value was 0.988 among healthy volunteers and 0.95 among hyponatremics. **DISCUSSION:** We present the proof of principle of an innovative low cost, point of care osmometer. The instrument would be a hand held device that runs on batteries, is easy to store and would cost under USD 250.

Learning Objectives
1. Innovation is the key when one comes across a conflict that needs to be resolved. For example, in our case we wanted compact, lightweight, battery operated, point of care osmometer in view of limited storage availability in space.
2. Innovation is again the key when tackling a problem and is best approached from first principles. Instead of improving the freezing point osmometer, we resolved the problem by exploiting other properties of urine.

[71] A JOINT INITIATIVE: INTERAGENCY KNOWLEDGE SHARING TO DEVELOP CREWED SPACEFLIGHT MISHAP INVESTIGATION RESOURCES

David Rubin[1], Travis Houser[1], Neal Zapp[2]
[1]*KBR, Houston, TX, United States;* [2]*NASA, Houston, TX, United States*

(Education - Program / Process Review)

BACKGROUND: A spaceflight mishap can occur at any point during the mission and may result in the deposit of spacecraft debris and crew remains anywhere on Earth. Currently, the first responders to the scene of such a mishap in most cases do not have the knowledge they need to keep themselves safe from spacecraft hazards and improve their ability to rescue any survivors. There is also a lack of knowledge among those involved in mishap investigations regarding the effects of the spaceflight environment on human physiology and its impact on the forensics process. Given the increased cadence of government and commercial launches, the dissemination of this knowledge is critical for an effective response to a spaceflight mishap. This presentation will discuss the vision and strategy for this effort, the work done to date, and future plans. **OVERVIEW:** NASA's Office of the Chief Health and Medical Officer (OCHMO), in partnership with the National Transportation Safety Board (NTSB), the Federal Aviation Administration (FAA), the United States Space Force (USSF), Air Force Medical Examiners (AFMEs), the National Search and Rescue Committee (NSARC), the Center for Disease Control (CDC) has launched an initiative to identify and aggregate critical areas of spaceflight mishap response knowledge as it relates to human physiological changes due to spaceflight, and make it available to the stakeholders who will benefit from it. Using a modular approach to the knowledge base, this content scope, depth, and format can be tailored specifically to individual stakeholder needs. **DISCUSSION:** Previous mishap investigations have relied on a significant amount of real-time education of those involved, from local first responders to medical forensics experts. A mechanism to actively disseminate spaceflight human physiology knowledge to relevant stakeholders should result in a well-informed spaceflight mishap response stakeholder community; this would increase safety and efficacy of the response teams and improves the ability of investigators to interpret findings.

Learning Objectives
1. The audience will understand the range of stakeholders involved in a spacecraft mishap response and investigation.
2. The audience will understand the breadth and depth of knowledge areas related to human spaceflight mishap response and how they apply to the various mishap stakeholders.

Monday, 06/02/2025 ***4:00 PM***
Centennial Ballroom IV

[S-14] PANEL: SAFETY CENTERS: YEAR IN REVIEW 2024

Chair: Philippe Stewart

Panel Overview: *Aeromedical medicine is an essential discipline within flight safety organizations, focusing on the promotion of optimal health and the enhancement of operational safety. By addressing aeromedical risks, it safeguards both primary and ancillary members of the aviation community, thereby contributing to more secure and efficient flight operations. Members of this panel each represent a particular international organizations including both civilian and military. Discussions will encompass general statistics related to occurrences affecting their respective organizations, including, where applicable, case reviews of specific instances that highlight key aeromedical concepts or present particularly complex or severe features. A common objective for each of these organizations is to identify the causal factors and patterns that contribute to hazards and incidents within their operations. This understanding aims to inform the development of corrective actions to prevent similar events in the future. By sharing this data, attendees can learn from these collective experiences, enhancing their knowledge base and enabling them to implement comparable measures in their respective organizations where applicable.*

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[72] U.S. NAVAL AVIATION SAFETY: 2024 YEAR IN REVIEW

Jonathan Erpenbach
U.S. Navy, Norfolk, VA, United States

(Education - Program / Process Review)

BACKGROUND: The Naval Safety Command analyzes Navy and Marine Corps aviation safety investigation reports in order to identify mishap causal factors and recommend corrective actions. **OVERVIEW:** All Class A flight mishaps involving U.S. Navy and Marine Corps aircraft during fiscal year 2024 (FY 2024) were reviewed using the Human Factors Analysis and Classification System (HFACS). During FY 2024, there were multiple Class A flight mishaps in the U.S. Navy and U.S. Marine Corps. A review of Class A flight mishaps over the past ten years demonstrated that human factors were the predominant causal factor. The Naval Safety Command team will also present a review of current physiological episodes and events in Naval Aviation. **DISCUSSION:** HFACS can be a useful tool in safety investigation analysis and assist in identifying mitigation strategies to prevent future mishaps. Evolving capabilities and understanding regarding physiological episodes and events are enabling technological improvements, better training, and impactful research to further reduce occurrences, risks, and impacts to mission.

Learning Objectives

1. Review the overall trend in U.S. Navy and Marine Corps flight mishaps and the most common human factors identified as causal factors.
2. Review the trends in Naval Aviation mishap HFACS causal factors over the last decade.
3. Become familiar with emerging topics of discussion at the Naval Safety Command related to aviation, including physiologic events.

[73] U.S. ARMY AVIATION SAFETY: 2024 YEAR IN REVIEW

Luis Rivero, Sean O'Connell
U.S. Army, Fort Novosel, AL, United States

(Education - Program / Process Review)

BACKGROUND: Discuss (FY) 2024 statistics and analysis for USA Class A aviation mishaps including Human Factors Analysis. **OVERVIEW:** FY2024 data was obtained from the USA Combat Readiness Center database (ASMIS2.0) for Class A thru C manned and Class A unmanned aviation mishaps and reviewed for human factors as determined by the Safety Investigation Boards. **DISCUSSION:** In the manned aircraft category, Army aviation experienced 15 Class A manned aircraft flight mishaps in FY24, with a mishap rate of 1.90 mishaps per 100,000 flight hours. This rate was above the 5-year average of 0.85 and higher than the FY23 rate of 1.08, although the number of fatalities decreased from 14 in FY23 to 9 in FY24. Mishap analysis points to a combination of reduced mid-level warrant officer flight experience and training gaps in the primary flight training course. Significant trends for FY24 include Loss of Trail Rotor Effectiveness (LTE) in 4 mishaps. There was also a significant rise in Class C mishaps driven by ground handling and service mishaps that were mainly attributed to experience gaps in maintenance personnel. In FY24, unmanned systems (UAS) saw only 1 Class A mishap involving MQ-1C (Gray Eagle). This is well below the 5-year rate. In FY24, Army phased out RQ-7 (Shadow) and RQ-11 (Raven) with a plan to focus on small UASs in the future. This presents several safety considerations that will affect manned and unmanned aviation in already congested airspace. In summary, in FY24, Army Aviation experienced an increase in the mishap rate above that of FY23 as well as the 5-year average. The most significant trend involves a gap in training in junior aviators in response to LTE. There were 15 Class A mishaps reported in FY24 with 9 reported fatalities given approximately 790,598 flight hours flown. There was 1 UAS Class A mishap in FY24. Human error continues to be the leading factor in Army Class A Flight mishaps.

Learning Objectives

1. Discuss the reasons for the increase in Army Class A mishap rate, despite a decrease in fatalities. Discuss the gap in mid-level experience in Army Aviation and the anticipated degradation in the capacity to effectively use power management, operate in degraded visual environments, and train terrain flight skills.
2. Learn the concept of Loss of Tail Rotor Effectiveness in rotary wing aviation and how it has been involved in recent Army Class A mishaps.
3. Human error remains the primary cause factor in manned aircraft mishaps. Discuss human factors that have been involved in FY24 Class A Flight mishaps (manned and unmanned).

[74] WITHDRAWN

[75] ROYAL CANADIAN AIR FORCE: 2024 YEAR-IN-REVIEW

Philippe Stewart
RCAF, Ottawa, Ontario, Canada

(Education - Program / Process Review)

BACKGROUND: The Commander of the Royal Canadian Air Force (RCAF) is appointed as the Airworthiness Authority for all aviation in the Canadian Armed Forces (CAF). The Director of Flight Safety (DFS) is appointed as the Airworthiness Investigative Authority for all flight safety occurrences with the goal of preventing accidental loss of aircraft and personnel. Contributory or causal human factors are identified using the Canadian Forces Human Factors Analysis and Classification System (CF-HFACS). Statistics and analysis from 2024 are discussed. **OVERVIEW:** Accidents and incidents from 2024 were reviewed to identify human factors which may have caused or contributed to these occurrences. **DISCUSSION:** Fatigue, culture, aging infrastructure and substances hazardous to aviation continue to be relevant hazards in the RCAF. DFS has helped to propel several risk mitigation initiatives specifically aimed at these factors, including the reviews and updates of the RCAF Fatigue Risk Management System, while continuing to demonstrate the benefits of using the SAI for accident investigations.

Learning Objectives

1. The audience will learn about the overall trends in RCAF flight occurrences in 2024.
2. The audience will learn to identify various Human Factors Analysis and Classification System (HFACS) categories that contribute to aviation incidents.
3. Increase familiarity with emerging topics of interest to flight safety in an evolving/modernizing air force.

[76] WITHDRAWN

Monday, 06/02/2025 ***4:00 PM***
Regency V

[S-15] SLIDE : FAST BEATS AND HIGH PEAKS: EXPLORING AI IN AVIATION MEDICINE

Chair: Alejandro Garbino
Co-Chair: Ian Curry

[77] CORONARY ARTERY DISEASE BURDEN AND RISK STRATIFICATION IN AIRCREW UTILIZING AGGREGATE STENOSIS: 2024 UPDATE

Eddie Davenport[1], Caleb James[1], William Timberlake[2], Maryrose Chuidian[3], Edwin Palileo[1]
[1]*USAFSAM, Wright Patterson AFB, OH, United States;* [2]*U.S. Air Force, Yakoda AFB, Japan;* [3]*U.S. Air Force, Hurlburt AFB, FL, United States*

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(Original Research)

INTRODUCTION: Coronary artery disease (CAD) is the leading cause of morbidity and mortality in industrialized nations. Hemodynamically significant stenosis is traditionally defined as coronary artery stenosis ≥70%, which correlates with ischemia and meets indication for revascularization. However, another marker of total CAD disease burden is necessary for risk assessment in aircrew. Previous aeromedical literature has used aggregate stenosis groupings of 1-49% considered mild risk, 50-119% were considered moderate risk, and >119% were considered severe risk. Current recommendations are to allow unrestricted flying in mild-risk individuals, restrict moderate-risk individuals to non-high-performance flight, and disqualify severe-risk individuals. This study aimed to determine if aggregate risk groupings can be safely broadened. **METHODS:** Aggregate stenosis data was obtained via left heart catheterization in 1790 male military aviators who were screened as high-risk for CAD on annual screening physicals or diagnosed with CAD between 1971 and 2023. Demographics, history, labs, and vital signs were obtained before catheterization. Individuals were followed to a cardiac event or termination of the study. The four experimental risk groups were defined as 0% stenosis, 1-95% aggregate with no single vessel stenosis (SVS) ≥70%, ≥95% aggregate with no SVS ≥70%, and any SVS ≥70%. **RESULTS:** Annualized risk of cardiac event for groups was <0.1%, 0.6%, 2.7%, and 3.8%, respectively. Experimental groupings, family history of CAD, and BMI were independent risk factors for 10-year cardiac event risk in asymptomatic individuals. For those with symptomatic CAD, Myocardial infarction, and/or revascularization, history of MI and smoking were also significant independent risk factors for recurrent event. **DISCUSSION:** Expanding the upper limit of the mild-risk aggregate stenosis grouping from 50% to 95% appears to broaden unrestricted flight duties in aircrew with CAD safely. Allowing unrestricted flight for aircrew with a 1-95% aggregate stenosis and allowing restricted flight to aircrew with aggregate >95% without any single stenosis over 70% could increase qualified pilots by approximately 2000 United States Air Force pilots. DISCLOSURE: The views expressed are those of the authors and do not reflect the official guidance or position of the United States Government, the Department of Defense or of the United States Air Force.

Learning Objectives

1. Understand that Coronary Artery aggregate stenosis is a marker of cardiovascular disease burden, which can risk stratify aircrew.
2. There is new evidence that expanding the aperture for burden of disease through changes in aggregate stenosis grouping is safe which can increase the number of pilots returned to flight.

[78] IMPACT OF LIFESTYLE AND GENETIC PREDISPOSITION ON HASH: EXPLORING AI AS A PREDICTIVE TOOL

Devdeep Ghosh[1], Biswajit Sinha[1], Debarati Ghosh[2], Kunal Bagul[3]
[1]*Institute of Aerospace Medicine, Indian Air Force, Bangalore, India;* [2]*TPS College, Patna, India;* [3]*Military Hospital, Gangtok, Indian Army, Gangtok, India*

(Original Research)

INTRODUCTION: High altitude deployment of Indian Armed Forces is encountered with various medical issues including High Altitude Associated Systemic Hypertension (HASH). A good number of personnel are found unfit during deployment despite being fit in High Altitude Medical Test (HAMT). Human resource issue is being encountered due to non-availability of trained manpower at right time at right place. Thus arises the need to analyse the causal association of HASH. Commercially available open source AI as a potential diagnostic modality has been explored for use as predictive tool. **METHODS:** Data of first half of 2023 of HAMT cleared 85 male with age 32.6±9 year from 02 units of an operational Armed Forces command were analysed. Age, BMI, WHR, fitness during acclimatization and final deployment, types of disabilities, previous history of HAA exposure, status of unfitness during previous deployment, family history of hypertension, smoking history, alcohol consumption, metabolic comorbidities and post-deinduction clinical status were analysed. Data were analysed using descriptive statistics and non-parametric test. Chi square test was applied to find out the association of categorical independent variables. Meta AI with Llama 3.2 has been used to predict HASH risk in the studied participants. **RESULTS:** 29-31% of HAMT fit personnel of the studied units became unfit during deployment. Hypertension contributed 68% of the unfit cases. Amongst 85 HAMT fit personnel, 20% developed HASH. Statistically significant correlation of family history of hypertension, previous history of HAA deployment and previous detection of hypertension in HAA ($p<0.05$) in respect of HASH was found. Considering 'Very high, high and moderately high risk' probable HASH cases as predicted by AI, diagnostic accuracy is 100% if all studied factors are considered. However, AI prediction accuracy gets reduced to 29.4%, if family history of hypertension, previous history of HAA deployment and previous detection of hypertension in HAA are not considered. **DISCUSSION:** Development of HASH during deployment is attributable to service, leading to increased financial burden of the organisation and adversely affecting trained manpower availability at HAA. AI may be suitably used to enhance diagnostic accuracy during HAMT with due emphasis on 'family history of hypertension, previous HAA exposure and hypertension in previous HAA exposure', to predict development of HASH as a user friendly tool in field.

Learning Objectives

1. The audience will learn about causal association for development of HASH. Statistically significant factors for development of HASH will give insight about impact of lifestyle and genetic predisposition on the subject.
2. The audience will learn about possibility of use of commercially available, open access AI to predict development of HASH as a user friendly tool in field. AI as diagnostic tool has been explored to assess its predictive accuracy to detect HASH.

[79] SUDDEN TACHYCARDIA DURING MODERATE EXERCISE IN A TEST PILOT

Karl-Magnus Kuloe[1], Nils Henrik Holmedahl[1], Eddie Davenport[2], Anthony Wagstaff[1]
[1]*Norwegian Armed Forces - Institute of Aviation Medicine, Oslo, Norway;* [2]*USAFSAM, Wright-Patterson AFB, OH, United States*

(Education - Case Study)

INTRODUCTION: This case describes a military test pilot and "Ironman" triathlon competitor who experienced sudden tachycardia during moderate exercise. **BACKGROUND:** Pilots who exercise and compete at a high level might have a higher risk of arrhythmia, which in turn may have aeromedical implications. An important concern in single pilot operations is the risk of any arrhythmia causing reduced +Gz tolerance, including G-LOC events. **CASE PRESENTATION:** A RNoAF test pilot and "ironman" triathlon competitor, 57 years of age, presented with sudden onset tachycardic events triggered by moderate exercise. The tachycardia was not triggered during maximal intensity exercise or other situations including flying in high-performance aircraft. Exercise ECG showed a sudden increase in heartrate from 157 to 190 bpm during moderate exercise with regular narrow complex tachyarrhythmia with no clear P waves. Further investigations included Echocardiography. A full electrophysiological workup at a university hospital, including several attempts to trigger the arrhythmia with sympathomimetic drugs, concluded that the arrhythmia was so minor that a second attempt to trigger the arrhytmia was not indicated, and decided against an ablation. He was recommended a small amount of Flecainide prophylactically, 25 mg per day by the hospital cardiologist. Conferring with USAF Aviation cardiologist the case was discussed from an aeromedical standpoint. Flecainide was advised against. No hemodynamic compromise had been shown, but due to possible effects on Cardiac output during High-Gz flying, an operational assessment was warranted. Hypoxia (ROBD) tests and in-flight cardiac monitoring with a safety pilot during High +Gz flight was performed with no triggering of arrhythmia. The pilot was again cleared for full flight duties, also given

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his own continued vigilant awareness of any changes in the situation. **DISCUSSION:** This case highlights the importance of assessing operational factors as well as clinical findings in arrythmia. Although exercise in general is important for military pilots, extreme levels of exercise may increase the risk of arrhythmias which might have flight safety implications. This case illustrates the importance of being aware of arrhythmias, and open dialogue between the aeromedical community and pilots, and collaborative decision- making where both clinical and operational factors are taken into account.

Learning Objectives

1. Extreme exercise over time can cause arrythmias which might affect flying status.
2. High performance pilots may be cleared for flying with a known supraventricular arrythmia if the risk of triggering the arrythmia in flight is low and the hemodynamic effects are small or negligable. A physiological stress test for high G and hypoxia may be warranted to inform the decision.

[80] A NOVEL, ARTIFICIAL INTELLIGENCE-BASED TOOL FOR RISK STRATIFICATION IN CORONARY ARTERY DISEASE: READY FOR AVIATION MEDICINE?

Denis Bron[1], Carolyne Gyoergy[2], Peter Ruff[2], Simon Frey[3], Michael Zellweger[3]

[1]*Aeromedical Centre Swiss Air Force, Duebendorf, Switzerland;* [2]*Exploris Health AG, Wallisellen, Switzerland;* [3]*University Hospital, Basel, Switzerland*

(Original Research)

BACKGROUND: Different risk scores are commonly used to screen aircrew members for coronary artery disease (CAD). However, current scores have limited diagnostic accuracy. Hence, a well validated, precise, safe and easily available artificial intelligence-based tool may improve identification of personnel at risk and clear those who are not. **METHODS:** The development, optimization and validation of a memetic pattern-based algorithm (MPA) for CAD evaluation will be summarized. Based on readily available clinical and laboratory variables, the model was developed and validated in a cohort of 373 patients with suspected CAD referred for invasive coronary angiography. The algorithm was then externally validated and optimized in an independent cohort of 987 patients. Additionally, the model was validated in high and low risk cohorts: patients referred for ischemia testing with 82Rb-Positron Emission Tomography and patients referred to a cardiology out-patient clinic. The diagnostic performance of the algorithm was compared to different commonly used risk prediction scores (e.g., Framingham Risk Score (FRS), pretest probability (PTP) of CAD as suggested by the European (ESC) and American societies of cardiology (ACC/AHA)). **RESULTS:** In the initial training population, the AUC and negative predictive value (NPV) of the MPA were higher than assessed by the FRS, 0.79 and 0.66, and 100% and 50%, respectively. By external validation and optimization, the AUC of the MPA could be improved to 0.87 with a NPV of 95%. Compared to commonly used pre-test probability tools from ESC and ACC guidelines, the MPA allocated significantly more patients to very low risk and was the only model to correctly predict ischemia in this group. AUC to predict ischemia was significantly higher than it was with PTP (0.758 vs. 0.673 (ESC 2019) vs. 0.667 (ACC 2021)). Sensitivity and NPV of the MPA to detect/exclude ischemia were >97% and >95%, respectively. In the low-risk setting, 68% of patients could have been cleared with the MPA model with an acceptable rate of missed CAD. **CONCLUSION:** The MPA was validated in >4000 patients and provided better discriminatory power to diagnose or exclude CAD compared to commonly used scores. Therefore, the MPA could be a useful tool also for risk assessment in aviation medicine. In a next step, it is planned to validate the MPA in a prospective study, risk stratifying aviation personnel in daily routine with respect to CAD.

Learning Objectives

1. Understand the strengths and weaknesses of various screening modalities for coronary artery disease in aircrew.
2. Appreciate the differences in how 7 different countries screen for coronary artery disease.
3. Learn a path forward for an international, evidence based, approach to screening for coronary artery disease in asymptomatic aircrew.

[81] IMPACT OF +9 GZ ACCELERATIONS ON PILOTS' RETINAL MICROSTRUCTURE DURING SIMULATED HIGH-MANEUVER FLIGHTS

Katarzyna Sowa[1], Slave Lobodzinski[2], Marek Prost[1], Krzysztof Kowalczuk[1], Magdalena Kozak[1]

[1]*Military Institute of Aviation Medicine, Warsaw, Poland;* [2]*University of CA, Los Angeles, CA, United States*

(Original Research)

BACKGROUND: Prolonged exposure to high G-forces during flight can imposesignificant strain on pilots' eyes, potentially resulting in alterations in retinal microstructure. This study aimed to evaluate the impact of +9 Gz accelerations lasting 15 secondson retinal microstructure using the Dynamic Flight Simulator(DFS), HTC-07 (AMST, Austria). **METHODS:** The study involved two groups of volunteers. Group I comprised 25 male pilots of high-maneuver aircraft (mean age 26.4 years), while Group II included 25 male non-pilots (meanage 26 years). Group I underwent microstructure analysis of the retina using a fundus camera with adaptive optics(RTX1™ Imagine Eyes, France) before and 5 minutes after exposure to accelerations. Group II underwent the same analysis without exposure to accelerative forces. Parametersassessed included cone cell density, spacing, regularity, and dispersion at four retinal locations, each 1.5 degrees from the foveal center. **RESULTS:** For Group I, the mean cone density prior to centrifugation was 32,499.17 cones/mm^2 (right eye) and 31,976.36 cones/mm^2 (left eye). Post-acceleration, densities were 32,416.19 cones/mm^2 (right eye) and 32,342.90 cones/mm^2 (left eye). For Group II, densities were 32,247.05 cones/mm^2 (right eye) and 32,949.62 cones/mm^2 (left eye). Cone spacing in Group I was 6.1339 µm (pre) and 6.1031 µm (post) for the right eye, with similar results for the left eye. Regularity was 93.4% (right eye) and 93.3% (left eye) in Group I before acceleration, remaining stable after exposure. Dispersion for Group I showed no significant changes. No statistically significantdifferences were found between the right and left eyes or between Groups I and II.The study confirmed a hexagonal mosaic structure of retinalarchitecture unaffected by acceleration, with higher conedensity in the nasal quadrants compared to the temporalquadrants. Spacing was significantly greater in the vertical plane and lower quadrants. **DISCUSSION:** Exposure to +9 Gz accelerations did not induce significantalterations in the microstructure of pilots' retinas. No instancesof retinal vascular hemorrhage or changes in the distributionof cone cells were observed.

Learning Objectives

1. Evaluate the retinal alterations occurring in response to gravitational overloads (G-forces) during high-stress conditions. Investigate the physiological changes in retinal morphology and function, including potential impacts on visual acuity and ocular health. Analyze the underlying mechanisms of adaptation and the clinical implications for individuals in aerospace and high-performance settings.
2. Investigate the application of adaptive optics in aerospace medicine for evaluating and managing ocular health in aviators. Examine its role in enhancing retinal imaging resolution, detecting microstructural changes, and diagnosing ocular pathologies to optimize visual function in high-altitude environments.

[82] "VISION ZERO" IN AVIATION - AN APPROACH FOR THE IMPROVEMENT OF SAFETY AND HEALTH

Joerg Hedtmann[1], Nadja Schilling[2], Martin Kueppers[2], Helge Homann[2], Bernd Muetzel[2]

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(Original Research)

INTRODUCTION: The International Social Security Association (ISSA) was founded in 1927 and the Section on Prevention in Transportation in 2014. 2017 the ISSA member organizations agreed on "Vision Zero" as a strategy to achieve a world free from serious and fatal occupational accidents and diseases. "Vision Zero" was also launched in the USA in 2018. Where does aviation stand today in relation to Vision Zero? **METHODS:** We determined the accident rates from the accident database of the BG Verkehr (the social accident insurance institution in Germany); for the years 2018 to 2022 for various transportation sectors. **RESULTS:** In 2022, an average of 40.26 accidents per 1,000 employees was reported for all transportation sectors, 56.53 for road construction, 42.62 for road haulage and only 16.30 for air transport. Maritime shipping had 10.75 accidents in the same period. Starting from 25.25 accidents per 1,000 employees in the aviation sector in 2018, there was a drop to 10.86 in 2020 as a result of the coronavirus pandemic, but the figures rose again the very next year - in contrast to other sectors. The trend in occupational diseases is inconsistent in aviation, at a comparatively low level but without a clear downward trend. This is partly due to new occupational diseases such as squamous cell carcinoma. Noise-induced hearing loss is on an upward trend. While maritime shipping has more than halved its accident rate since 2018, aviation is the only sector in which the number of accidents is on the rise again. Whether this is a global trend needs to be monitored. **DISCUSSION:** "Vision Zero" has never been officially adopted in aviation. This may be partly due to the consistently low accident and illness rates compared to other sectors. However, the current unsatisfactory development implies that aviation should also adopt the "Vision Zero"-Strategy. In an industry that is already safety-oriented, this requires a comprehensive approach and the need to raise awareness among all stakeholders. BG Verkehr has therefore created a set of guidelines and a network of responsible persons to help bring the idea of Vision Zero to the attention of aviation companies.

Learning Objectives

1. The audience will learn about the International Social Security Association, the "Vision Zero"-strategy and their impact on aviation.
2. The audience will understand, that the implementation of "Vision Zero" in aviation will help to break the upward trend in accident rates.

Monday, 06/02/2025 ***4:00 PM***
Regency VII

[S-16] SLIDE : G- FACTORS

Chair: Matthew Cooper
Co-Chair: Tamara Averett-Brauer

[83] ELECTROMYOGRAPHY VS. FOOT PEDAL FORCE MEASUREMENT FOR ASSESSING ANTI-G STRAINING MANEUVER IN CENTRIFUGE TRAINING

Jia Hao Alvin Woo
Changi General Hospital, Singapore, Singapore

(Original Research)

INTRODUCTION: The Anti-G Straining Maneuver (AGSM) is crucial for fighter aircrew to prevent G-induced loss of consciousness. While foot pedal force measurement has been traditionally used to assess AGSM during centrifuge training, it may not accurately reflect all muscle groups involved. Surface electromyography (EMG) offers a potential alternative, but no studies have compared EMG to foot pedal force during routine centrifuge training. This study aimed to evaluate EMG as an alternative to foot pedal force measurement for assessing AGSM. **METHODS:** A retrospective observational study was conducted on 19 male aircrew trainees undergoing centrifuge training in April-May 2021. Subjects completed four training sessions over 4-5 weeks. EMG activity was recorded from four muscle groups: left medial gastrocnemius (MG), left biceps femoris (BF), right vastus medialis (VM), and right rectus abdominis (RA). Foot pedal force was also measured. Five gradual onset runs (GOR, 0.1 +Gz/s) and four rapid onset runs (ROR, 6 +Gz/s) were analyzed. Pearson correlation and ANOVA were used for statistical analysis. The study was exempted from review by the DSO-SAF Institutional Review Board. **RESULTS:** In the GOR profile at peak Gz with AGSM and anti-G suit, positive correlations were found between left pedal force and VM (r=0.557, P=0.013), and between right pedal force and MG (r=0.54, P=0.017). RA tensing duration was significantly shorter than right pedal tensing (28.98±17.27s vs 46.36±17.92s, P=0.043). ROR profiles consistently showed positive correlation between right pedal force and VM (r=0.463, P=0.046). RA activity was significantly lower than other muscle groups before (P<0.005) and during (P=0.017) Gz acceleration in the ROR +8Gz profile. **DISCUSSION:** EMG provides more detailed information on individual muscle activity during AGSM compared to foot pedal force measurement. The lower RA activity observed suggests potential areas for improvement in AGSM technique. EMG appears to be a viable alternative to foot pedal force measurement in routine centrifuge training, offering real-time and post-session analysis of multiple muscle groups to better achieve the objective of improving G tolerance and endurance.

Learning Objectives

1. The participant will be able to understand the advantages and limitations of using electromyography compared to foot pedal force measurement in assessing the Anti-G Straining Maneuver during centrifuge training.
2. The audience will learn about the correlation between specific muscle group activities and foot pedal force measurements during gradual and rapid onset acceleration profiles in centrifuge training.
3. The participant will be able to identify potential areas for improvement in Anti-G Straining Maneuver technique based on electromyography data from multiple muscle groups.

[84] ASSESSMENT OF HUMAN LUNGS CAPACITY DURING SIMULATED PUSH PULL MANEUVERS OF AN AIRCRAFT PILOT

Munna Khan[1], Kashif Islam Khan Sherwani[2], Uzair Niaz Siddiqui[2], Ashfaque Usmani[2], Affan Ahmad Khan[2], Mohammad Mohsin Khan[3]
[1]*JAMIA MILLIA ISLAMIA (CENTRAL UNIVERSITY), NEW DELHI, New Delhi, India;* [2]*Jamia Millia Islamia (Central University), New Delhi, India;* [3]*Brunel University, London, United Kingdom*

(Original Research)

INTRODUCTION: Fighter and aerobatic pilots are subjected to intense difficulties when a -Gz maneuver (push) is performed before a +Gz maneuver (pull). The push-pull maneuver (PPM) is responsible for accidents involving G-induced loss of consciousness (G-LOC). The PPM may cause physical stress to lung tissues affecting human lung capacity (HLC). The HLC responsible for oxygen transimission to the brain can fluctuate resulting in a physiological episode (PE) and may be life threatening to the pilots. An attepmt has been made to assess HLC of human volunteers during simulated PPM. **METHODS:** The PPM was simulated using tilt table keeping head down and legs up of human volunteers as Push. Inversion of human body keeping head up and legs down simulated as Pull. The 25 healthy subjects were enrolled with age range from 21 to 27 years and RMS Helios 401 PC based spirometer used to measure lung parameters: total Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), the 25%, 50 %, and 75 % of forced expiratory flow as FEF 25, FEF 50, and FEF 75 respectively. The spirometer data was recored during four distinct positions: sitting (baseline), supine (tilt table parallel to the ground), Push, and Pull positions. Artificial Inteligences (AI) Ridge Regression (RR) and Support Vector Regression (SVR) techniques were applied using python software. A prediction model was developed to estimate simulated Push from Pull spirometric data of the human volunteers. **RESULTS:** The AI techniquies revealed suboptimal results characterized by significant deviation from ideal prediction plot lines duiring simulated PPM. Various analysis showed a 10.70% drop in FVC capacity when transitioning from the sitting position to the Push position compare to Pull position. The difference was obtained as 12.27 % in the

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FVC capacity during simulated PPM using tilt table. The model achieved a Mean Squared Error (MSE) of 0.0155 and an R^2 (coefficient of determination) of 0.9327, indicating high predictive accuracy and reliability. **DISCUSSION:** Output of research works done yielded relationship between phases of PPM and HLC parameters. Trained model estimated -Gz spirometric values from +Gz values of individuals. The model may eliminates testing need of the pilots in Push maneuvers. The results may be used to refine fitness assessments of an of aircraft pilot during high-G maneuvers. A novel application of AI techniques has been explored in the ffield aerospace medicine.

Learning Objectives

1. Simulation of Push (-Gz) maneuver keeping head down and legs up and Pull (+Gz) maneuver keeping head up and legs down of human volunteers on the tilt table.
2. To study physiological consequences of push pull effect on the lung capacity of respiratory system of an aircraft.
3. Develpment and training of Artificial Intelligence (AI) model to estimate Push (-Gz) Spirometrics values from Pull (+Gz) values of the human volunteers.

[85] WITHDRAWN

[86] WITHDRAWN

[87] WITHDRAWN

[88] IMPACT OF BODY COMPOSITION ON G TOLERANCE IN INDIAN FIGHTER PILOTS

Avinash Krishnegowda, Prathu Rastogi, Mona Dahiya
Institute of Aerospace Medicine, Bengaluru, India

(Original Research)

INTRODUCTION: Ability to tolerate high G stress (G tolerance) during aerial combat enables a pilot to exploit his aircraft to its fullest design capabilities to achieve operational effectiveness. The G level and duration tolerance of an individual depends on a number of physical and physiological factors. In this study, an attempt has been made to assess the relationship of body composition variables like weight, height, BMI, lean body mass, fat mass(FM) and fat free mass(FFM) with +Gz level and duration tolerance. **METHOD:** 32 healthy, male fighter pilots were subjected to body composition analysis. They were subjected to a GOR (0.1G/sec) run to assess their Relaxed and Straining +Gz tolerance (RGT & SGT) and to a Simulated Air Combat Maneuver (SACM; 4G 15 sec and 8G 10 sec) run to evaluate their Gz duration tolerance (SACMT) in the High Performance Human Centrifuge (HPHC). The data recorded was assessed for normality using the Kolmogorov-Smirnov test, and correlation between different parameters was studied using Pearson product moment correlation. **RESULTS:** RGT has strong positive correlation with body weight ($r=0.41$, $p<0.01$), BMI ($r=0.588$, $p<0.01$) and FM ($r=0.592$, $p<0.01$), while SGT is associated with FFM($r=0.356$, $p<0.05$), which represents muscle mass. SACMT was not found to be significantly correlated with any of the body composition variables studied; however, it seems to be inclined towards FFM ($r=0.162$, $p<0.05$) and thus associated with muscle mass and not with weight, BMI or FM of the individual. **DISCUSSION:** The positive correlation of weight, BMI and FM with RGT signifies the importance of FM, within the permissible limits, for a better G level tolerance. However, insignificant correlation of these with SACMT and weak association with FFM indicated that muscle strength is of more importance in order to combat G forces in sustained operations. Further studies which consider levels of physical conditioning as well as progressive effects of physical conditioning with larger sample size should be conducted to substantiate the findings.

Learning Objectives

1. The audience will able to understand the impact of body composition i.e body weight, body fat, muscle mass on G tolerance.
2. The audience will be able to understand methods to assess G endurance tolerance and how the body mass has limited role in ability tolerate high sustained G.

Monday, 06/02/2025 ***4:00 PM***
Hanover F/G

[S-17] PANEL: AEROMEDICAL OPERATIONAL AND CLINICAL PSYCHOLOGY BRANCH OCCUPATIONAL HEALTH PROGRAM 2024 INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE WING PANEL

Chair: Floyd Manley

Panel Overview: *This panel presents the results from occupational health assessments provided to the Intelligence, Surveillance and Reconnaissance Wing in 2024. The assessment was conducted by U.S. Air Force School of Aerospace Medicine researchers to identify the unique characteristics of the Distributed Common Ground System operational environment. The study was reviewed by the Air Force Research Laboratory Institutional Review Board at Wright-Patterson Air Force Base, was determined not research, and assigned protocol number F-WR-2023-0107-N. We will provide a broad-spectrum snapshot of occupational health for these Air Force operators and draw comparisons to findings from previous assessments of this population from 2011, 2013, 2016, and 2019. The first presentation gives overarching findings from the occupational health questionnaire. The second presentation introduces the job demands and resources model. The third presentation further explains one of the environmental demands on operators, burnout, and the fourth presentation further explains one of the individual demands on operators, moral injury. The fifth presentation gives an introduction to the Process-Based Assessment Tool (PBAT) and findings that support further study into its usefulness as a screening and outcome tracking measure for embedded resiliency support.*

[89] INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE WING OCCUPATIONAL HEALTH PROGRAM TRENDS

Rachael Martinez
U.S. Air Force, Dayton, OH, United States

(Original Research)

INTRODUCTION: The increasingly dynamic state of global political and military affairs sustains the high demand for intelligence (intel) personnel. The nature and magnitude of missions conducted by intel operators impart unique stressors. Thus, the need to monitor stressors and occupational health of this community is important. **METHODS:** A large sample of intel personnel (n>1000) responded to a comprehensive occupational health assessment in April-July 2024 that included questions on demographics (e.g., age), occupational factors (Air Force Specialty Code, unit, time in unit, work schedule), sources of stress (e.g., organizational issues, unit manning concerns), stress outcomes (e.g., Patient Health Questionnaire-2, Generalized Anxiety Disorder-2), and health behaviors. High perceived sources of stress, rates of stress outcomes, and health behaviors (e.g., sleep, alcohol, tobacco, exercise) were examined and comparisons to findings from previous assessments were conducted. **RESULTS:** Approximately 14% of intel personnel met the threshold for depression and 19% met the threshold for anxiety. With respect to operational risk factors, high role overload

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and role conflict were associated with greater risk of psychological distress. When reviewing personal risk factors, operators endorsing relationship difficulties with a significant other, chronic inadequate sleep, and increased caffeine, alcohol, or tobacco use had an increased risk for psychological distress. **DISCUSSION:** Various demographic, occupational, and health factors were found to be associated with higher levels of stress outcomes. The results of this study further clarify potential risk factors for negative psychological outcomes among individuals working in the Air Force intel community. The descriptive nature of this study can increase awareness among military medical practitioners as to factors that may increase an operator's likelihood of experiencing stress outcomes. Interventions designed to mitigate the impact of potential risk factors can be designed to improve the health and well-being of intel personnel.

Learning Objectives

1. Examine unique occupational stressors among U.S. Air Force intelligence personnel and how these stressors compare over time.
2. Discuss relationships between occupational stress, stress outcomes, and health behaviors among members of the U.S. Air Force intel community.

[90] BURNOUT PROFILES AMONG INTELLIGENCE PERSONNEL

Tanya Goodman
U.S. Air Force, Victoria, TX, United States

(Original Research)

INTRODUCTION: Burnout occurs when personal factors interact with inadequate work and environmental conditions. U.S. Air Force intelligence (intel) operators have high rates of overall burnout and higher rates of exhaustion (severe physical and mental loss of energy) and mental distancing (strong reluctance or aversion from work) when compared to other mission areas in the Air Force. Health outcomes, like sleep, physical activity, and job satisfaction, may be impacted by one's burnout profile. Understanding unique profiles expressing overall burnout, high exhaustion, and high mental distancing can point to interventions that target specific coping skills and/or changes in the workplace. **METHODS:** A large sample of intel personnel (n>1000) responded to a comprehensive occupational health assessment in April-July 2024 that included questions on demographics, occupational factors, stress outcomes, and health behaviors. The Burnout Assessment Tool was used to measure overall burnout, exhaustion, mental distancing, emotional impairment, and cognitive impairment. **RESULTS:** A series of latent profile analyses was conducted using maximum likelihood estimation. Models for overall burnout included all of intel personnel, including those with low, moderate, and high rates of burnout. Separate models for intel personnel high on two of the subscales allowed for further granularity of results and included intel personnel who reported high exhaustion and high mental distancing. **DISCUSSION:** Interventions could target the potentially at-risk/moderate overall burnout group, which may prevent them from moving into the at-risk/high burnout group. Coping skills employed by the low burnout group may inform useful strategies for the moderate and high to mitigate the effects of burnout.

Learning Objectives

1. Identify similarities and differences in profiles for low, moderate, and high burnout among intelligence personnel.
2. Understand key demographic and occupational factors relevant to high exhaustion and high mental distancing.

[91] APPLYING THE JOB DEMANDS-RESOURCES MODEL TO AN INTELLIGENCE SAMPLE

Kinsey Bryant-Lees
NeuroStat Analytical Solutions, Newport, KY, United States

(Original Research)

INTRODUCTION: According to the Job Demands-Resource model, job characteristics can be classified into two general categories: job demands and job resources. Job demands describe the physical, mental, social, or organizational characteristics of the job or work environment that require sustained physical or psychological effort and are associated with costs to employee well-being and productivity. Job resources refer to the physical, mental, social, or organizational characteristics that are motivational and are associated with productivity and well-being. The model posits that these two categories of job characteristics (i.e., demands and resources) both play a crucial role in predicting work engagement and other important individual and organizational outcomes via two psychological processes: (1) a stress process, initiated by excessive job demands and lacking resources that leads to low work engagement, and (2) a motivational process. We apply the model to a sample of U.S. Air Force Intel personnel. **METHODS:** A large sample of intel personnel (n>1000) responded to a comprehensive occupational health assessment in April-July 2024 that included questions on demographics, occupational factors, stress outcomes, and health behaviors. To capture the experience of stress from job demands, we measured three components of work role strain using a 15-item survey on job resources using the Deployment Risk and Resilience Inventory-2 Social Support Scale. Work engagement was measured by the Utrecht Work Engagement Scale. We examined the relationships between job demands (i.e., role ambiguity, role conflict, and role overload) and resources (i.e., unit social support) in predicting work engagement. **RESULTS:** Correlations among demands, resources, and outcomes were moderate to high. Role stressors had a negative effect on work engagement. Unit social support had a positive effect on work engagement. **DISCUSSION:** In the current study, we examined the impact of job demands (i.e., role ambiguity, role conflict, and role overload) on work engagement by applying the Job Demands-Resource model in the context of intelligence personnel. Understanding the overall health and health-related behaviors of these operators and how these are affected by changes in the demands and resources in the work environment are critical for sustaining operators' health and well-being and maintaining effective U.S. military operations.

Learning Objectives

1. Describe the Job Demands-Resources model and its utility for understanding the impact of job demands and resources on work and health outcomes.
2. Apply the Job Demands-Resource model to assess the associations among job demands, job resources, and outcomes within a U.S. Air Force intelligence sample.

[92] MORAL INJURY

Ivan Colon-Rivera
U.S. Air Force, Dayton, OH, United States

(Original Research)

INTRODUCTION: U.S. Air Force intelligence (intel) personnel regularly encounter challenging combat environments. While many in the intel community might be expected to cope with the psychological stresses of their work, some may struggle, leading to a condition known as moral injury. Moral injury occurs when individuals feel they have violated deeply held moral beliefs, whether by committing, failing to prevent, witnessing, or learning about acts that transgress these values. Moral injury has garnered attention in recent years due to its overlap with post-traumatic stress disorder (PTSD) and its potential to hinder recovery from trauma. **METHODS:** From April to July 2024, a large sample of intel personnel (n>1000) participated in a comprehensive occupational health assessment that included questions on demographics, occupational factors, stress outcomes, and health behaviors. The Moral Injury Events Scale (MIES) was employed to assess exposure to perceived moral transgressions and betrayals. Participants who reported experiencing a highly stressful, potentially traumatic event were asked to complete the Primary Care PTSD Screen for DSM-5 (PC-PTSD-5). The patterns of individual symptom and symptom categories were examined and compared to PTSD findings from

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previous assessments. **RESULTS:** High moral injury was reported by 17.7% of intel participants. Moderate correlations with moral injury were found for unit member social support (r = -.32, p < .01), burnout (r = .35, p < .01), existential well-being (r = -.35, p < .01), Patient Health Questionnaire-2 (r = .33, p < .01), Generalized Anxiety Disorder-2 (r = .33, p < .01), and PC-PTSD-5 (r = .37, p < .01). Of the 712 personnel who responded to exposure to a potentially traumatic event, 54% witnessed death or a serious injury. Of those participants responding to the PC-PTSD-5, 15% met the threshold, indicating they are likely to meet the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition criteria for PTSD. **DISCUSSION:** This study indicates that a significant portion of the 480 Intelligence, Surveillance and Reconnaissance Wing community experiences moral injury, which is strongly linked to negative health outcomes. Intel personnel often operate in morally complex environments, which may contribute to the risk of moral injury. The findings also suggest that incorporating the MIES into organizational assessments can provide valuable insights, guiding targeted interventions to address the factors driving moral injury.

Learning Objectives

1. Comprehend and articulate the concept of moral injury in relationship to post-traumatic stress disorder and other psychological diagnoses.
2. Understand how to effectively apply the Moral Injury Events Scale to assess the presence and severity of moral injury within the intelligence community.

[93] PROCESS-BASED ASSESSMENT TOOL

David Tubman
U.S. Air Force, Dayton, OH, United States

(Original Research)

INTRODUCTION: To address unique job demands, U.S. Air Force intelligence leaders have implemented Airmen Resiliency Teams consisting of multidisciplinary professionals who embed within organizations to consult and deliver prevention and performance enhancement interventions. While Airmen Resiliency Teams, like other embedded care teams, tend to have high satisfaction ratings, it is difficult to understand their effect on improving resiliency due to the lack of appropriate screening and outcome tracking measures for embedded care contexts. To address this problem, this study presents evidence that supports the use of the Process-Based Assessment Tool (PBAT), which is a brief, transdiagnostic, and transtheoretical tool that provides embedded resiliency practitioners with specific prevention and performance optimization intervention areas and outcome tracking. **METHODS:** Intelligence personnel (n=1763) completed an occupational health assessment in April-July 2024 that included demographics, occupational factors, stress outcomes, and health behaviors. The 18-item PBAT was included to assess participants' endorsement of biopsychosocial behaviors that correspond with resilience, namely behavioral variation, behavioral retention, social connection, affect, competence, health behaviors, coherence, orientation, and autonomy. PBAT item scores were correlated with other relevant occupational health variables, including depression, anxiety, post-traumatic stress disorder, burnout, work engagement, and existential wellbeing. **RESULTS:** Significant correlations (p < .001) were found between all 18 PBAT items and scores on screening tools for depression (Patient Health Questionnaire-2), anxiety (Generalized Anxiety Disorder-2), burnout (Burnout Assessment Tool), work engagement (Utrecht Work Engagement Scale), and existential well-being (Spiritual Well-Being Scale). Medium to large effect sizes were observed between PBAT items and several other measures of resilience (e.g., r2 for PBAT orientation and Patient Health Questionnaire-2 total scores were = .25, Generalized Anxiety Disorder-2 = .16, Primary Care PTSD Screen for DSM-5 = .14, Burnout Assessment Tool = .19, and existential well-being = .24). **DISCUSSION:** These findings support the use of the PBAT as a standalone, brief, and easily interpretable screening instrument that can equip embedded providers with target areas for intervention and as an outcome tracking tool to test intervention effectiveness.

Learning Objectives

1. Analyze the relationship between scores on a measure of biopsychosocial behaviors and occupational health outcomes.
2. Consider ways in which a process-oriented instrument can be used in embedded resiliency care settings.

TUESDAY, JUNE 03, 2025

Tuesday, 06/03/2025 ***2:00 PM***
Centennial Ballroom I

[S-18] PANEL: CELEBRATING OVER 50 YEARS OF AEROSPACE MEDICINE EDUCATION, TRAINING AND RESEARCH IN THE UK: A COLLABORATION ACROSS THE MILITARY, ACADEMIA AND INDUSTRY

Chair: Stephen Harridge
Co-Chair: Kristian Mears

Panel Overview: *This panel celebrates over five decades of excellence in aerospace medicine education and research in the UK, highlighting the vital role of collaboration across the military, academia, and industry. The session will delve into the historic achievements and future directions of aerospace medicine, the importance of international collaboration and aligning with the conference theme "Innovation: Journey to the Future". Professor Gradwell (RAF ret'd) will provide a historic perspective on the internationally recognised Diploma in Aviation Medicine (DAvMed) course and exam. Revisiting the history from its inception to present day and illustrating its evolution and close links with "Ernsting's Textbook of Aviation and Space Medicine". This foundational work has set the stage for the UK's prominence in the international aerospace medicine community. Dr. Pollock will explore "Aerospace Medicine Education in the 21st Century and a Look to the Future." This will discuss the research informed approach to educational practices and anticipate future trends in aerospace medicine, emphasizing the importance of innovation and adaptation in training the next generation of professionals and operational needs. Wg Cdr Posselt will highlight "The UK Specialty of Aviation and Space Medicine." This talk will discuss the integrated nature of training for the GMC recognised specialty of Aviation and Space Medicine, highlighting the close relationships between the military, academia, and industry in cultivating UK expertise and fostering a strong academic foundation. Wg Cdr Leeming will address " The military and operational relevance at the core of educational approach, including practical experiences that shape future practice." This will share insights into how military requirements and operational experiences are integrated into the educational framework, ensuring relevance and applicability in real-world scenarios. Finally, Dr. Bird will discuss " The military and operational relevance at the core of educational approach, including practical experiences that shape future practice." This will connect the dots between aeromedical research, education, and their direct impact on aircrew training and operational support, showcasing the comprehensive approach to aerospace medicine research and education in the UK. Attendees will gain insights into the multidisciplinary nature of aerospace medicine and the critical role of education in shaping the future of the field.*

[94] EDUCATION FOR THE AEROMEDICAL SPECIALIST - THE DIPLOMA IN AVIATION MEDICINE

David Gradwell
King's College London, London, London, United Kingdom

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(Education - Program / Process Review)

BACKGROUND: Rapid advances in aircraft in the 1960's spurred the need for improved training in aviation medicine for front-line medical officers in the Royal Air Force. **OVERVIEW:** A course was devised, approved by medical Royal Colleges, and delivered at the RAF Institute of Aviation Medicine, Farnborough by specialists in aviation medicine and many clinical specialities. This course and examination are known worldwide as the Diploma in Aviation Medicine. Topic. By 1965 aircraft operated by the RAF were faster, flew higher and further than previous generations and posed additional challenges to medical officers on operational stations required to understand the physiological and clinical implications for the aircrew in their charge. Specialist aeromedical staff at the RAF IAM and their clinical colleagues in military hospitals imparted their knowledge to a cadre of medical officers who would become the aeromedical leads on stations worldwide. After a trial exercise the Diploma in Aviation Medicine course started at Farnborough in 1967. It covered aviation physiology, psychology, clinical medicine and many experiential opportunities including hypoxia, acceleration and sea survival. In 1998 RAF IAM closed and direction of the course moved to King's College London. Students, now drawn from military and civilian cadres from across the global, are taught in London and the RAF Centre of Aerospace Medicine at Henlow. This is augmented by visits to centres of excellence providing insight into airline and space operations, equipment manufacturers and air traffic centres. In 1978 the first edition of the UK specialist textbook, now called Ernsting's Aviation & Space Medicine, was published. This is now a standard text not only for the course but also as a widely used reference in aeromedical centres worldwide. Application. **DISCUSSION:** The DAvMed course is a well-known, accessible training course for those specialising in aerospace medicine, either as future consultants, and for military and civilian flight surgeons gaining scientific and clinical training for their future roles. The associated examination is a rigorous, respected benchmark of knowledge and understanding.

Learning Objectives

1. The participant will be able to understand the need for specialist training in aerospace medicine.
2. The audience will learn about the means the UK has developed specialist training in aerospace medicine.

[95] AEROSPACE MEDICINE EDUCATION IN THE 21ST CENTURY AND A LOOK TO THE FUTURE

Ross Pollock[1], Peter Hodkinson[1], Tom Smith[1], David Newman[1], Michael Harrigan[2], Desmond Connolly[3], Ian Mollan[4], Felicity Leaming[4], Philip MacMillan[5]

[1]*King's College London, London, United Kingdom;* [2]*British Airways, Landford, United Kingdom;* [3]*QinetiQ, Farnborough, United Kingdom;* [4]*RAF, Henlow, United Kingdom;* [5]*Civil Aviation Authority, Crawley, United Kingdom*

(Education - Program / Process Review)

BACKGROUND: Aerospace medicine education has evolved significantly over the past five decades driven by significant changes to air(space) craft and environments we operate in. Looking ahead there remains both challenges and opportunities to further integrate research-led teaching and interdisciplinary approaches to train the next generation of aerospace medicine professionals. **OVERVIEW:** Close collaboration between academia, military, and industry can ensure that aerospace medicine education remains dynamic and operationally relevant. Research-led teaching, which leverages the most current scientific advancements, is crucial for preparing medical personnel to address complex physiological challenges in both aviation and space environments. Through collaborations with the latest industry developments and military operational expertise, students can gain a holistic view of health and safety in the aerospace environment. Moving forward inclusivity (regarding what is taught and who is taught) must play a central role in aerospace medicine education. Historically, aerospace medicine research has focused predominantly on male subjects and lacked sufficient representation of all ethnic groups. To gain a comprehensive understanding of human physiology in the aerospace environment, applicable to all, curricula must be developed to address these gaps. Expanding our knowledge base to include diverse populations will not only improve the safety and well-being of all individuals but also open new research avenues that account for varying physiological responses across gender and ethnic groups. **DISCUSSION:** Historically aviation medicine was taught and subsequently many of the fundamental principles in aviation were extended to space medicine (e.g. knowledge of full pressure suits being applied to the development of space suits). In modern aerospace medicine with continual advancements in the field it is important to maintain this approach while ensuring the fundamental principles remain a core component of our syllabi. In doing so practitioners will gain valuable insights that can deepen their understanding of human health in both aerospace and terrestrial contexts, potentially informing future aerospace operations or healthcare innovations. Through fostering international collaboration across military, academic, and industrial, aerospace medicine education can remain at the forefront of scientific discovery, inclusivity, and global health improvement.

Learning Objectives

1. The audience will gain an understanding of the approaches to aerospace medicine education in the UK.
2. The audience will gain an understanding of the importance of inclusivity in aerospace education.

[96] AVIATION AND SPACE MEDICINE SPECIALTY TRAINING IN THE UK

Bonnie Posselt[1], Payam Ghoddousi[2], Mark Cairns[2], Ryan Anderton[2]

[1]*RAF, Henlow, Bedfordshire, United Kingdom;* [2]*Civil Aviation Authority, Crawley, United Kingdom*

(Education - Program / Process Review)

BACKGROUND: Aviation medicine has existed since humans first took to the skies in hot air balloons when it became apparent the new aviation environment had a profound effect on the human body. Subsequently, and with the advent of powered flight, healthcare professionals have played a vital role in researching these physiological effects, developing life support equipment to protect aviators, improving flight safety and making clinical fitness to fly decisions. In the UK, training in Aviation Medicine was by and large done by apprenticeship predominantly in the military. The UK medical regulatory body, the General Medical Council, recognized the lack of a standardized training pathway, which led to the development of a Specialty Advisory Committee made up of experienced practitioners in Aviation Medicine. Space Medicine was included in the curriculum as the UK's has ambitions to continue growth in the space sector. After a period of consultation, in 2016 a national training program was approved to train doctors in Aviation and Space Medicine. The four-year curriculum now includes placements in military and civilian aerospace environments, as well as industry and academia. Accreditation as a specialist is achieved through continuous work-place based assessment and formal examination. Despite the UK's relatively low numbers of accredited specialists in Aviation and Space Medicine, super-specialisation has been both possible and necessary to ensure coverage of the sheer breadth of aerospace medicine activity on both a national and international level. **OVERVIEW:** This presentation will describe the development of Aviation and Space Medicine in the UK, highlighting the challenges and successes of implementing such a training program. How UK training aligns with other international Aerospace Medicine training programs will also be discussed. **DISCUSSION:** The UK has a rich heritage and expertise in Aviation and Space Medicine but lacked a formalised route to accreditation. It now has a dedicated and regulated training program with a growing number of doctors being trained from military and civilian organizations.

Learning Objectives

1. The audience will learn about the accredited training program in Aviation and Space Medicine in the UK.
2. The audience will learn what challenges exist in establishing an accredited training program in Aviation and Space Medicine.

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[97] THE MILITARY AND OPERATIONAL RELEVANCE AT THE CORE OF EDUCATIONAL APPROACH, INCLUDING PRACTICAL EXPERIENCES THAT SHAPE FUTURE PRACTICE

Felicity Leaming[1], Claire Goldie[2], Alexander Wrigley[3], Nicholas Jefferey[4], Ian Mollan[1]
[1]*RAF, Bedfordshire, United Kingdom;* [2]*British Army, Middle Wallop, United Kingdom;* [3]*Royal Navy, Portsmouth, United Kingdom;* [4]*British Army, Andover, United Kingdom*

(Education - Program / Process Review)

BACKGROUND: Practical knowledge and understanding of the Operational requirements of military and civilian flying is essential for MOs who wish to provide the Chain of Command a full picture of the impact of a disease or disorder on aircrew's ability to fly. This understanding is vital for keeping aircrew flying safely and healthily through their career. **OVERVIEW:** The Programme of Operational Aviation Medicine was developed for doctors working for the military who have completed the Diploma in Aerospace Medicine at Kings College London. The premise of the course is to expose the attendees to the full range of aircraft, aircrew roles and flying in the military so that they better understand how to manage aircrew. This allows those more highly trained Aviation doctors to enact existing policy with some degree of flexion in discussion with Duty Holders and RAF CAM so that we can continue to keep aircrew flying for longer, using the time and money that has already been invested in them to best effect. It also allows the future policy makers to better understand how to develop policy and training so that we can adapt and grow to cover any developments or changes in military flying. Acknowledging that not all our MOs will have the good fortune, or wish, to study for the Diploma, RAF CAM are developing a MAME Refresher course which will ensure MAME doctors continue to be updated and encouraged to learn more about their aircrew, their roles and platforms. This gives Defence more flexibility in who sees their aircrew as all MAME MOs should have a similar level of knowledge but also gives MOs confidence to see aircrew from platforms they are not familiar with. **DISCUSSION:** Global shortages in medical staff mean that MOs are required to gain knowledge of their population with less time in the day to do so. Gone are the days of Squadron doctors! By ensuring practical training is built into our training pipeline and is actively encouraged as part of the working day, we can try to instil an ethos of continued practical learning for our MOs.

Learning Objectives

1. The audience will learn gain a greater understanding of military flying allows better risk assessment of aircrew to allow the Military to use their experience to best effect.
2. The audience will learn gain a greater understanding of the gaps in our MOs knowledge and developing training in order to address these.

[98] FROM AEROMEDICAL RESEARCH AND EDUCATION TO IMPACTING AIRCREW TRAINING IN SUPPORT OF OPERATIONS

Oliver Bird, Kristian Mears
RAF, Henlow, Bedfordshire, United Kingdom

(Education - Program / Process Review)

BACKGROUND: Contemporaneous, mission-oriented training of aviators, based on sound physiological principles, is the hallmark of many nations' aerospace medicine commitment to promoting flight safety and reducing risk to life. Educators need a grounding in the specialty, built on knowledge and experience. Through the lens of history, the strides taken in the UK to disseminate contextualised learning to aviators will be explored, encouraging aerospace medicine practitioners to become champions of learning. **OVERVIEW:** Since the early days of lighter than air flight, investigators and researchers have contributed to the knowledge and understanding of aviators, mediated through educators. From the 1930s, a need for investigation into the effects of the aviation environment and the development of equipment and procedures to protect aviators from these was recognised. By the 1940s, decompression chambers were based throughout the UK. With the introduction of partial pressure suits into the RAF, it was recognised that the establishment of an aircrew training centre, run by specially qualified staff, would be required. The RAF Aviation Medicine Training Centre (AMTC) opened in 1960, where medical officers developed a high level of expertise, not only on aircrew equipment, but also on aircrew problems that might arise during operations. The AMTC staff became authorities, with aircrew getting to know the Centre and its instructors. This unexpected but important feature of the training environment fostered a climate favourable to a franker exchange of information and discussion between aircrew and instructors than would otherwise have been possible. Through the following decades, the formalisation of the training of healthcare professionals in aviation medicine has benchmarked educational and professional standards in the specialty that endure to this day. **DISCUSSION:** The passing on of aerospace medicine knowledge to aviators is one link in the flight safety chain. Through the efforts of experts in the discipline, healthcare professionals can acquire the knowledge, skills, and proficiency to continue this tradition. The engagement, education, and empowerment of aviators will continue to reduce risk to life for them.

Learning Objectives

1. The audience will understand the synergy between investigators, researchers, and educators.
2. The audience with appreciate the need for educators to translate physiological concepts for aviators.

Tuesday, 06/03/2025 ***2:00 PM***
Centennial Ballroom II

[S-19] PANEL: EVALUATING THE NEUROPHYSIOLOGICAL MARKERS OF NON-STANDARD OXYGEN DELIVERY PRESSURE

Chair: Stephanie Warner

PANEL OVERVIEW: *The U.S. Navy defines a physiological event (PE) as a known or suspected aircraft malfunction and physiological symptoms experienced by aircrew. PEs have caused in-flight mishaps, aborted missions, and temporary groundings, an impetus to them becoming the number one safety priority in Naval aviation in 2018. Considerable research has evaluated the physiological impacts of the various components of the aviation life support system (ALSS) while operating both within and outside of military standards. The F/A-18 and T-45 are known to commonly provide low inlet pressure to the CRU-103 breathing regulator and have historically reported a high incidence of PEs. Currently, there is limited understanding of the neurophysiological and cerebral effects of the variable breathing dynamics presented by the ALSS. To address this, Naval Medical Research Unit Dayton (NAMRU-D) and Wright State University (WSU) executed a study to evaluate the neurophysiological markers of non-standard oxygen delivery pressure. This body of work will provide a detailed, start to finish, explanation of the magnetic resonance imaging (MRI) study executed in the Department of Defense-WSU Center of Neuroimaging and Neuro-Evaluation of Cognitive Technologies (CoNNECT) facility. The panel will contribute to an improved understanding of the complex human reaction to dynamic respiratory conditions similar to those experienced in fixed wing jets.* ***PANEL STRUCTURE:*** *The first presentation provides the study motivation through a description of the interactions of aviation life support system components and their contributions to breathing-related physiological events. The second presentation describes the MRI-compatible, simulated ALSS test configuration and the MRI-based Neurophysiological Marker research study protocol. The third presentation highlights the 3-dimensional pseudo-continuous arterial spin labeling MRI research study outcomes across our three study conditions: standard, low, and safety. The fourth presentation summarizes findings from our functional MRI scan sequences and the aeromedical implications or hyperoxia and ALSS malfunctions. The final presentation provides outcomes from our 3-dmensional amide proton transfer-weighted scan sequences and how this could further research into the neuroinflammatory effects of variable regulator inlet pressures.*

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[99] PHYSIOLOGICAL EVENTS: A MOTIVATION TO UNDERSTAND THE NEUROPHYSIOLOGICAL EFFECTS OF THE AVIATION LIFE SUPPORT SYSTEM

Jesse Leiffer, Eilis McCormick, Stephanie Warner
Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States

(Education - Program / Process Review)

BACKGROUND: In 2017, the U.S. Navy's physiological event (PE) rate peaked, with aircrew experiencing physiological symptoms corresponding with an aircraft and/or aircrew systems malfunction. PEs were linked to malfunctions in the aviation life support system (ALSS) or environmental control system (ECS). Subsequent research aimed to identify the contributing factors behind PEs, including focused investigations into the ALSS due to its vital role in protecting aircrew from altitude-related hazards in tactical jet aircraft. A key component of the ALSS is the aircrew breathing regulator, which controls the flow and delivery pressure of breathing gas. Regulator operational performance depends on the ECS, other ALSS components, and the aircrew respiratory demands. While previous research has shown how these systems interact to affect aircrew breathing and physiology, further investigation is needed to understand the neurophysiological and cerebral impacts of ALSS malfunctions. **OVERVIEW:** The CRU-103 is a chest-mounted breathing regulator used in U.S. Navy T-45 and F/A-18 jets. Unlike most U.S. Air Force regulators, the CRU-103 has a safety pressure feature that provides a small, continuous positive pressure to prevent mask leaks at high altitudes. Despite operational specifications, low regulator inlet pressure was a common issue in the T-45 due to insufficient engine bleed air supply. This required aircrew to exert greater inhalation pressure to achieve desired flow rates, which led to difficulty breathing and physiological symptoms. To explore the neurophysiological effects of low regulator inlet pressure and safety pressure, researchers conducted the MRI-based study "Neurophysiological Markers on Non-Standard Oxygen Delivery Pressure," led by the Naval Medical Research Unit Dayton and Wright State University. **DISCUSSION:** Addressing PEs associated with ALSS malfunctions is a significant Naval operational safety and aeromedical research priority. Investigating the neurophysiological effects of ALSS malfunctions and breathing gas delivery pressure is crucial for understanding and mitigating PEs. Insights gained from this research could enhance training protocols, improve ALSS functionality, and facilitate physiological monitoring development, ultimately ensuring aircrew safety and performance.

Learning Objectives

1. The audience will be able to explain how an aircrew breathing regulator functions.
2. The audience will understand the problem of low regulator inlet pressure and its known impacts to aircrew.

[100] DESIGN AND DEVELOPMENT OF THE NEUROPHYSIOLOGICAL MARKERS OF NON-STANDARD OXYGEN DELIVERY PRESSURE TESTING PROTOCOL

Stephanie Warner[1], Matthew Sherwood[2], Samantha Keller[2]
[1]*Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States;* [2]*Wright State University, Dayton, OH, United States*

(Education - Program / Process Review)

BACKGROUND: For more than a decade, tactical aviators have reported experiencing physiological symptoms resulting from aviation life support system (ALSS) malfunctions. Protection from and mitigation of these physiological events has been deemed a "super-priority" to the Aircrew Systems Enabler Naval Aviation Requirements Group. As a result, the aeromedical research community has emphasized characterizing how the ALSS contributes to variable respiratory conditions and PE symptomology. Naval Medical Research Unit Dayton (NAMRU-D), Wright State University (WSU), and the 711th Human Performance Wing collaborated to create a high-fidelity magnetic resonance imaging (MRI)-compatible simulated ALSS to mimic aviation breathing scenarios. This innovative setup enabled MRI-based evaluation of how hyperoxia, low regulator inlet pressure, increased breathing resistance, and their interactions impact aircrew physiology as well as neurophysiological and cognitive performance. **OVERVIEW:** Sixteen healthy volunteers completed three experimental sessions using a 3-Tesla MRI. The participants received 100% oxygen during the scan protocol using NAMRU-D's Hypoxia Ventilation Research Device, two MR-compatible Eaton CRU-103 breathing regulators with and without safety pressure, and a modified Gentex MBU-20/P mask. The scanning sequence was identical in each session consisting of 30 minutes of baseline, exposure, and recovery, respectively. During baseline and recovery, 25 PSI inlet pressure was provided to the standard CRU-103 with safety pressure enabled. The exposure condition settings included: 1) standard (control) – 25 PSI, standard CRU-103; 2) low – 4 PSI, standard CRU-103; 3) safety – 25 PSI, modified CRU-103. Images of amide proton transfer-weighted, functional MRI, and pseudo-continuous arterial spin labeling were acquired throughout the protocol to contrast low regulator inlet pressure and a lack of safety pressure against standard pressure conditions. **DISCUSSION:** This study utilized a precision gas delivery system and actual ALSS components to simulate the aviation environment and capture physiological and neurophysiological measures of performance with high fidelity. Outcomes from this study will help researchers to better understand the neurological response mechanisms to variable breathing dynamics, alterations to cerebral hemodynamics following tactical aviation breathing simulations, and the underpinnings of cognitive decrements reported in military aviation.

Learning Objectives

1. The audience will learn about the study protocol and testing capabilities for the Neurophysiological Markers of Non-Standard Oxygen Delivery Pressure study conducted by Naval Medical Research Unit Dayton and Wright State University.
2. The audience will be able to identify how components of the MRI-compatible simulated aviation life support system were used or modified to elicit conditions and symptomology similar to those experienced in tactical flight.

[101] UNDERSTANDING THE NEUROPHYSIOLOGICAL EFFECTS OF NON-STANDARD OXYGEN DELIVERY PRESSURE USING 3-DIMENSIONAL PSEUDO-CONTINUOUS ARTERIAL SPIN LABELING

Matthew Sherwood[1], Julia Milo[2], Samantha Keller[2], Kelsie Pyle[1], Stephanie Warner[2]
[1]*Wright State University, Dayton, OH, United States;* [2]*Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States*

(Original Research)

INTRODUCTION: Variable inlet pressure to the aircrew breathing regulator is thought to cause changes in breathing dynamics, leading to complex alterations in cortical metabolism which may disrupt aircrew flight performance. These alterations may be quantified through the measurement of cerebral perfusion using 3-dimensional pseudo-continuous arterial spin labeling (pcASL) in magnetic resonance imaging (MRI). This scanning sequence produces a quantitative map of cerebral blood perfusion (CBF) by using inflowing arterial blood as an endogenous contrast agent. Measuring CBF during non-standard oxygen delivery pressure conditions may improve our understanding of breathing dynamics that occur during tactical flight. **METHODS:** 16 participants completed three experimental sessions using a 3-Tesla MRI. All participants received 100% oxygen during each 90-minute scan procedure using an MRI-compatible, simulated aviation life support system. Each session had three 30-minute conditions: baseline, exposure, and recovery, with the pressure settings only altered during exposure. The condition settings included: 1) standard (control) – 25 PSI, standard CRU-103; 2) low – 4 PSI, standard CRU-103; 3) safety – 25 PSI, modified CRU-103. Ten total pcASL measurements were taken across the scan protocol, each lasting for approximately two minutes. Changes in CBF

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were evaluated using region of interest (ROI)-based and voxelwise analyses. **RESULTS:** In both ROI and voxelwise analysis, the standard condition displayed no significant changes in CBF throughout scanning sequences. ROI analyses showed CBF decreased from baseline to exposure for the safety and low conditions, followed by an increase back to near-baseline levels during recovery. However, the voxelwise analysis revealed global decreases in the low and safety conditions from baseline to exposure, with safety having a more significant change in magnitude and volume of the decreases. Additionally, the safety condition saw significant increases in frontal and occipital lobes from exposure to recovery, while no changes were observed in the low condition. **DISCUSSION:** The global decreases in CBF observed during the safety condition may indicate that a 30-minute exposure to a regulator without safety pressure disrupts cerebral metabolism similarly to low inlet pressure. Alterations in metabolism may disrupt normal functional processes already strained by the intense demand of flight operations leading to diminished performance.

Learning Objectives

1. The audience will learn about 3-dimensional pseudo-continuous arterial spin labeling (pcASL) as a method to measure changes in cerebral blood perfusion (CBF).
2. The audience will understand how exposure to varying inlet pressure conditions can impact CBF and recognize possible ramifications if these inlet pressure conditions occur in flight.

[102] INVESTIGATING THE NEUROPHYSIOLOGICAL EFFECTS OF NON-STANDARD OXYGEN DELIVERY PRESSURE USING FUNCTIONAL MAGNETIC RESONANCE IMAGING

Julia Milo[1], Stephanie Warner[1], Kelsie Pyle[2], Samantha Keller[1], Matthew Sherwood[2]

[1]*Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States;* [2]*Wright State University, Dayton, OH, United States*

(Original Research)

INTRODUCTION: Investigating the neurophysiological effects of aviation life support system (ALSS) malfunctions may improve our understanding of breathing-related physiologic events (PEs). Throughout flight, variable breathing gas delivery pressure may cause complex alterations to cerebral hemodynamics, potentially contributing to disruptions in aircrew cognitive performance. To better understand these impacts, we leveraged functional magnetic resonance imaging (fMRI) to examine effects of regulator inlet pressure changes. **METHODS:** 16 healthy participants completed three experimental sessions in a 3-Tesla MRI. Participants breathed 100% oxygen through each scan and followed the Neurophysiological Marker research protocol settings across baseline, exposure (standard, low, safety), and recovery. We acquired fMRI during an auditory Stroop task manipulating the congruency of words and the spoken pitch. We acquired one fMRI during baseline and recovery, and two during exposure. Data from each sequence were processed to produce maps of significantly altered blood oxygen between congruent and incongruent blocks. Group analyses were performed to compare these maps between the three exposure conditions. **RESULTS:** Group average maps comparing incongruent to congruent blocks revealed expected patterns of activation from the task, including: the left dorsolateral prefrontal cortex, superior frontal gyrus (SFG), insula, and the superior parietal lobule. In the standard group, we saw a significant increase in activation in the SFG and right insula from baseline to exposure. In contrast, the safety group indicated a decrease in activation in the SFG from baseline to exposure. No changes were observed in the low group. **DISCUSSION:** Increased activation magnitude following 60-minutes of hyperoxia observed in the standard group indicates increased blood oxygenation in the right insula and SFG. Blood oxygenation might increase for several reasons including a learning effect, increased metabolism, or a neuroinflammatory response. Our observations of the safety group reveal a different response: decreased blood oxygenation in the SFG. This suggests the use of safety pressure in ALSS may augment cognitive function, cerebral metabolism, or hyperoxia's neuroinflammatory effects. These findings indicate functional task-relevant processes are disrupted when alterations in ALSS breathing gas delivery pressure occur.

Learning Objectives

1. The audience will learn about functional magnetic resonance imaging (fMRI) and how it can be used to measure patterns of cerebral activation from task completion. d oxygenation.
2. The audience will be able to identify trends in activation across variable inlet pressure conditions.

[103] QUANTIFYING THE NEUROPHYSIOLOGICAL EFFECTS OF NON-STANDARD OXYGEN DELIVERY PRESSURE USING A 3-DIMENSIONAL AIMDE PROTON TRANSFER-WEIGHTED SCAN SEQUENCE

Kelsie Pyle[1], Stephanie Warner[2], Julia Milo[2], Samantha Keller[2], Matthew Sherwood[1], Madison Larsen[2]

[1]*Wright State University, Dayton, OH, United States;* [2]*Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States*

(Original Research)

INTRODUCTION: Researching variable breathing dynamics experienced in tactical aviation is essential for understanding and mitigating physiological events (PEs). To evaluate the neurophysiological effects of PEs, 3-dimensional amide proton transfer-weighted (APTw) magnetic resonance imaging (MRI) can detect a signal sensitive to cerebral tissue pH and neuroinflammation. This imaging sequence allows for investigation of novel neurophysiological changes following non-standard oxygen delivery pressure from the aviation life support system (ALSS). **METHODS:** 16 healthy volunteers completed three experimental sessions using a 3-Tesla MRI. The participants received 100% oxygen during the 90-minute scan protocol using an MRI-compatible simulated ALSS. The scan protocol included 30 minutes each of baseline, exposure, and recovery, with the pressure modified only during exposure. The condition settings included: 1) standard (control) – 25 PSI, standard CRU-103; 2) low – 4 PSI, standard CRU-103; 3) safety – 25 PSI, modified CRU-103. We acquired APTw images once during baseline and recovery, with each sequence lasting 10 minutes. On an individual level, we evaluated maps of the asymmetry in magnetization transfer (%) to determine changes from baseline to recovery in voxelwise analyses. **RESULTS:** Across all exposure conditions, we observed similar increases in the APTw signal saturation within the left fusiform gyrus and bilaterally in the superior parietal lobe. However, the magnitude and volume of the APTw signal saturation increases were lower in the standard condition compared to the safety condition. Both the low and safety conditions exhibited decreased APTw signal, particularly in the bilateral amygdala and the right entorhinal cortex. **DISCUSSION:** Increases in APTw observed across all conditions indicates effects of prolonged hyperoxic exposure. However, the significant increase in APTw during the safety condition, particularly in areas associated with attention and executive function, indicates additional accumulations of abnormal proteins when safety pressure is not provided. Additionally, decreases in APTw signal may arise from an increase in semi-solid macromolecular content or altered pH which may indicate differential neuroinflammatory response mechanisms. These findings demonstrate a differential response to variable ALSS delivery pressures, which could alter cognitive function and warrants further investigation into the overall impact to aircrew safety.

Learning Objectives

1. The audience will learn about 3-dimensional amide proton transfer-weighted (3D APTw) magnetic resonance imaging (MRI) and understand how it can be used to evaluate cerebral tissue pH and neuroinflammation.
2. The audience will be able to identify how trends in the APTw signal change in relation to varying inlet pressures.

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Tuesday, 06/03/2025 ***2:00 PM***
Centennial Ballroom III

[S-20] PANEL: IMPACT OF SPACEFLIGHT ON THE BRAIN – A DECADE OF MRI IMAGING. LITTLE DID WE KNOW.

Chair: Floris Wuyts
Co-Chair: Donna Roberts

Panel Overview: BACKGROUND: *The impact of spaceflight studied on the human brain using MRI methods has only been tackled in the past decade, revealing unexpected findings like an upward brain shift, increased ventricular volumes, altered CSF redistribution patterns, increased perivascular changes, white matter increase, vestibular as well as cognitive effects related to functional connectivity changes and so on. Several of these effects were still observed a half to a full year after return to Earth.* ***PANEL:*** *The panel consists of the pioneers of this topic. Dr Roberts from the ISS National Laboratories was the first to show the upward brainshift in astronauts returning from space (New England Journal of Medicine, 2017). Prof Petersen, Associate Professor of Aeronautics and Astronautics at MIT has an extensive knowlegde on Low Body Negative Pressure countermeasures, instrumental to preserve health in space, particularly related to the brain. Prof Peter Zu Eulenburg from Ludwig-Maximilians University in Munich, Germany has identified the vestibular cortext in humans, and participates in several advisory groups for ESA and NASA. His knowledge is essential for a profound understanding of the effect of spaceflight on the human brain, and he is a core researcher in the BRAIN-DTI project. Prof Floris Wuyts is Principal Investigator of the ESA BRAIN-DTI project which was the first prospective study to investigate the impact of spaceflight on the human brain. The BRAIN-DTI team has up to date gathered MRI data of 28 space crew before and after spaceflight, yielding a unique source of information. During this panel, recent findings of the impact of spaceflight on the human brain will be presented in a global overview, and the impact of countermeasures will be discussed, as well as future steps. Particularly will SANS be addressed.* ***RELEVANCE:*** *NASA and ESA identified spaceflight associated neuro-ocular syndrome (SANS) as a major hazard for future spaceflight missions because of its impact on the performance as well as astronauts health. SANS is inevitably related to the above mentioned changes on the brain and an epiphenomena of the impact of prolonged microgravity on the brain. Without proper mitigation of SANS by appropriate countermeasures, the performance during future missions, in particular to Moon and Mars are heavily jeopardized. Advanced MRI analysis tools needed for returning astronauts are of great benefit to study patient populations with brain pathology on earth.*

[104] SPACEFLIGHT ALTERED OTOLITH MEDIATED GRAVITY DETECTION CAN BE EXPLAINED BY MRI FUNCTIONAL CONNECTIVITY CHANGES

Floris Wuyts[1], Catho Schoenmaekers[1], Steven Jillings[1], Elena Tomilovskaya[2], Peter Zu Eulenburg[3], Angelique Van Ombergen[4]
[1]*University of Antwerp, Wilrijk, Antwerp, Belgium;* [2]*Russian Academy of Sciences, Moscow, Russian Federation;* [3]*Ludwig Maximilians University Munich, Munich, Germany;* [4]*ESA, Koln, Germany*

(Original Research)

INTRODUCTION: Spaceflight impacts the vestibular system of astronauts. Our research team has previously investigated the otolith-mediated ocular counter-roll (OCR) where we found a difference in eye torsion pre- to postflight, which was moreover governed by flight experience. The more space crew had travelled to space, the better was their gravity detection, resulting in a 'closer to normal' OCR post flight. Additionally, resting-state functional magnetic resonance imaging (rsfMRI) analysis in a largely overlapping cosmonaut cohort has revealed functional connectivity (FC) changes after spaceflight. Up to date, no relationship was investigated between vestibular outcome measures for gravity detection and MRI functional connectivity. **METHODS:** Fourteen cosmonauts (mission duration: 187±51 days) underwent pre- and post-spaceflight brain MRI scans (pre: 89±199 days; post: 9±3 days). The OCR was evaluated 154±109 days pre-launch and 3±1 days post-landing. Resting-state fMRI scans were acquired to evaluate the brain's functional architecture by examining spontaneous low-frequency fluctuations in the BOLD signal. FC was derived using a cortical vestibular atlas-based region-of-interest (ROI) approach. Vestibular function was measured using the OCR generated by off-axis centrifugation. Correlation between pre- to post-flight seed-based-connectivity and OCR differences was examined ($p<0.001$ uncorrected, cluster-level $p<0.05$ corrected with FDR). **RESULTS:** Our results show that the FC changes between the vestibular seed region Area 3aV l and a cluster (+22 -16 +70) covering the precentral gyrus, postcentral gyrus, superior parietal lobule and precuneus cortex, correlate with a decrease of the OCR pre- to postflight ($p(FDR)<0.0001$). **DISCUSSION:** These cluster regions are responsible for proprioception, control of volitional movements, visuospatial coordination and perception. The data show also a relationship between functional connectivity in Area 3aV 1 and OCR changes after long-duration spaceflight. This correlation explains partially why experienced space crew detect better gravity than first time flyers. This research stresses the importance of recruiting very experienced space crew to explore Moon and Mars, given their better and faster detection of the reduced gravity levels, necessary for appropriate performance and well-being. **LEARNING OBJECTIVE:** To understand that a relationship exists between vestibular function and specific functional connectivity alterations in the brain, based on rsfMRI.

Learning Objectives

1. The participants will understand that spaceflight decreases the otolith mediated ocular counter roll.
2. The participants will understand that previous spaceflight experience improves the robustness for gravity detection after spaceflight.
3. The audience understands the correlation between ocular counter roll changes and functional changes in the brain.

[105] PHYSIOLOGICAL LINK BETWEEN BRAIN AND EYE ACCOUNTS FOR THE CONCURRENT REMODELING OF BOTH STRUCTURES IN LONG-DURATION SPACEFLIGHT

Peter Zu Eulenburg[1], Ge Tang[1], Steven Jillings[2], Elena Tomilovskaya[3], Angelique Van Ombergen[4]
[1]*Ludwig Maximilians University, Munich, Munich, Germany;* [2]*University of Antwerp, WIlrijk, Belgium;* [3]*Russian Academy of Sciences, Moscow, Russian Federation;* [4]*ESA, Koln, Germany*

(Original Research)

INTRODUCTION: During long-duration spaceflight (LDSF), spacefarers experience diminished near-distance visual acuity whilst developing several ocular and retroorbital changes. This syndrome has been termed spaceflight-associated neuro-ocular syndrome (SANS). Together with radiation it is considered one of top health risks on the road to Mars. At the same time, the human brain in LDSF seems to respond with an intracranial fluid accumulation at the cost of grey matter volume. A physiological link between the brain-structural alterations and the changes of and behind the eye has never been substantiated. We therefore aimed to develop an automatic ocular and retroorbital morphometrics pipeline to investigate the potential relation with intracranial cerebrospinal fluid (CSF) compartment size in humans in general and in LDSF astronauts and cosmonauts in particular. **METHODS:** T1 images from a 3T MRI scanner of 13 cosmonauts prior and after their LDSF and 15 controls with similar times in between were investigated. **RESULTS:** Our findings directly reveal a profound association of intracranial CSF volumes and ocular as well as retroorbital parameters for normal subjects and LDSF spacefarers alike. There was a significant correlation observed between the extent of expansion for the third ventricle and the degree of reduction in the volume of the eyeball, as well as the degree of forward ocular displacement and shortening of the eyeball's axial length after LDSF. The optic nerve sheath volume increased by ~0.01cm3 postflight in the right eye and ~0.03 cm3 in the left eye. The right

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optic nerve lengthened by ~0.38mm postflight, and the left optic nerve by ~0.47mm. **DISCUSSION:** Surprisingly, we also discovered several substantial structural differences between the left and right eye for humans in general. These might play a role in the manifestation laterality of slow and marginally increased intracranial pressure phenomena in neurology and LDSF. The data significantly support our hypothesis that the changes observed in the brain and eye after LDSF are driven by the same circulatory mechanism.

Learning Objectives

1. The participants understands that spaceflight yields deformation of the eye ball of space crew related to intracranial alterations.
2. The participants understands that the eye ball deformation is related to SANS, and connected to fluid redistribution as well as ventricular volume changes.

[106] VOLUMETRIC ANALYSIS OF THE PRE- AND POST-FLIGHT BRAIN MRI SCANS OF SHORT- AND LONG-DURATION ASTRONAUTS

Donna Roberts
International Space Station National Laboratory, Washington, DC, United States

(Original Research)

INTRODUCTION: Little is known concerning the adaptation of the human central nervous system to the spaceflight environment. Recently, there have been reports of astronauts returning from long-term missions aboard the International Space Station (ISS) with visual changes and some astronauts with increased intracranial pressure at lumbar puncture known as spaceflight associated neuro-ocular syndrome (SANS). We reviewed the pre- and post-flight brain MRI scans of US Space Shuttle, ISS astronauts and commercial astronauts participating on the Polaris Dawn Mission to: (1) assess the impact of short- and long-duration spaceflight on the human brain and cerebrospinal fluid (CSF) spaces and (2) provide insight into the etiology of SANS. **METHODS:** Analysis was performed using the open access FMRIB Software Library program (http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/), MATLAB, Paraview, ITK-SNAP, and IBM SPSS. The analysis was realized through: 1. brain extraction (by nonlinear MNI mapping), 2. segmentation (FSL-FAST) into partial volume estimate (PVE) images, and 3. volumetric change calculation. To accurately study the effects of spaceflight, the volumes of ventricles and the brain were computed based on PVE images and within the original subject space associated with the highest resolution. **RESULTS:** There was a significant enlargement of the ventricles post-flight compared to the pre-flight values (+14% increase post-flight, p=0.001). No significant change was seen between pre- and post-flight brains in the volume of grey matter or white matter for either the Shuttle or ISS astronauts. There was a significant association between flight duration and the % increase in ventricular volume post-flight, $p < .001$, 2-tailed. **CONCLUSIONS:** Long-term microgravity exposure during spaceflight causes significant enlargement of the ventricles representing an alteration in CSF homeostasis. This may play a role in the development of SANS through the redistribution of CSF flow and pressure intracranially. Further research is needed to determine the etiology of the ventricular enlargement. This study has important implications for designers planning a human mission to Mars.

Learning Objectives

1. The audience understands that spaceflight as an impact on the ventricular volumes in space crew, and that the duration of the flight has a significant effect.
2. The audience understands that no gray matter changes were observed in space crew after short or long duration flight.

[107] LOWER BODY NEGATIVE PRESSURE COUNTERMEASURE FOR SANS DURING SPACEFLIGHT AND EXTRAPLANETARY MISSIONS

Lonnie Petersen, Daniela Davalos, Fabian Moller, Johan Petersen
MIT, Boston, MA, United States

(Original Research)

INTRODUCTION: Human spaceflight risks include cranial fluid shift and loss of diurnal variation in pressure and fluid filling of the brain associated with posture change on Earth. Astronauts cannot "stand up" in space, the resultant lack of periodic pressure and volume unloading of cerebral structures is hypothesized to cause a low and slow, but consistent overload of brain and eyes which contributes to the constellation of findings in spaceflight associated neuroocular syndrome (SANS). It is unknow if the partial gravity of the Moon and Mars is sufficient to prevent SANS entirely or keep symptoms to pre-clinical levels. Lower-body negative pressure (LBNP) as a promising integrative countermeasure which simulates effects of gravity by displacing fluid caudally. Our team and others have demonstrated amelioration of early signs of SANS by using LBNP in bed-rests studies. More importantly, by translating the LBNP into a wearable and mobile device (the Gravity Suit) we have demonstrated it's feasibility for implementation in space and potentially during surface exploration missions to the Moon or Mars to augment the partial-G and provide a countermeasure or a treatment for SANS. **METHODS AND RESULTS:** Here we summarize current status of countermeasure development and present first ever proof of concept experimental testing of 20 mmHg LBNP during 0, Moon, and Mars-G induced by parabolic flight as well as ground-based simulation trials using incremental tilt angles of -6°, 9.5°, and 22.3°, as simulation of weightlessness, Moon and Martian-G. Applying LBNP in-flight generated ground-reaction forces and mechanical loading corresponding one full body weight and a concomitant caudal fluid shift which decreased stroke volume and increased heart rate to overall maintain cardiac output and mean arterial blood pressure. **DISCUSSION:** Wearable LBNP is feasible and well-tolerated during weightlessness and partial- G induced parabolic-flight or simulated by whole body tilt. LBNP applied in weightlessness simulated effects of upright standing on Earth as evaluated by ground reaction forces and cardiovascular changes. Moreover, LBNP including a subjective "sense of gravity" similar to upright standing in 1G. The flexible LBNP-design seems a promising potential and can be applied both in weightlessness and partial gravity conditions for exploration class missions.

Learning Objectives

1. The audience will learn about the fact that SANS remains a significant risk during long-duration spaceflight including missions to Moon and Mars.
2. The audience will learn that it is unknown if the partial G of Moon and Mars is sufficient to prevent SANS. Hence LBNP could be a promising countermeasure for both classes of mission.

Tuesday, 06/03/2025 ***2:00 PM***
Centennial Ballroom IV

[S-21] PANEL: UPDATE: ADVANCED DISEASE DEFENSE AND UV-C DISINFECTION IN AVIATION

Chair: Charles DeJohn
Co-Chair: Kris Belland

Panel Overview: *Advancing the Aviation Multi-Layered Disease Defense Strategy (AMLDDS): Integrating UV-C Disinfection for Enhanced Disease Prevention. This presentation builds upon the AMLDDS by examining UV-C disinfection as a crucial component in strengthening disease prevention strategies onboard aircraft. Leveraging recent findings from systematic reviews and industry safety research, we will highlight UV-C's effectiveness within safe exposure guidelines, demonstrating its role in a layered pandemic response alongside established measures, such as HEPA filtration, optimized ventilation, and both manual and robotic disinfection. Through data from the International Civil Aviation Organization (ICAO) and Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation (CAPSCA), this session illustrates UV-C's practical application and efficacy in reducing airborne disease transmission risk. Insights from diverse applications, engineering controls, and safety compliance measures*

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underscore UV-C's ability to contribute significantly to multi-layered airborne pathogen control strategies in aviation, enhancing overall passenger safety and health resilience.

[108] COMPARING METHODS OF AIRCRAFT DISINFECTION REDUCE AIRBORNE INFECTIOUS DISEASE TRANSMISSION

Charles DeJohn[1], Kris Belland[2]
[1]*None, Oklahoma City, OK, United States;* [2]*None, Keller, TX, United States*

(Education - Tutorial / Review)

INTRODUCTION: While the transmission of infectious diseases within aircraft cabins is generally low, instances of passengers infecting fellow travelers on commercial flights have been documented, and a 2023 study found strong evidence of in-flight transmission. **TOPIC:** Aircraft disinfection has traditionally relied on episodic manual cleaning using chemicals, robotic cleaning using ultraviolet light, and continuous inflight cleaning using HEPA filters. However, manual and robotic methods risk recontamination if an infected passenger boards after cleaning, while HEPA filters only capture pathogens that pass through them. A new, promising approach is the addition of ultraviolet-C (UV-C) technology to traditional methods, using wavelengths between 100– 280 nm, which effectively inactivates pathogens by damaging their deoxyribonucleic acid (DNA). This technology has the potential to significantly mitigate the risk of disease transmission when proper optical engineering controls are in place. Optical engineering systems include multiple redundancies to provide reliable emitter processing integrity, such as ultrasound and infrared ranging. Because UV-C light could potentially be used continuously in flight, it is effective at decontaminating the cabin if a contaminated passenger were to board the aircraft following episodic manual or robotic disinfection. **APPLICATION:** To safeguard passengers, it is vital to ensure UV-C exposure remains within safe limits as defined by industry-standard exposure limits (ELs). The International Electrotechnical Commission defines an acceptable EL of 30 J/m2 in any 8-h period. The development of engineering controls, made feasible through advancements in UV-C LED technology, are essential to maintaining UV light levels well below the recommended ELs in occupied spaces. By adhering to these ELs and implementing appropriate engineering measures, any risk of harm to the aircraft occupants can be effectively minimized while reducing the risk of airborne transmission within the aircraft cabin during flight.

Learning Objectives

1. Understand extent transmission of infectious diseases within aircraft cabins.
2. Understand the different methods to disinfect commercial aircraft.
3. Understand the safety issues associated involved in the use of UV-C light in disinfection of aircraft.

[109] INTEGRATING UV-C DISINFECTION IN MULTI-LAYERED DEFENSE FOR AVIATION SAFETY

Kris Belland[1], Charles DeJohn[2]
[1]*None, Keller, TX, United States;* [2]*None, Oklahoma City, OK, United States*

(Education - Tutorial / Review)

Building on the Aviation Multi-Layered Disease Defense Strategy (AMLDDS), this presentation explores UV-C disinfection's role in enhancing disease prevention aboard aircraft. Using recent insights from systematic reviews and safety research, the discussion highlights UV-C disinfection within safe exposure guidelines, showcasing its role in a comprehensive pandemic response alongside multi-layered risk reduction including robotic, manual, ventilation and HEPA filtration. Data from the International Civil Aviation Organization (ICAO) and Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation (CAPSCA) will illustrate UV-C's efficacy as a vital layer in airborne disease control strategies in aviation.

Learning Objectives

1. Understanding the risk mitigation layers (James Reason Swiss Cheese Theory) as it applies to inflight reduction of disease transmission and translocation.
2. Become familiar with updated information contained in research, papers and Aerospace Medical Association (AsMA) resolution on utilization of UV-C inflight as a risk mitigation layer.
3. Understand the international aerospace medicine community and how it works together (AsMA, ICAO, CAPSCA, WHO) to reduce disease transmission and translocation.

[110] WITHDRAWN

[111] WITHDRAWN

[112] ADVANCES IN UV-C TECHNOLOGY: IMPLEMENTING UV-C DISINFECTION WITHIN EXPOSURE LIMITS

Diego Garcia[1], Charles DeJohn[2]
[1]*Embry-Riddle Aeronautical University, Daytona Beach, FL, United States;* [2]*None, Oklahoma City, OK, United States*

(Education - Tutorial / Review)

BACKGROUND: The COVID-19 pandemic highlighted the critical importance of indoor air quality and accelerated advancements in air disinfection strategies for populated spaces. Ultraviolet C (UV-C) radiation, with a long-standing history in high-level disinfection, is now increasingly applied in occupied settings—such as schools, hospitals, restaurants, and dental offices—thanks to new safety measures that allow safe exposure levels. This update examines the latest science, regulatory guidelines, and practical applications of UV-C technology for air and surface disinfection, with a focus on scalable applications successful in numerous settings and contexts **OVERVIEW:** Direct UV-C irradiation, historically restricted to unoccupied spaces, has evolved with innovations that allow safe, continuous exposure below harmful thresholds, effectively reducing airborne and surface pathogens in populated areas. This discussion reviews technological advances in UV-C applications, including the use of varied wavelengths, autonomous systems, and sensors that maintain direct irradiation within safety limits. Emphasis will be placed on UV-C's proven germicidal effects on airborne and surface pathogens, installation and operational considerations for limiting irradiation exposure, and UV-C's role as part of multi-layered infection control strategies. **DISCUSSION:** Implementing UV-C disinfection within safety exposure limits can substantially reduce transmission and translocation risks in densely populated areas within air transport systems, such as boarding lounges, customs areas, and aircraft interiors. This scalable approach, integrating UV-C with HVAC systems and automation, offers a transformative solution for enhancing indoor air quality and mitigating infection risk. This session will provide attendees with a cross-industry perspective about successful cases of optimizing UV-C technology use to bolster infection control, increase traveler confidence, and address emerging health threats in air transport environments.

Learning Objectives

1. Identify the latest advancements in UV-C disinfection technology, including wavelength variations, automated systems, and safety sensors, to ensure effective pathogen reduction in populated indoor environments.
2. Describe how UV-C technology can be integrated into HVAC systems and applied within safety limits as part of a multi-layered infection control strategy, specifically in high-density areas like airports and aircraft.
3. Understand primary benefit of using UV-C technology in populated spaces.

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Tuesday, 06/03/2025 ***2:00 PM***
Regency V

[S-63] PANEL: PEER SUPPORT AND MENTAL HEALTH IN CIVIL AVIATION ACROSS THE GLOBE

Chair: William Hoffman
Co-Chair: Quay Snyder

Panel Overview: BACKGROUND: *Mental health in global commercial aviation faces a period of major change, fueled by efforts around the world including the 2024 FAA Aviation Rulemaking Committee on Mental Health, the EASA Mental Health for Aviation Safety (MESAFE) effort, the ICAO Working Paper 256 on Medical Certification and Mental Illness. Aviation peer support programs – where volunteers of the same aviation professions provide emotional support to personnel requesting services – have been forwarded as a novel solution to existing challenges related to mental health in commercial aviation on a global scale. That said, many open questions exist including the optimal scope of peer support practice, its role in aeromedical certification and the need for future research.* ***OVERVIEW:*** *The current panel is a focused update on clinical, regulatory, and research considerations related to peer support and mental health in global commercial aviation. The first presentation will discuss the ethical considerations of research in peer support followed a presentation discussing healthcare seeking behavior in a population of pilots from New Zealand. The third presentation will summarize available epidemiological data related to peer support in a European cohort followed by a presentation about a novel peer support approach in Australian and New Zealand. The final presentation will discuss regulatory considerations related to mental health and peer support in commercial aviation.* ***DISCUSSION:*** *Despite its relatively recent addition to aerospace medicine, peer support is anticipated to serve an increasingly critical role in the aerospace system of the future. The current panel aims to provide a multi-dimensional update on this important practice in civil aviation on a global scale.*

[349] PROPOSED ETHICAL APPROACH FOR RESEARCH IN PEER SUPPORT PROGRAMS

Diederik de Rooy
Transparant Leiden, Leiden, Zuid-Holland, Netherlands

(Education - Program / Process Review)

BACKGROUND: Up to this date, scientific research into Peer Support Programs (PSP's) in civil aviation has been relatively limited. As they deal with medical problems, it seems logical though that PSPs are studied by medical-scientific methods to improve them. That said, no ethical framework exists to guide such work in this field that poses different risks to various stakeholders. **OVERVIEW:** For medical-scientific studies, obtaining data generally is a prerequisite. At first instance however, the collection of data seems at odds with the confidential nature of PSPs. Therefore, a balance has to be found between collecting sufficient data to come to reliable research outcomes on the one side, and safeguarding the privacy of those involved and the confidentiality of the information they share on the other. PSPs have to take into account not only safety, but also the wellbeing of the persons involved. The underlying values, that cannot be assessed in a quantitative way or be prioritized in an absolute way, can only be balanced by making an ethical consideration. In the end, an ethically sound research framework for PSPs will need to make a thoughtful balance between autonomy and safety. In this framework, we propose criteria to conduct research in PSP aiming to maximize benefits and minimizing harms to all parties. **DISCUSSION:** To our knowledge, this is the effort to inform research on PSPs in civil aviation, a topic of growing importance and interest. In this presentation, values with regards to research into PSPs and some practical criteria to balance them are discussed. These values may be used to inform research, regulatory, and communications efforts related to this topic.

Learning Objectives
1. The participant will define possible advantages of performing research into peer support programs by medical-scientific methods.
2. The participant will define possible ethical and practical challenges in relation to studying peer support programs, as well as the major ethical values at stake.

[350] PILOT PEER SUPPORT: EXPERIENCE FROM A MULTINATIONAL EUROPEAN PROGAM

Aedrian Bekker
The Centre for Aviation Psychology, Rugeley, Staffordshire, United Kingdom

(Education - Program / Process Review)

BACKGROUND: Peer Support within the aviation sector is an increasingly prominent mental health intervention for those seeking to support aviator mental health. With regulators around the world either mandating or strongly recommending it, a diverse range of peer support programmes are emerging to suit the cultures (and budgets) of the operators deploying them. As these programmes become embedded as a unique resource, they have the potential of generating valuable experience. Used judiciously, these experiences promise to aid our understanding of, and provide for, improved aviator mental health. **OVERVIEW:** As welcome as the enthusiasm for peer support is, and perhaps typical of a new and rapidly developing field, there is little published related to operational experience and application of this tool in civil aviation. This presentation seeks to address this gap. Through the preliminary experience of 850+ peer support cases across multiple operators, the following questions will be addressed by the clinical leaders of a large European peer support program: 1) What are the issues prompting pilots to use this service from the perspective of program administrators? 2) How debilitating are these issues? 3) What are the characteristics of cases requiring referral to professional services? 5) What are the outcomes of these cases? **DISCUSSION:** The implications and sensitivities of these findings will be discussed from the perspectives of those who provide these programmes as well as those of key stakeholders (e.g. operators, unions, healthcare professionals, regulators, researchers) who engage with them. Developing meaningful evidence will better inform our collective understanding of this field and direct our energies, resources and future research efforts accordingly.

Learning Objectives
1. The participant will describe experience providing peer support services on a multinational setting.
2. The learning will describe common uses of peer support services in civil aviation.

[351] ADDRESSING BARRIERS TO MENTAL HEALTH IN AVIATION: SAFE HAVEN

Tim Sprott[1], Kate Manderson[2]
[1]*Civil Aviation Authority New Zealand, Auckland, New Zealand;* [2]*CASA Australia, Canberra, Australia*

(Education - Program / Process Review)

BACKGROUND: Efforts around the world are working to address healthcare avoidance in aviation personnel in hopes of optimizing mental health, wellness and aviation safety. This presentation focuses on the design and implementation of a novel regulatory program in Australia and New Zealand aiming to meet these objectives. **OVERVIEW:** Safe Haven is a novel program being implemented in Australia and New Zealand. This program is a high trust model aimed specifically at addressing the known reluctance of pilots to report medical problems, and the even greater problem of healthcare avoidance by aviators. Two regulators, CASA and CAA New Zealand, have selected, trained, and have empowered some of their Aviation Medical Examiners (AMEs), known as MESHs, to work with certificate holders (air traffic controllers and pilots) with self-reported health problems. Safe Haven Australia has a focus on mental health

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concerns, while in New Zealand Safe Haven in New Zealand will cover any health concerns. This will be undertaken without the usual requirement for the details of those problems to be notified to the regulators within specified criteria. Safe Haven is a medically based program which is separate from peer support groups but sits alongside them with similar aims. Safe Haven in many ways formalises the approach of many AMEs have been undertaking successfully for many years. Safe Haven's design is based on sound risked based regulatory and safety management principles, escalation protocols, professional supervision of MESHs, governance, and regulatory oversight, alongside a degree of independence from the regulators. This will be a co-presentation by the regulators of both jurisdictions.

Learning Objectives

1. The participant will describe the organization and objectives of the Safe Have program in New Zealand and Australia.
2. The participant will describe how the Safe Haven program fits into a regulatory framework.

[352] MENTAL HEALTH AND THE AVIATION REGULATOR

Johann Magnusson
European Association for Aviation Psychology, Reykjavik, Iceland

(Education - Program / Process Review)

BACKGROUND: Aviation is embedded in a complex system of international and domestic regulatory agencies. In that system, mental health is not a new phenomenon and is accounted for in a number of places within International Civil Aviation Organization (ICAO) annexes, documents and guidance materials, as well as other civil aviation agencies, such as the European Union Aviation Safety Authority (EASA), Federal Aviation Administration (FAA) or Australian Civil Safety Aviation Authority (CASA). **OVERVIEW:** This presentation aims to give an overview of the history of mental health in the aviation regulatory system, where specific requirements or recommendations on aviation mental health can be found and specific examples that may be of use and interest to practitioners. The presentation will list available guidance material from ICAO, EASA, FAA, CASA and others and give helpful advice on how to navigate the regulatory environment. Significant regulatory materials from outside of aviation will also be covered to some extent. **DISCUSSION:** Participants will discuss various regulatory aspects that are connected to mental health and can compare and contrast approaches between major regulatory bodies. While presentations from the regulator are usually focused on one agency, this presentation will aim to give a cohesive, global view on how the topic of aviation mental health connects to aviation rules and regulations.

Learning Objectives

1. Understand the different responsibilities of International Civil Aviation Organization (ICAO) versus European Union Aviation Safety Authority (EASA), Federal Aviation Administration (FAA) or Australian Civil Safety Aviation Authority (CASA).
2. Describe select mental health-related requirements and recommendations as defined by ICAO.
3. Describe the overlap of mental health requirements in human factors, aviation medicine, fatigue and stress management, and training.

[353] HEALTHCARE AVOIDANCE BEHAVIOUR IN NEW ZEALAND AVIATION PERSONNEL

Herwin Bongers
Air New Zealand, Auckland, New Zealand

(Original Research)

INTRODUCTION: Previous studies have shown that the issue of healthcare avoidance in aviation personnel is of significance in North American (NA) pilots. This study has endeavoured to discover if the issue exists in New Zealand (NZ) and in an extension to the original study, introduces the cohort of Air Traffic Controllers (ATCO) into the study population. Additionally, the impact of life stress influences were sought to determine if any correlation exists such that more targeted peer support methodologies could possibly be derived. **METHODS:** We conducted a cross-sectional survey study. Study questions of the four primary elements to replicate the NA study were asked with the addition of a specific binary yes/no mental health avoidance element. Extension of study knowledge was sought through the collection of Holmes/Rahe life stress scale (HRSS) scored data to correlate against the healthcare avoidance behaviours. **RESULTS:** 450 subjects visited the survey URL of which 371 completing enough of the demographic and primary questions for analysis. This equates to 5% of the whole population. Study results found the prevalence of healthcare avoidance has an occurrence rate in the study sample of 75%. The ATCO population was of a greater prevalence at 80%. Demographic returns between the sexes gave a similar return for the four basic avoidance questions. Specific to the mental health avoidance question however, the males returned 20% greater yes responses than the females. The mean HRSS for the study population was 182, falling in the range of 150 to 300 pts which indicates approximately a 50% chance of major health breakdown in the next two years. **DISCUSSION:** We found that HA may be higher in this population than other populations, which may warrant study. The ATCO population that answered the study questions responded with a higher avoidance rate than the study pilots. The correlation of HRRS returns as they apply to demographics and roles indicates a sizeable predictive health breakdown effect. As a non-probabilistic sampling methodology, it remains important to highlight the limitations to self-reporting surveys include response bias and recall bias, along with the limitations of convenience sampling.

Learning Objectives

1. The participant will define healthcare avoidance and factors that influence this behaviour in NZ pilots and ATCOs.
2. The participant will define the rate of mental health care avoidance in a sample of NZ pilots and ATCOs.
3. The Participant will define the rate of Holmes/Rahe life stress scale (HRSS) returns of health breakdown significance in a sample of NZ pilots and ATCOs.

Tuesday, 06/03/2025 ***2:00 PM***
Regency VII

[S-23] SLIDE : PHYSIOLOGICAL AND COGNITIVE MONITORING

Chair: Erica Murray
Co-Chair: Michael Yue

[119] INTEGRATING PHYSIOLOGICAL MONITORING INTO NEXT-GENERATION AIRCRAFT LIFE SUPPORT SYSTEMS

Noémi S. Hutubessy[1], Ross D. Pollock[1], John Rogers[2], Peter D. Hodkinson[1]
[1]*King's College London, London, United Kingdom;* [2]*Honeywell, Yeovil, United Kingdom*

(Education - Program / Process Review)

BACKGROUND: The occurrence of physiological episodes in military pilots has driven an interest in pilot physiological monitoring. Existing efforts have focused on the development, testing and potential use of portable monitoring devices in legacy aircraft. This retrofitting approach limits the number of parameters that can be assessed. Our project uniquely offers a blank-page and a future-oriented approach – with no preconceived technology to market, and with an aim to leverage the potential of such systems when designed from the concept and requirements stage of next-generation aircraft systems (including life support). We address

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shortcomings and caveats, offering a broader scope for integration of novel sensor technologies, a wider range of measurable parameters, and greater potential use cases. **OVERVIEW:** The project pioneers an integrated aircraft and pilot physiological monitoring system for sensing and informing whole-system performance during and following flight. We review our approach to identify parameters that can be measured reliably and yield meaningful data. We discuss innovative and suitable sensor technologies and present the down selection and assessment process of their feasibility and capability, in terms of real-time measurement, while exploring integration requirements. We present potential applications, such as real-time feedback on pilot and life support system performance, and post-flight analysis. The project culminates with construction of a proof-of-concept prototype, validated through human physiological and engineering testing. **DISCUSSION:** Our project proposes a roadmap to address the potential for integrating human physiology monitoring into the design and concept of next-generation fast jet aircraft. The proposed system collects and integrates physiological data (e.g., heart rate, oxygen saturation) with aircraft parameters (e.g., altitude, acceleration), cockpit environment data (e.g., pressure, temperature), and pilot ensemble information (e.g., suit pressure, regulator settings). This integrated system has the potential to shed light on human performance status, inform system performance and provide data for post-flight analysis (including accident/incident investigation). Ultimately, it provides a comprehensive understanding of human-aircraft interaction, the human physiology of fast-jet flight, and contribute to our understanding of physiological episodes.

Learning Objectives

1. The participant will be able to interpret how physiological monitoring contributes to a holistic understanding of human performance in high-stress flight environments and supports life support system optimization.
2. The participant will be able to explore how emerging sensor technologies enable the measurement of physiological parameters, expanding the scope of pilot monitoring and informing the design of next-generation aviation systems.

[120] TAKING IT UP A NOTCH: PART 1 - HYPOXIA RISK DURING RAPID DECOMPRESSION.

Nicholas Green, Joseph Britton
RAF Centre of Aerospace Medicine, Henlow, United Kingdom

(Education - Tutorial / Review)

INTRODUCTION: Recent military operational requirements have prompted a review of the principles underlying protection against hypoxia during and after rapid cabin decompression. Material accessed from UK RAF archives in addition to a recent AMHP publication highlight the importance of understanding how to determine the correct oxygen schedule. This is one of two presentations intended to explain the process. **TOPIC:** The reduction in barometric pressure with ascent to altitude results in reduced partial pressure of oxygen in the alveolus and the blood, leading to impaired cognitive performance with attendant flight safety implications. Primary protection is provided by the pressure cabin, with pressurisation schedules dependent on aircraft type. Supplemental oxygen is also required routinely in pressure cabins using a low differential pressure. If cabin pressure is lost, the partial pressure of oxygen in the alveolus will drop rapidly, and under certain circumstances oxygen will diffuse paradoxically from the bloodstream into the alveolus. Delay in the provision of supplemental oxygen (for high differential pressure cabin occupants) or increase in oxygen concentration (for low differential pressure occupants) can worsen any hypoxia experienced. Even if oxygen is breathed immediately after decompression, hypoxia may still be experienced due to the presence of nitrogen in the lung before the decompression. It takes time and breathing cycles for the oxygen to be washed in and the nitrogen to be washed out: for a decompression from 8000ft to 40,000ft pressure altitude, it can take more than 30s for arterial oxygen tension to rise to 60mmHg even if the first breath of 100% oxygen is taken immediately on decompression. **APPLICATION:** The oxygen schedule required to prevent hypoxia in a pressurised cabin may be insufficient to prevent hypoxia after a rapid decompression, even if 100% oxygen is breathed immediately. This is due to the presence of nitrogen in the lung. A different oxygen schedule must be used, which increases oxygen concentration at certain altitudes in normal pressurised operation (the "Notch") to ensure that arterial oxygen concentration remains adequate after decompression. Calculation of the Notch will be explained in Part 2, with examples.

Learning Objectives

1. The audience will learn that the alveolar contents before a rapid decompression are key to the level of hypoxia experienced after decompression.
2. The audience will learn the effects of a rapid decompression on the alveolar gas contents.
3. The audience will understand that a special oxygen schedule must be used in normal operations to prepare for the risk of rapid decompression.

[121] TAKING IT UP A NOTCH: PART 2 - PREVENTING HYPOXIA DURING RAPID DECOMPRESSION

Joseph Britton, Nicholas Green
RAF Centre of Aerospace Medicine, Henlow, United Kingdom

(Education - Tutorial / Review)

INTRODUCTION: Recent military operational requirements and literature review have prompted a reassessment of the principles underlying protection against hypoxia during and after rapid cabin decompression. This is one of two presentations intended to explain how to protect occupants during such events. This talk explains and demonstrates the practical approach to derive suitable oxygen schedules, alongside the supporting evidence. **TOPIC:** To protect against significant hypoxia, an oxygen schedule must consider both the required concentration of oxygen during rapid changes in pressure as well as during sustained flight. As discussed in Part 1, the concentration of oxygen breathed prior to a decompression has a direct impact on post-decompression outcome. Upon rapid decompression, nitrogen in the alveolus can result in alveolar oxygen tension (PAO2) falling below expected levels. Safe exposures are determined by both the minimum PAO2, and the duration below a critical value of 30 mmHg (the 'P30 area'). As duration can be affected by non-controllable factors (such as respiratory rate), the safest approach is to prevent PAO2 from falling below this critical value. The required oxygen concentration being breathed prior to decompression to ensure this is achieved can be calculated through an equation which considers, among other factors, the lung pressures before and after decompression. When applying this to an oxygen schedule it results in a deflection from the smooth curve, known as 'Ernsting's Notch'. The location and size of this Notch in the schedule is determined by several factors, primarily the cabin pressurisation schedule. Whilst the impact of the Notch is better understood for combat aircraft with low cabin pressure differentials, and for airliners with high pressure differentials, the implications for small utility turboprop aircraft with intermediate pressure differentials have been less well explored. In such aircraft, rapid decompressions to altitudes above approximately 26,000ft may result in PAO2 falling below the critical value. **APPLICATION:** Calculation of the Notch and using it to generate an oxygen schedule will be demonstrated. Examples of the effect of different aircraft design features on the Notch will be illustrated, highlighting some challenges for aerospace medicine and aeronautical engineering professionals of intermediate pressure differentials.

Learning Objectives

1. The audience will learn about the reasoning and evidence behind the critical line for minimum alveolar oxygen tension upon rapid decompression.
2. The audience will learn about the building blocks of the Notch equation and how to employ this to generate suitable oxygen schedules.

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[122] THE DIGITAL PILOT – CONTINUOUS MONITORING OF OXYGEN SATURATION DURING HYPOBARIC HYPOXIA

Simon Annaheim[1], Denis Bron[2], Rene Rossi[1]
[1]*Empa, Swiss Federal Laboratories for Materials Science and Technology, St. Gallen, Switzerland;* [2]*Swiss Air Force, Duebendorf, Switzerland*

(Original Research)

INTRODUCTION: The availability of oxygen is critical to completing the tasks of aircraft pilots. During hypobaric hypoxia training sessions, pilots experience their perceptions while being exposed to hypoxia. This way, pilots should be able to detect symptoms of hypoxia early and take appropriate actions to avoid critical incidents. However, it has been shown that the correct interpretation of hypoxia signs on duty is challenging. We aim to develop a textile-based physiological multi-parameter monitoring tool able to continuously record various vital signs, including blood oxygen saturation (SPO2). The current study aimed to investigate changes in SPO2 during a hypobaric hypoxia training session in male military pilots. **METHODS:** A commercially available tool (Nonin Wrist Ox2® 3150, Plymouth, USA) was applied to measure SPO2. Four military pilots were monitored during the occasion of a standard hypobaric hypoxia exposition in the Swiss Aeromedical Center (hypoxia exposure at 7500m (24600ft.) and 9000m (29500ft.) altitude). Measurements were conducted according to the principles described in the Declaration of Helsinki and written informed consent was obtained from each participant. **RESULTS:** A first significant drop in SPO2 (-17.4% ± 6.8%) and a rise in HR (+10.2% ± 13.8%) was observed at an altitude of 6000m (19700ft.) when compared to initial values just before the cessation of oxygen supply. A further reduction in SPO2 to 72% (-27.5% ± 7.0%) and an increase in HR to 108bpm (+20.0% ± 12.5%) was observed when oxygen was administered again due to severe symptoms of hypoxia. Pilots fully recovered (SPO2 > 97%) within 45s ± 16s. During hypoxia exposure at 9000m, severe symptoms of hypoxia were detected after 103s ± 19s, accompanied by a drop in SPO2 (-26.0% ± 10.7%) and a rise in HR (+18.2% ± 5.7%). Recovery time after oxygen administration was 46s ± 25s. **DISCUSSION:** The results presented give us a detailed understanding of general and individual responses to stressors aircraft pilots are exposed to. This provides the basis to adapt training and exercise recommendations for individual pilots to safeguard their fitness on duty effectively. Furthermore, the data is used for training to increase awareness of changes in body perceptions. Finally, continuous monitoring on duty helps to process subjective perceptions (e.g. about psychophysiological conditions of reduced performance) with objective data.

Learning Objectives

1. The audience will learn about the cardiovascular responses and changes in blood oxygen saturation due to hypobaric hypoxia.
2. The study outcome shall contribute to a better understanding of the temporal development of hypoxia symptoms to early recognize such symptoms and take appropriate actions.

[123] PHYSIOLOGICAL INDICATIONS OF INCREASED COGNITIVE WORKLOAD IN NATIONAL GUARD SOLDIERS PERFORMING SIMULATED DRIVING EXERCISES

Christopher Aura[1], Xiaomin Yue[2], Christopher Mackie[3], Amanda Kelly[1], Johnell Brooks[4]
[1]*U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States;* [2]*U.S. Army Aeromedical Research Lab (and Goldbelt Frontier, LLC.), Fort Novosel (and Alexandria, VA), AL, United States;* [3]*U.S. Army Aeromedical Research Lab (and Oak Ridge Institute for Science and Engineering), Fort Novosel (and Oak Ridge, TN), AL, United States;* [4]*Clemson University, Greenville, SC, United States*

(Original Research)

INTRODUCTION: The US Army is seeking tools to improve Soldier monitoring in the operational environment through the collection of neurophysiological signals and responses to discern cognitive states and threats to performance. The primary objective of this study was to evaluate neurophysiological changes relative to increases in cognitive workload using simulated driving exercises. **METHODS:** Electroencephalography (EEG) signals were collected from 31 Soldiers serving in the South Carolina Army National Guard. The tasks, administered using a driving simulator, involved responding to a series of driving-themed visual cues by turning a steering wheel or depressing foot pedals, all while performing a secondary visual search and matching task. **RESULTS:** Task difficulty showed a significant effect on neurophysiological responses collected. EEG data was averaged in both the frequency and time domains to generate four power spectral density (PSD) values corresponding to each frequency band: delta, theta, alpha, and beta. Our analysis showed that increasing task difficulty elevated frontal beta PSD values for both interactive exercises (Stoplight and Steering© (Levels 1 to 3): $F(2, 60) = 11.25$, $p = 7.11*10\text{-}5$I; Slider task© (Levels 1 to 4): $F(3,90) = 39.55$, $p = 2.15*10\text{-}16$). **DISCUSSION:** These data suggest that EEG signals captured from frontal regions of the brain may be used to discern cognitive workload in Warfighters performing a functional task. With further development, and the incorporation of other synchronized physiological signals, models may be developed to predict cognitive state changes to inform command decisions and tailor automation in the military operational environment.

Learning Objectives

1. Electroencephalography is sensitive to changes in cognitive workload imposed by increasing task difficulty.
2. Electroencephalographic signals of sufficient quality to discern cognitive workload can be collected from Soldiers performing a simulated driving task.

[124] WITHDRAWN

Tuesday, 06/03/2025 ***2:00 PM***
Hanover F/G

[S-24] PANEL: SLEEP DISORDERS AS A FATIGUE FACTOR IN AVIATION

Chair: John Caldwell
Co-Chair: J. Lynn Caldwell

Panel Overview: *Fatigue is a major concern in aviation because of the impairments in pilot performance and safety it causes. Duty-time limitations and crew-rest requirements, along with a variety of other control strategies, have long been required to ensure that crews are adequately rested and ready for flight. Such measures have no doubt contributed to the fact that both commercial and military aviation is safer than ever despite the myriad challenges present in the operational environment. However, one factor that is often-overlooked could further enhance aviation safety. Since the most common cause of excessive sleepiness and fatigue is insufficient sleep, and since these are both hallmarks of several sleep disorders, increased recognition of the link between fatigue and sleep-disorders is warranted. The first presentation in this panel will briefly summarize the effects of sleep disorders—sleep apnea in particular—on alertness and performance. The remaining four presentations will describe the manner in which sleep-apnea is being identified and managed by 1) the US Army, 2) the US Air Force, 3) the US Navy, and 4) by the Federal Aviation Administration. The panel will conclude with a discussion of the adequacy of current strategies and recommendations on the manner in which comprehensive cross-agency sleep-disorder tracking and reporting can be conducted both now and in the future.*

[125] EFFECTS OF SLEEP DISORDERS ON ALERTNESS AND PERFORMANCE

John Caldwell
Coastal Performance Consulting, Yellow Springs, OH, United States

(Education - Program / Process Review)

BACKGROUND: Emerging evidence suggests that sleep disorders among pilots, both civilian and military, are prevalent. A 2013 study of civilian aircrews showed that a quarter reported excessive daytime sleepiness and/or a history of in-flight sleep lapses potentially attributable to

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sleep disorders. Seventeen percent were at high risk of insomnia, 6% were at risk of obstructive sleep apnea (OSA), and 11% were at risk of restless legs syndrome (RLS). A more recent investigation reported that 46% of the civilian aircrews studied had at least one sleep disorder. Military aviators are faring no better. A 2024 study reported that 10% of pilots had been diagnosed with insomnia and 25% had been diagnosed with OSA. The prevalence of sleep disorders—especially insomnia and OSA—from 2006 to 2022 has increased 61% and 158%, respectively. This suggests that sleep disorders have become a serious flight safety concern from excessive on-duty sleepiness due to chronically-disrupted, non-restorative sleep. **OVERVIEW:** Sleep disorders cause cognitive decrements, slow reaction times, memory impairments, inattention, and irritability on the flight deck, all of which increase the likelihood of a fatigue-related mishap. However, the importance of sleep disorders in fatigue management is frequently overlooked, and the etiology and treatment of sleep disorders is poorly understood. This presentation will explain 1) insomnia (difficulty initiating or maintaining sleep), 2) sleep apnea (repetitive breathing disruptions that fragment sleep), 3) restless legs syndrome (limb movement urges that delay sleep onset), and 4) periodic limb movements of sleep (repetitive leg/arm movements that disrupt sleep) and will describe the manner in which they threaten alertness and flight performance. **DISCUSSION:** Sleep disorders pose a danger in the aviation context. All 3 services have taken action to mitigate this danger, but expanding the focus beyond OSA will further enhance fatigue management in aviation.

Learning Objectives

1. The audience will learn the characteristics of the most common sleep disorders and the manner in which they contribute to aircrew fatigue.
2. The audience will learn the potential negative impact of Obstructive Sleep Apnea in particular on aircrew in both civil and military aviation.
3. The audience will learn the manner in which Obstructive Sleep Apnea in aircrew is identified and the aeromedical waiver requirements in both civil and military aviation.

[126] IDENTIFICATION AND MANAGEMENT OF SLEEP APNEA—US AIR FORCE

Tory Woodard
Headquarters, Air Force Materiel Command, Wright-Patterson AFB, OH, United States

(Education - Program / Process Review)

BACKGROUND: Sleep disorders exert a negative impact on the restorative value of sleep, resulting in a potentially serious threat to aviation safety because of the excessive on-duty sleepiness and fatigue they produce. According to the NTSB, pilots with Obstructive Sleep Apnea (OSA)—one of the most common sleep disorders – are six times more likely to have an aviation mishap than their healthy counterparts. While sleep apnea is rarely mentioned as a causal factor in aircraft accidents, the NTSB database includes well over 200 incidents in which some type of sleep disorder is noted in the pilot's history. The Air Force recognizes the flight-safety ramifications of OSA, and as such has continued to develop and update aircrew evaluation and waiver criteria. **OVERVIEW:** OSA is a disqualifying for all flying and operational classes, and aircrew must be placed on non-flying duties at the time of diagnosis, or prior to diagnosis when symptoms hinder quality of life, driving, performance of ground duties, and/or critical phases of flight. A high-quality in-lab sleep study is recommended for any aviator with complaints of non-restorative sleep, if conservative measures such as improved sleep hygiene have failed. If OSA is formally diagnosed, auto-titrating continuous positive airway pressure (PAP) is recommended over other types of therapy. Once evidence of at least 30 days of PAP data showing effective treatment (apnea hypopnea index/respiratory disturbance index of less than 5 per hour) are available, a request for initial waiver can be submitted. Once granted, waivers require periodic renewal with reassessment of symptoms and verification of continued PAP compliance **DISCUSSION:** Obstructive sleep apnea represents a risk to aviation safety. Returning aircrew safely to flying duties requires not only establishing a diagnosis of OSA but involves continuing to assess efficacy of treatment and clinical optimization to mitigate aeromedical risks. Current US Air Force aeromedical guidance, waiver criteria, and waiver data will be presented for discussion.

Learning Objectives

1. The audience will learn the manner in which sleep apnea is identified in US Air Force aircrew members.
2. The audience will learn which sleep apnea treatment procedures are efficacious and recommended for US Air Force crewmembers.
3. The audience will learn the criteria that must be met in order to qualify for an aeromedical waiver in US Air Force crewmembers.

[127] IDENTIFICATION AND MANAGEMENT OF SLEEP APNEA—US ARMY

John Crowley
U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Education - Program / Process Review)

BACKGROUND: Obstructive Sleep Apnea (OSA) is a condition with significant aeromedical relevance to mission accomplishment, aviation safety, and aviator health. The primary mechanism of OSA is airway closure with subsequent effects on oxygenation, daytime sleepiness, and cognitive function, among other health effects. While various remedies exist for OSA, there are compliance and efficacy issues that are relevant for all aircrew. This presentation will address the aeromedical relevance of OSA in general, while highlighting issues of particular importance to Army aircrew. **OVERVIEW:** OSA is disqualifying for all classes of Army aircrew, with exceptions to policy for initial pilot applicants being rarely recommended. Waivers for other initial applicants and trained aviation personnel are recommended once the individual demonstrates compliance on prescribed therapy and is free of aeromedically significant symptomatology. All individuals require a sleep/pulmonary medicine consult and polysomnography initially, and annually in the event of any significant change. Positive airway pressure (PAP) device therapy must be used 90% of nights for at least 5 hrs/night and an apnea-hypopnea index (AHI) of < 5. APAP, BiPAP, and CPAP are all acceptable. Other acceptable treatments, if successful, include oral appliance therapy (OA), surgery, and weight loss. **DISCUSSION:** OSA can result in disrupted sleep and excessive daytime sleepiness with resulting deficits in cognitive and psychomotor performance. OSA is also linked to potentially incapacitating conditions as cardiac arrhythmias, myocardial infarction, and cerebrovascular accidents. Specific concerns for Army aircrew include the austere deployed environment (i.e., without electrical power) that can preclude reliance on PAP therapy. Note that positional therapy or implantable hypoglossal nerve stimulators are not authorized as standalone therapy, and medications promoting wakefulness are not recommended for waiver. Undiagnosed and/or inadequately treated OSA poses an unacceptable risk to aviation safety, but is frequently modifiable and waiverable.

Learning Objectives

1. The audience will learn the manner in which sleep apnea is identified in US Army aircrew members.
2. The audience will learn which sleep apnea treatment procedures are efficacious and recommended for US Army aircrew members.
3. The audience will learn the criteria that must be met in order to qualify for an aeromedical waiver in US Army aircrew members.

[128] IDENTIFICATION AND MANAGEMENT OF SLEEP APNEA—US NAVY

Walter Dalitsch
Wadath Human Performance Consulting, LLC, Wasilla, AK, United States

(Education - Program / Process Review)

BACKGROUND: Disruption of normal sleep architecture and poor sleep hygiene are contributors to excessive daytime somnolence and insomnia that result in deficits in cognitive and motor performance common in the general population. The resulting fatigue, sleepiness and circadian rhythm disruptions have critical negative impact on performance in Naval Aviation. **OVERVIEW:** Obstructive Sleep Apnea (OSA) results in excessive Daytime Sleepiness (EDS), leading to a primary

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aeromedical safety concern of cognitive impairment. This manifests as difficulty maintaining attention, increased reaction time, a negative impact on reasoning, judgment and decision-making, and an overall decrement in the ability to multi-task and a reduction in situational awareness. Naval mission requirements, including 24-hour operations and the crossing of multiple time zones can compound these effects. Therefore, the Navy considers OSA to be a disqualifying condition. However, if certain criteria are met, aircrew may be granted a waiver. **DISCUSSION:** The presenter will review data reflecting the prevalence of OSA in the Naval Aviation community, and the incidence of granted waivers. The Navy's requirements for diagnosis, treatment and waiver criteria will be presented for discussion.

Learning Objectives

1. The audience will learn the manner in which sleep apnea is identified in US Navy aircrew members.
2. The audience will learn the potential negative impact of Obstructive Sleep Apnea among aircrew in Naval Aviation.
3. The audience will learn the requirements for, and the prevalence of, Obstructive Sleep Apnea waivers in Naval Aviation.

[129] IDENTIFICATION AND MANAGEMENT OF SLEEP APNEA—US FAA

David O'Brien
FAA, CAMI, Oklahoma City, OK, United States

(Education - Program / Process Review)

BACKGROUND: Obstructive Sleep Apnea is a common medical condition in the US population including US pilots. OSA is associated with fatigue and reduced cognitive performance. Long term, OSA is also associated with stroke, diabetes and atrial fibrillation. These conditions all pose a risk of sudden and/or subtle incapacitation in flight and are potential risks to aviation safety. **OVERVIEW:** OSA is a generally disqualifying condition for first-, second- and third-class medical certification. OSA must be sufficiently risk mitigated in order for the FAA to consider a special issuance for an airman with OSA. Of the 57,000 special issuances in 2024, over 9% were for OSA. Federal policy requires a baseline sleep study and ongoing monitoring for continued special issuance. **DISCUSSION:** OSA presents a risk to the national aerospace system which can be adequately treated through a variety of modalities. These modalities will be discussed as well as the thresholds for special issuance and continued clinical monitoring in order to ensure aviation safety through adequate risk mitigation.

Learning Objectives

1. The audience will learn the manner in which sleep apnea is identified in US civil aircrew members.
2. The audience will learn which sleep apnea treatment procedures are efficacious and recommended for US civil aircrew members.
3. The audience will learn the criteria that must be met in order to qualify for an aeromedical waiver in US civil aircrew members.

Tuesday, 06/03/2025 ***2:00 PM***
Grand Hall East Corridor - Posters Only

[S-25] POSTER : CONSTELLATION OF SPACE MEDICINE

Chair: Kenneth J. Myers
Co-Chair: Cathy DiBiase

[130] MAGNESIUM HOMEOSTASIS IN THE SPACE ENVIRONMENT: A SYSTEMATIC REVIEW

Tom Diaz[1], Ryan Sullivan[2], Sam Buesking[3], Bria Carmichael[4], Andrew Haggarty[2], Ganeev Singh[5]
[1]*The Johns Hopkins Hospital, Baltimore, MD, United States;* [2]*University of Massachusetts (UMass) Chan Medical School, Worcester, MA, United States;* [3]*University of Missouri-Kansas City, Kansas City, MO, United States;* [4]*University of North Carolina (UNC) at Chapel Hill, Chapel Hill, NC, United States;* [5]*Scripps Mercy Hospital San Diego, San Diego, CA, United States*

(Original Research)

INTRODUCTION: Magnesium is the second most abundant intracellular cation in the human body, serving as a cofactor in over 300 ATP-generating enzymatic reactions. In addition, magnesium maintains cardiac activity, bone health, neuromuscular function, and metabolic homeostasis. There are few studies which explore magnesium alterations during spaceflight. The goal of this study was to summarize magnesium intake and changes that occur to both serum and urine magnesium before, during, and after spaceflight. **METHODS:** A systematic review of PubMed, Scopus, Ovid Medline, Cochrane Library, OCLC, DTIC (Department of Defense de-classified database), and NASA-specific databases was conducted with 53 distinct search terms. Inclusion criteria were English studies with adult astronauts in spaceflight of any duration and containing at least one measurement of serum/urine magnesium or magnesium intake before, during, or after flight. Exclusion criteria comprised any non-microgravity environments (ie., bedrest or centrifuge studies). Covidence was used for study extraction. We employed descriptive analytics using Microsoft Excel. **RESULTS:** The database search yielded 5,334 articles, of which 978 duplicates were removed. 94 studies were selected for full text review and 19 studies met inclusion criteria. Five studies collected serum (n=312), five studies collected urine (n=61), one study collected intake (n=9), five studies collected both serum and urine (n=136), and three studies collected both urine and intake (n=10). On average, serum magnesium decreased by 5%, urine magnesium increased by 15%, and magnesium intake decreased by 52% inflight compared to preflight. On landing day, serum magnesium decreased by 9% and urine magnesium decreased by 25% compared to preflight. Magnesium intake and both serum and urine magnesium trended toward baseline within one week of landing. **DISCUSSION:** Urine magnesium demonstrated interpatient variability and time-dependent lability, with trends potentially correlated to spaceflight related fluid shifts. Although serum magnesium remained numerically stable during and after flight, intracellular and total body magnesium levels remain unknown. Magnesium intake decreased during flight, but this was skewed by outliers and small sample sizes. There were no reported signs or symptoms related to hypomagnesemia. Magnesium alterations should be further explored to ensure the safety of astronauts during future long-duration spaceflight missions.

Learning Objectives

1. Recognize the impact of spaceflight on magnesium homeostasis in astronauts.
2. Understand trends and the potential implications of magnesium alterations at various intervals surrounding space travel.
3. Evaluate the possible role of magnesium supplementation based on serum and urine magnesium alterations in the microgravity environment.

[131] A REVIEW OF BREAST CANCER CELL RESEARCH UNDER MICROGRAVITY CONDITIONS

Matthew Kornas, Ramez Barsoom, Abba Zubair
Mayo Clinic, Jacksonville, FL, United States

(Education - Tutorial / Review)

INTRODUCTION: Breast cancer cells cultured under microgravity conditions demonstrate reproducible changes in cellular morphology, cytoskeletal architecture, gene expression, and signaling pathway activity. Insights from this research can improve understanding of breast cancer pathophysiology and guide the development of new drug targets. **TOPIC:** Microgravity contributes toward several adverse health risks to astronauts, including at the cellular level. Microgravity can be reproduced via real or simulated environments to study its impact on human cell cultures. Simulated environments (including the Clinostat, random positioning machine, and magnetic levitation) can counteract the gravity vector, but are limited in the period of microgravity achievable and potential shear forces. Real environments (including parabolic flights, sounding rockets, and orbital spacecrafts) provide longer periods of microgravity conditions, but require significant resources and involve periods of hypergravity forces on samples. Studies in these environments provide improved conditions to evaluate pathophysiology of cancer cells

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when compared to traditional culture methods. This stems from the reproducible production of 3D multicellular spherules when breast cancer cell cultures are exposed to microgravity conditions. A proposed theory for this development states that cell liberation from gravity forces allows cancer cell physiology to mimic their original in vivo tissue. The spherules exhibit disrupted cytoskeletal organization with corresponding cell cycle impairment and apoptosis. Intercellular focal adhesion changes also contribute to the altered cellular morphology within these spherules. Gene expression of proteins involved in cytoskeletal production, intercellular adhesions, angiogenesis, mitosis, and survival pathways diverge among different breast cancer cell lines and microgravity conditions. Some of these genes contribute to cancer cell proliferation and may serve as candidates for future targeted therapies. Additional research is necessary to better catalog changes in gene expression under microgravity conditions to guide drug development and testing. **APPLICATION:** Microgravity-focused breast cancer cell research provides an optimal environment for the study of cancer pathophysiology. These cellular models can improve understanding and development of novel therapies to treat malignant diseases and improve patient outcomes.

Learning Objectives

1. The participant will be able to describe the different methods of achieving real and simulated microgravity environments.
2. The audience will learn about the cellular and genomic level changes of breast cancer cells that occur in microgravity conditions.
3. The audience will learn about the 3D multicellular spherule as a model for metastasis.

[132] SYSTEMATIC REVIEW OF TERRESTRIAL ANIMAL MODELS OF DECOMPRESSION SICKNESS: USING EMPIRIC CALCULATIONS OF TISSUE RATIO TO COMPARE TO HUMAN EXPOSURES

Hayley Brawley[1], Andrew Kozminski[2], Lyle Babcock[1], Craig Nowadly[1]
[1]*Clinical and Operational Space Medicine Innovation Consortium (COSMIC), San Antonio, TX, United States;* [2]*University of Iowa Health Care, Iowa City, IA, United States*

(Original Research)

INTRODUCTION: Experimental animal models are vital in decompression sickness (DCS) research, offering insights into its pathophysiology when human studies are impractical or unsafe. However, cognitive and neuropsychological effects of human DCS are often challenging to replicate in animals. Understanding how various exposure durations and severities in differing animals models translate to human DCS risk is limited. We performed a systematic review of available DCS literature that utilizes animal models and evaluated the quality of evidence and relevance to human DCS cases. We calculated nitrogen tissue ratio, a relationship between nitrogen partial pressure and decompression severity, using published decompression methods of animal research studies. **METHODS:** PubMed, Google Scholar, the Defense Technical Information Center, and the NASA Task Book were searched from inception to Dec 2023. A refined search strategy was employed to identify studies relevant to calculating tissue ratios. Abstracts were screened for references to tissue composition, gas exchange, or decompression models. Experimental papers were included if they featured a control group and sufficient data to allow for DCS incidence and tissue ratio calculations, focusing solely on control-group animals to prevent confounding with experimental test variables. **RESULTS:** The initial search identified 201 articles, with 60 articles included in the review. The selection of animal models reviewed primarily comprised rodents (35%) and swine (30%) with fewer studies on rabbit, dog, sheep, and hamster models. Tissue ratio vs. DCS incidence for each animal study was compared to human DCS risk modeling efforts. **DISCUSSION:** Our investigation utilized control-group animals from a wide variety of models and DCS exposure conditions to determine the relationship between animals and human DCS models. Our initial data shows that most animal DCS studies do not mimic the expected probability of DCS in humans. Some animal models, especially swine, displayed unique characteristics that resulted in lower DCS incidence than expected despite exhibiting high tissue ratios based on experimental conditions. These differences could be due to species-specific physiological mechanisms, unique experimental conditions, or variations in gas exchange and bubble formation influenced by body size and soft tissue distributions, underscoring the complexities in using animal models to predict human responses to decompression.

Learning Objectives

1. [The participant will be able to…] understand the role and limitations of terrestrial animal models in DCS research and their relevance to human DCS cases.
2. [The audience will learn about...] the methodology of calculating nitrogen tissue ratios in animal models and how these ratios correlate with DCS incidence.
3. [Participants will gain insights into...] the species-specific physiological differences in DCS susceptibility and how these may affect the extrapolation of animal model data to human DCS risk prediction.

[133] LONG-TERM MHC CLASS I SUPPRESSION IN ASTRONAUTS AND ITS CLINICAL IMPLICATION

Erik LeRoy[1], JangKeun Kim[2], Helena Ruland[3], Nathan Schanzer[4], Anurag Sakharkar[5], Zachary Feinstein[2], Robert Chen[2], Mohith Reddy Arikatla[6], Kubra Can Kurt[6], Christopher Mason[2]
[1]*Association of Spaceflight Professionals, Tampa, FL, United States;* [2]*Weill Cornell Medicine, New York, NY, United States;* [3]*ETH Zurich, Zurich, Switzerland;* [4]*New York Medical College School of Medicine, Valhalla, NY, United States;* [5]*University of Saskatchewan, Saskatoon, SK, Canada*

(Education - Tutorial / Review)

INTRODUCTION: The space environment poses significant risks to human health, particularly concerning viral reactivation and cancer risk. Still, the impact of immune dysregulation in space on the viral reactivation and cancer risk is not clear. **TOPIC:** Among these immune challenges, a critical concern is the long-term down-regulation of Major Histocompatibility Complex (MHC) class I genes observed during multiple astronaut missions, including long duration (over 6 months) stays on the International Space Station (ISS) and shorter missions (3 days) like Inspiration4. MHC class I down-regulation, a known mechanism of immune evasion in viral infections and cancer, could potentially exacerbate these health risks in space after spaceflight on Earth. However, the underlying mechanisms, clinical implications, and potential therapeutic interventions remain underexplored. **APPLICATION:** Here, we will address the potential long-term risks associated with MHC class I down-regulation in astronauts, propose directions for future research to fill the existing knowledge gaps, and discuss possible therapeutic approaches to mitigate these risks. Understanding and addressing MHC class I suppression is crucial for improving astronaut health and performance in long-duration space missions, with broader implications for related health challenges on Earth.

Learning Objectives

1. Understand the possible long-term risks linked to the downregulation of MHC class I in astronauts.
2. Identify future research directions to address current knowledge gaps and explore potential therapeutic strategies to alleviate these risks.

[134] TARGETING SEROTONIN PATHWAYS FOR ASTRONAUT SAFETY AND PERFORMANCE

Taylor Casey[1], John French[2], Diego M. Garcia[2]
[1]*University of Pittsburgh Medical Center at Harrisburg, Harrisburg, PA, United States;* [2]*Embry-Riddle Aeronautical University, Daytona Beach, FL, United States*

(Education - Program / Process Review)

BACKGROUND: Serotonin (5-HT) receptors significantly impact astronaut physiology, influencing gastrointestinal, musculoskeletal, and neuropsychiatric systems. Understanding the role of 5-HT in these effects is key to mitigating spaceflight-related health risks and supporting

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astronaut performance, especially on long-duration missions. **OVERVIEW:** Up to 95% of 5-HT is produced in the gut enterochromaffin cells. Serotonin helps regulate nausea, bone/muscle calcium, mood, and fatigue. This regulation is quickly disrupted by microgravity and radiation effects in hostile space environments. For example, central and vagal 5-HT receptors are key in space adaptation syndrome, triggering nausea, emesis, and spatial disorientation. Peripheral 5-HT receptors inhibit osteoblasts, while central 5-HT receptors promote bone mass accrual. Astronauts lose about 1% of total bone mass per month, causing hypercalcemia that disrupts calcium regulation, affecting bone, muscle, neurons, and vestibular function, and increasing nephrolithiasis risk. Microgravity-induced skeletal muscle changes can arise from lack of axial body loading over the long term and nausea induced 5-HT release episodically, altering strength, gait, and sensorimotor coordination. 5-HT3 antagonists have long been used to manage nausea and emesis, especially radiation-induced symptoms, which is relevant as astronauts face radiation levels hundreds of times higher than on Earth. 5-HT dysregulation can also affect mental health traits such as depression, anxiety and aggression. Fatigue and disorientation, or "sopite syndrome," can stem from 5-HT metabolizing to melatonin, a chronobiotic important in synchronizing circadian regulation. **DISCUSSION:** Many of the health and safety issues facing astronauts involve the neurohormone serotonin at their core. Conditions where specific 5-HT receptor modulators have distinct efficacy and advantages include migraine, anxiety, psychosis, obesity and emesis induced by cytotoxic drugs and radiation. Expanded research into pharmaceuticals that target the 5-HT subtypes involved promises to mitigate serotonin related military and civilian risks as well as human spaceflight-related challenges.

Learning Objectives

1. Participants will develop an understanding of serotonin physiology and pathophysiology.
2. Participants will understand the role serotonin antagonists may play in mitigating the multisystemic effects of the space environment on human physiology.

[135] WITHDRAWN

[136] SELECTION OF A URINE CONTAINMENT BAG FOR INTERMITTENT URINARY CATHETERS USED IN SPACEFLIGHT

Jason Sanchez, Richard Cole
NASA JSC, Houston, TX, United States

(Original Research)

INTRODUCTION: Urinary retention is a spaceflight risk with a 1.8% incidence rate per person-flights. While bladder catheters mitigate this risk, intermittent catheters can allow urine to escape into the cabin violating NASA standards by damaging hardware and posing health risks to crew. Urine collection devices (UCDs) are closed-system bags that collect urine for research and could potentially be dual purposed to contain urine obtained from bladders catheterized during spaceflight. **METHODS:** An artificial bladder was created and connected to a urine containment bag (either a leg bag, male UCD, female UCD, or a diaper inside a ziplock bag) using a 16 Fr straight-tip male catheter. The weight difference before and after simulated urinary drainage was calculated to obtain the amount of urine that leaked outside each containment bag in various positions: standing, supine, and inverted positions. **RESULTS:** Almost all the water remained inside the leg bag, male UCD, female UCD, and ziplock bag at all positions except for the inverted ziplock bag where 28.3 mL (±14.8) of water leaked. These findings corresponded to the water weight of absorbent pads placed under the containment bags to collect water leakage. The female UCD was easier to attach to the drainage end of the bladder catheter as compared to the male UCD. **DISCUSSION:** This study shows UCDs can successfully contain fluid draining from a bladder catheter independent of gravity. Further validation is required in microgravity before spaceflight implementation. Urinary tract infection (UTI) is seen in 17% of urinary retention events seen in spaceflight. The UCD bag provides a reliable means to obtain urine for UTI testing. UCDs are already available on the International Space Station and Boeing CST-100 making this a cost-effective solution.

Learning Objectives

1. The audience will learn how NASA standards address body waste management.
2. The audience will learn how the female UCD bag provides an easy and cost-effective solution to contain urinary drainage from an intermittent bladder catheter in microgravity.

[137] CHANNEL CAPACITY CONSIDERATIONS FOR MEDICAL OPERATIONS ON EXPLORATION SPACE MISSIONS

Imelda Muller[1], Emily Stratton[2], Shean Phelps[2], David Hilmers[3], Josef Schmid[4]
[1]*Johns Hopkins Anesthesia & Critical Care Medicine, Baltimore, MD, United States;* [2]*UTMB, NASA JSC, Galveston, TX, United States;* [3]*Baylor College of Medicine, Translational Research Institute for Space Health, Houston, TX, United States;* [4]*NASA JSC, Houston, TX, United States*

(Education - Program / Process Review)

BACKGROUND: Communication latency and channel capacity constraints pose significant challenges to providing medical care beyond low earth orbit (LEO). Developments such as NASA's Deep Space Optical Communications (DSOC) network provide workable solutions to near-term challenges in channel capacity by utilizing laser (optical) signals in the higher frequency near infra-red spectrum. This network aims to support data transmission at rates 10-100 times higher than currently employed radiofrequency (RF) channel capacities and allow high volume data transfers. Despite such recent advancements however, communication delays and anticipated data downlink limitations - combined with the inability to rapidly return astronauts to Earth in beyond LEO missions - mandate a shift in medical operations towards greater crew autonomy and away from Earth-reliant approaches to medical care. **OVERVIEW:** 75 data-producing medical capabilities were identified from among 635 capabilities in NASA's Information Mission Planning via Analysis of Complex Tradespaces (IMPACT) database. Data file sizes for each capability were estimated. Channel capacity downlink durations were estimated in the context of a 10% channel capacity allocation for data-generating medical capabilities. Downlink durations varied for each medical capability when examined in the context of current RF capabilities as well as near-term and futuristic optical capabilities. **DISCUSSION:** As human space exploration moves toward missions beyond LEO, relying on RF-based communications alone will prove insufficient to sustain the current level of ground-based medical support allocated to LEO missions. Advancements in optical communications such as DSOC offer promise in augmenting transmission capabilities, albeit with undeniable constraints. These constraints include limited allocation of channel capacity supporting medical capabilities, data processing time, SME expert evaluation, and slower uplink compared with downlink rates. In addition to variable latency delays, a fixed speed-of-light limitation must also be considered when assessing the impact of latency on medical operations. Reliance on ground support for clinical decision-making during exploration missions could result in delays measuring in hours or days. While some advancements in technology offer latency mitigation strategies, the concept of Earth Independent Medical Operations will be critical for the future of medical care to crew beyond LEO.

Learning Objectives

1. Develop a basic understanding for how medical data is exchanged between ground and space operations as it relates to channel capacity.
2. Describe how communication latency and channel capacity constraints pose challenges to providing medical care beyond low earth orbit (LEO).
3. Consider the importance of latency mitigation strategies for future exploration missions beyond low earth orbit.

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[138] Q-ORBIT: A SYSTEMATIC APPROACH TO SPACE ANALOG MEDICAL RISK QUANTIFICATION AND CURRICULUM DEVELOPMENT

Brock Jenkins[1], Deepasree Bangaru-Raju[2], Dhivyashree Bangaru-Raju[2], Richard D. Maricle[3], Donna Marie Fearon[4]
[1]*World's Biggest Analog, Columbus, OH, United States;* [2]*World's Biggest Analog, San Diego, CA, United States;* [3]*World's Biggest Analog, San Antonio, TX, United States;* [4]*World's Biggest Analog, Washington, DC, United States*

(Education - Program / Process Review)

BACKGROUND: The Quantified Operational Risk and Brock's Integrated Training (Q-ORBIT) Scoring System is designed to quantify medical risks in space analog missions while providing a structured medical training curriculum tailored to the needs of crew members. Developed by the World's Biggest Analog (WBA) Medical Team, Q-ORBIT addresses unique challenges posed by limited medical access, extreme environmental conditions, and diverse mission profiles. Unlike traditional risk assessment models, Q-ORBIT incorporates medical training as a core component of mission preparation, enhancing both crew safety and mission success by linking risk quantification directly to pre-mission medical training needs. **OVERVIEW:** Q-ORBIT assesses 12 critical risk factors that impact mission safety and crew health. These factors include medical access, environmental severity, crew training, equipment availability, mission duration, and a Crew Health Amplification Factor. Each factor is scored, and the total score is adjusted based on the specific medical needs of the crew. The final risk score, ranging from 12 to 63, stratifies missions into Low, Moderate, High, or Severe risk levels. Based on the risk category, a corresponding Medical Training Package (MTP) is assigned. Low-risk missions may only require basic first aid, while severe-risk missions necessitate advanced medical training and specialized equipment to manage potential medical challenges. **DISCUSSION:** The primary innovation and novelty of Q-ORBIT lies in its integration of analog risk quantification with tailored medical training of participants, ensuring clinical preparedness aligns with mission-specific risks. Traditional models often fail to account for the diversity of analog mission profiles or the need for specific medical training. By contrast, Q-ORBIT directly links operational risk levels to a proactive medical education plan, addressing potential medical issues through targeted training and resources. As space analog missions venture into increasingly isolated and austere environments, Q-ORBIT provides an essential framework for crew safety and medical readiness. The upcoming WBA missions will test the system's validity, with future research focused on refining the model and integrating emerging technologies to further improve mission preparedness and safety.

Learning Objectives

1. Participants will be able to describe how Q-ORBIT's integrated framework links operational risk assessments with tailored medical training, ultimately enhancing analog crew safety in austere and isolated environments.
2. Participants will learn how the 12 critical risk factors assessed by Q-ORBIT influence both mission safety and analog crew health, guiding the development of mission-specific Medical Training Packages (MTPs) to address identified risks.
3. Most importantly, participants will understand the importance of integrating risk quantification with actionable, personalized medical training protocols, ensuring analog crew members are fully equipped to handle mission-specific medical challenges in resource-limited settings.

[139] AEROSPACE MEDICINE IN JAPAN: OVERVIEW OF EDUCATIONAL OPPORTUNITIES

Yoshika Saito[1], Takuma Ishibashi[2], Reo Takizawa[3], Hiroki Bochimoto[3], Takeshi Nikawa[4], Masahiro Terada[5]
[1]*Sendai Kousei Hospital, Sendai, Japan;* [2]*The University of Tokyo Hospital, Tokyo, Japan;* [3]*The Jikei University School of Medicine, Tokyo, Japan;* [4]*Tokushima University Graduate School, Tokushima, Japan;* [5]*Kyoto University, Kyoto, Japan*

(Education - Program / Process Review)

BACKGROUND: Japan has made notable strides in aerospace medicine and human spaceflight, with the third-largest astronaut population among individual nations. Traditionally, aerospace medicine education in Japan has relied on the Japan Aerospace Exploration Agency's (JAXA) on-the-job training for flight surgeons. However, the recent surge in commercial spaceflight, both globally and domestically, has spurred the development of new educational programs across Japan. This poster examines the significant educational and training initiatives that have emerged in Japan in response to these evolving needs. **DESCRIPTION:** Programs are categorized into three main sectors: public, university, and student organization. The public sector includes a JAXA internship and a course by the Japanese Society of Aviation and Space Environmental Medicine (JSASEM). JAXA offers medical students a week-long immersion in aerospace medicine research, while JSASEM provides a three-day hands-on seminar for practicing physicians, culminating in a JSASEM certification. In the university sector, initiatives are growing. Kyoto University offers a six-month online lecture series on space physiology and biology, open to all students and supplemented by study tours to NASA facilities. Tokyo University of Science enables students to design and conduct parabolic flight missions. Jikei Medical University and the International University of Health and Welfare have created aerospace medicine pathways for early exposure to the field, and Tokushima University recently introduced a graduate diploma program focused on aerospace nutrition science. Japan's first student-led aerospace medicine group, Space Medicine Japan Youth Community (SMJYC), has over 500 members nationwide. SMJYC organizes monthly webinars featuring experts in aerospace physiology, biology, and medical operations, and collaborates with JAXA and the Japan Air Self-Defense Force on annual study tours. **DISCUSSION:** Aerospace medicine education in Japan is expanding dynamically, fostering a unique ecosystem with distinctive characteristics. Japan's programs are anticipated to become increasingly accessible internationally, opening new doors for students and trainees with limited access to aerospace medicine education elsewhere.

Learning Objectives

1. Identify Key Educational Programs in Aerospace Medicine in Japan: Understand the primary training opportunities available in aerospace medicine within Japan, including initiatives by JAXA, JSASEM, and various universities.
2. Recognize the Potential for International Accessibility in Japan's Aerospace Medicine Programs: Assess how Japan's evolving educational landscape in aerospace medicine may provide new international learning opportunities for students and trainees globally.

[140] BRINGING OUTER-SPACE OUTREACH TO STUDENTS AND TEACHERS (BOOSTING!) THROUGH AEROSPACE MEDICINE AND PHYSIOLOGY STEM EDUCATION AND OUTREACH ACTIVITIES

Samyukta Ravisankar, Peter Hodkinson
King's College London, London, United Kingdom

(Education - Program / Process Review)

BACKGROUND: Human space exploration is in the next phase of evolution with many upcoming crewed missions, and humans will be returning to the Moon in the next five years. The growth of aerospace medicine and physiology (ASMP) is critical to the future of such crewed missions to the Moon, Mars and beyond. Future growth of ASMP must be supported by grassroot outreach efforts in schools that kindle curiosity in aerospace sciences and STEM subjects, whilst increasing awareness of career opportunities in ASMP and the space sector more broadly. **OVERVIEW:** Currently, there are minimal ASMP-focussed teaching packages in STEM outreach programs in the UK. To address this gap, we are running a collaborative initiative between ASMP and STEM experts to identify teaching opportunities in the school national curriculum where foundational concepts in science or mathematics, for instance, can be contextualised within real examples of ASMP, such

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as spacesuit and EVA physiology. These discussions are feeding into the development of educator-friendly ASMP-based outreach materials. We will share examples of these materials during the conference and would welcome discussion and feedback from attendees as we evolve the content. Various 'Train the trainer' options are being considered for educators and STEM ambassadors to learn about ASMP and to become familiarised with the ASMP material. **DISCUSSION:** In the UK, previous space outreach programs though highly successful, did not exploit the potential of ASMP. Of 889 available resources on the ESERO-UK platform, six activities have a human physiology focus. Similarly, on the ESA international education platform, Mission X, of 41 resources, seven have a human physiology focus. Igniting curiosity among youth about the human body's responses to space can cultivate interest in physiology and its intersections with other sciences, mathematics, and engineering. We propose that ASMP provide a different perspective to illuminate essential concepts in the school curriculum. We believe this collaborative effort between ASMP experts and experienced educators will lead to the development of meaningful, user-friendly outreach materials that will encourage lateral thinking, application of foundational concepts, and an appreciation for human physiology and medicine that can inspire the next generation.

Learning Objectives

1. Cultivating an interest in physiology and its intersections with other STEM subjects will help students develop application skills and an integrated, holistic approach to learning foundational concepts in school.
2. Educating the youth about the human body and its responses to the austere outer space environment can inspire interest in careers within the aerospace industry.
3. Collaborative initiatives between subject matter experts and STEM specialists can lead to the development of meaningful and user-friendly content for educators.

Tuesday, 06/03/2025 ***4:00 PM***
Centennial Ballroom I

[S-26] PANEL: USAF AEROSPACE MEDICINE WAIVER GUIDE: KEY INSIGHTS ON PTSD, AUD, AND TBI SEIZURE RISK

Chair: Kevin Heacock
Co-Chair: Aven Ford

Panel Overview: *This Panel will focus on the United States Air Force Aerospace Medicine Waiver Guide Compendium, a comprehensive resource for aerospace medicine professionals throughout the world. The Panel, comprised of 5 specialists from the United States Air Force School of Aerospace Medicine (USAFSAM) Aeromedical Consultation Service (ACS), will each discuss a chapter of the waiver guide, providing attendees with a comprehensive understanding of the medical standards for each diagnosis and the waiver application process in the Air Force. The session will cover topics such as the evaluation of each of the medical conditions, the use of medical waivers for those conditions, and the impact of each of the medical conditions on operational aircrew and support personnel. Participants will gain insight into the real-world application of the waiver guide, its relevance to their practice, and its timeliness in light of the ever-evolving landscape of aerospace medicine. The unique interest of this session lies in its focus on the Air Force's specific waiver process and its impact on the readiness and safety of aircrew and support personnel. Topics will include Alcohol Use Disorder (AUD), Posttraumatic Stress Disorder (PTSD), and seizure risk in Traumatic Brain Injury (TBI).*

[141] PTSD: UPDATED CLINICAL AND AEROMEDICAL PRACTICE GUIDELINES

Justin Bunn
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Tutorial / Review)

INTRODUCTION: Posttraumatic stress disorder (PTSD) is a disqualifying mental health diagnosis for all classes of flying in the U.S. Air Force. Therefore, the diagnosis can have a significant impact on an individual and mission readiness. **TOPIC:** Posttraumatic Stress Disorder (PTSD) is disqualifying for all flying classes: FCI/IA, FCII, FCIII, ATC, GBO, and SWA. Untreated or undertreated PTSD may have potentially disastrous consequences. A diagnosis of PTSD does NOT require a waiver if the member is able to return to full duty within 60 days after starting treatment (minor residual symptoms are acceptable). However, the condition is disqualifying and a waiver will be required before consideration of return to flight status if any of the following conditions are met: (a) DNIF lasts greater than 60 days after the start of treatment; (b) level of care higher than weekly outpatient treatment was needed; (c) member experiences a recurrence of debilitating symptoms upon return to the operational environment; or (d) original symptom severity was such that in the opinion of the flight surgeon, return to the operational environment would entail high risk to the member, the mission or flight safety should the symptoms recur. Flight surgeons caring for distressed aviators, especially in times of combat, need to be particularly sensitive to these issues and work closely with a psychiatrist or psychologist early in the evaluation, treatment and aeromedical disposition of these aviators whether or not their symptoms are caused by combat/operational stress or other traumatic incidents. PTSD can remit to the point of being eligible for a waiver, especially when treated with evidence-based exposure psychotherapy (the treatment of choice for flyers), healthy lifestyle interventions, and/or antidepressants. The ACS recommends a flyer or operator with PTSD achieve clinical stability (i.e., symptoms of the diagnosis are no longer causing clinically significant distress or impairment and the aviator demonstrates adequate function in social, occupational, and other important areas for functioning) with the period of stability at the discretion of the flight surgeon to pursue waiver. **APPLICATION:** This presentation will simplify the flight surgeon's job by elucidating these concepts and describe effective management strategies for posttraumatic stress disorder (PTSD). **RESOURCES:** 1. Heacock KF and Bunn JA. Posttraumatic stress disorder (PTSD) (Apr 2024). In: Air Force waiver guide. Wright-Patterson AFB (OH): U.S. Air Force School of Aerospace Medicine; 2024:678-684. 2. American Psychiatric Association (Ed.). (2022). Diagnostic and statistical manual of mental disorders: DSM-5-TR (Fifth edition, text revision). American Psychiatric Association Publishing.

Learning Objectives

1. Understand the criteria and conditions under which a PTSD diagnosis becomes disqualifying for flight status in the U.S. Air Force, including the circumstances that necessitate a waiver for return to flight duties.
2. Identify and implement effective management strategies for PTSD in aviators, emphasizing the importance of early collaboration with mental health professionals and the use of evidence-based treatments such as exposure psychotherapy, healthy lifestyle interventions, and antidepressants to achieve clinical stability and support waiver eligibility.

[142] ALCOHOL USE DISORDER: CLINICAL AND AEROMEDICAL PRACTICE GUIDELINES - PART 1

Ryan Peirson
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Tutorial / Review)

INTRODUCTION: Alcohol use is widely accepted and utilized in our society and by United States Air Force (USAF) personnel. It is known to be one of the most problematic and common interferences in the careers of many USAF aviators. **TOPIC:** Even legal, sanctioned use of alcohol can have adverse effects on aviation safety and optimal flying abilities. A diagnosis of alcohol use disorder is disqualifying for all USAF flying classes and requires detailed and assured treatment to be become eligible for a waiver. This presentation will focus on the diagnosis of alcohol use disorder, new ideas to ensure success, and treatment/waiver policy considerations in aircrew. **APPLICATION:** Although specific for Air Force pilots and aircrew evaluated at the Aeromedical Consultation Service, the underlying issues are common to aviators and waiver processes in all the military services and civilian organizations.

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Learning Objectives
1. Understand the diagnosis and treatment of alcohol use disorder in aviators.
2. Enable aviation medical specialists to create the best possible waiver package.

[143] ALCOHOL USE DISORDER: CLINICAL AND AEROMEDICAL PRACTICE GUIDELINES - PART 2

Henrik Close
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Tutorial / Review)

INTRODUCTION: Alcohol use remains one of the most expensive threats to public health and is a common reason for interpersonal, medical, and occupational problems—including the military. **TOPIC:** Even legal, sanctioned use of alcohol can have adverse effects on aviation safety and optimal flying abilities. A diagnosis of Alcohol Use Disorder is disqualifying for all USAF flying classes and requires detailed and assured treatment to be become eligible for a waiver. This presentation will build on the content in Part One and focus on the elements of successful treatment and waiver outcomes. Effective ways to support aircrew in recovery and achieving remission will be discussed and recent monitoring trends will be reviewed. **APPLICATION:** Although specific for Air Force pilots and aircrew evaluated at the Aeromedical Consultation Service, the underlying issues are common to aviators and waiver processes in all the military services and civilian organizations.

Learning Objectives
1. Understand the diagnosis and treatment of alcohol use disorder in aviators.
2. Enable aviation medical specialists to create the best possible waiver package.

[144] ALCOHOL USE DISORDER: CLINICAL AND AEROMEDICAL PRACTICE GUIDELINES - PART 3

Terry Correll
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Tutorial / Review)

INTRODUCTION: It is widely known that alcohol use is one of the most common mental health conditions in US Air Force flyers, causes significant disruption in operational readiness, and is also one of the most common reasons flyers lose their ability to fly and even their aviator careers. **TOPIC:** Even legal, sanctioned use of alcohol can have adverse effects on aviation safety and optimal flying abilities. A diagnosis of Alcohol Use Disorder is disqualifying for all USAF flying classes and requires detailed and assured treatment to be become eligible for a waiver. This presentation will build on the content in Parts One and Two and focus on the elements of successful treatment and waiver outcomes. The focus will primarily be on new and innovation strategies in the US Air Force to hasten the process of obtaining a waiver while providing better oversight and accountability. **APPLICATION:** Although specific for Air Force pilots and aircrew evaluated at the Aeromedical Consultation Service, the underlying issues are common to aviators and waiver processes in all the military services and civilian organizations. 1.Examine and discuss new and innovation strategies in the US Air Force to hasten the process of obtaining a waiver for Alcohol Use Disorder while providing better oversight and accountability during and after treatment.

Learning Objectives
1. Examine and discuss new and innovative strategies in the US Air Force to hasten the process of obtaining a waiver for Alcohol Use Disorder while providing better oversight and accountability during and after treatment.
2. Understand the adverse effects of even legal, sanctioned use of alcohol on aviation safety and optimal flying abilities, and the disqualifying nature of an Alcohol Use Disorder diagnosis for all USAF flying classes.

[145] SEIZURE RISK IN USAF RATED AVIATORS WITH AEROMEDICAL WAIVER FOR TBI

Allan Ward, Joseph Connolly, Aven Ford, Jared Haynes
U.S. Air Force, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Traumatic brain injury (TBI) is the leading neurologic cause of aeromedical disqualification for US Air Force (USAF) aviators due to risks of seizure and neurocognitive disability. Current aeromedical standards for TBI are based on pre-CT era general population studies. We hypothesize that traditional post-TBI seizure rates overestimate seizure risk in asymptomatic USAF rated flyers who have recovered neurocognitively. We sought to ascertain the seizure incidence in this population using longitudinal clinical data. **METHODS:** Aeromedical waiver summaries of USAF rated flyers (Flying Class I, IA, II) with history of TBI were mined using the Aeromedical Information Management Waiver Tracking System (AIMWTS) database. Demographic data, TBI date, age at TBI, TBI severity, mechanisms of injury, loss of consciousness (LOC) and post-traumatic amnesia (PTA) incidence and duration, CT/MRI imaging results, and post-TBI seizure date were extracted. Last known clinical encounter date or last FAA medical certification date, whichever was later, was used to determine seizure-free interval. The study protocol was approved by the USAF 711th HPW IRB. **RESULTS:** AIMWTS query identified 1503 TBI cases in rated flyers between 2001-2023. Mean age at TBI event was 19.41 years (range: 0.26-56.8 years). 1132 (75.3%) TBI cases were mild in severity, with mean follow-up of 13.75 years; 233 (15.5%) TBI cases were moderate, with mean follow-up 15.62 years; and 128 (8.5%) TBI cases were severe, with mean follow-up of 14.96 years. 2 flyers (1 mild, 1 severe TBI) experienced post-TBI seizure. Total time at risk was 21,226.43 years. Seizure incidence was 6.42 cases per 100,000 person-years for mild TBI and 53.89 cases per 100,000 person-years for severe TBI, with an overall seizure rate of 9.42 cases per 100,000 person-years. **DISCUSSION:** Among this cohort of 1503 USAF flyers with TBI, followed for 21,226.43 years combined, there were only 2 cases of post-TBI seizure. The overall seizure incidence (9.42/100,000 person-years) is considerably lower than previously published rates of post-TBI seizure and thus has implications for revising USAF aeromedical waiver standards. Current post-TBI observation times may be too conservative for rated flyers without late posttraumatic seizure, who have recovered neurocognitively and lack clear epileptogenic pathology on brain imaging.

Learning Objectives
1. The participant will be able to identify the primary risks associated with TBI in personnel on flying status.
2. The participant will review the current USAF aeromedical waiver standards for determining degree of head injury and requirements for aeromedical waiver consideration.
3. The participant will learn the observed seizure rate for each TBI severity category in this aviator cohort.

Tuesday, 06/03/2025 ***4:00 PM***
Centennial Ballroom II

[S-37] SLIDE : VISUAL AND VESTIBULAR PHYSIOLOGY AND PERFORMANCE

Chair: Jennifer Benincasa
Co-Chair: Jim Lucas

[197] WITHDRAWN

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[198] EYE-TRACKING AND PERFORMANCE WITH EXTENDED REALITY DISPLAYS

Steven Hadley[1], Marc Winterbottom[1], Eleanor O'Keefe[2], Eric Seemiller[1]
[1]*711th Human Performance Wing, U.S. Air Force Aeromedical Research Lab, U.S. Air Force, Wright-Patterson AFB, OH, United States;* [2]*KBR, Inc., Beavercreek, OH, United States*

(Original Research)

INTRODUCTION: During natural viewing, the oculomotor system interacts with depth information through a tightly related linkage between convergence, accommodation, and pupil miosis, known as the near response. Natural viewing can break down when depth distortions and cue conflicts are introduced in extended reality (XR) displays such as stereoscopic remote vision system (sRVS) or augmented reality (AR) displays. Individual demands of the near response may be in conflict (e.g., vergence-accommodation, or VA, mismatch), limiting the comfort and usability of the XR display. The near response may become more tightly linked to preserve image quality in the presence of VA mismatch. In this experiment, we measured vergence and pupil size of participants using an sRVS. We manipulated depth distortion by changing the viewing distance, creating perceptual compression of the image space, and increasing the VA mismatch. **METHODS:** Thirty-eight participants completed a simulated telerobotic arm task while viewing an sRVS. Participants maneuvered the robotic arm to place a ball in a receptacle as quickly and accurately as possible under two different viewing conditions: 1) near viewing distance (96 cm), high depth compression, 2) far viewing distance (170 cm), low depth compression. An Eyelink 1000 Plus eye-tracker was used to record horizontal and vertical eye position and pupil size at 1000 Hz. **RESULTS:** The mean peak correlation between pupil velocity and vergence was 0.454 in the near viewing condition and 0.389 in the far viewing condition, which was significantly different ($t = 3.22$, $p = 0.003$). There was also a significant correlation between an individual's peak correlation at near and far ($r = 0.542$, $p = 0.002$). **DISCUSSION:** We found a strong positive cross-correlation of vergence posture and pupil size in all participants in both conditions. The response was significantly stronger and quicker in the near viewing condition, which may indicate a physiological response to compensate for VA mismatch by increasing the depth of focus. The use of eye-tracking provides a methodology to examine performance with the use of XR displays such as sRVS and AR displays used in many different simulation and training applications where vision and physiological symptoms have frequently impaired performance.

Learning Objectives

1. The audience will understand how vergence-accommodation mismatch and related distortions may impair the use of extended reality displays.
2. The audience will consider how eye-tracking technology can potentially be used to examine performance with extended reality displays.

[199] EYE MOVEMENT BIOMARKERS WITHIN A POPULATION AND THEIR RELATIONSHIP TO OPERATIONAL PERFORMANCE

Marc Winterbottom[1], Steven Hadley[1], Eric Seemiller[2]
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(Original Research)

INTRODUCTION: Variation in eye movement behavior can provide objective insight to an individual's neurological health and can also be used as a performance biomarker to predict future operational performance. Smooth pursuit eye movements (SPEM), a class of eye movement where one smoothly tracks a moving target, may be uniquely suited at providing a broad snapshot of useful performance markers because of its extensive neural control circuitry. To test this, we examined SPEM-based biomarkers in a large population and related them to performance on a telerobotic-arm operation task. **METHODS:** Eighty-seven participants ran a SPEM protocol on a commercially-available eye-tracking-based health screening device (neuroFit ONE, neuroFit, Mountain View, CA). This device reports 11 different biomarkers related to smooth pursuit, plus a summary metric. Participants were also tested on a stereoscopic 3D telerobotic arm operation task, in which the had to quickly an accurately align the arm to a remote target between 6 and 12 m downrange. Task performance was then related to individual biomarkers at the population level and to subgroups following a clustering analysis. **RESULTS:** At the population level, SPEM biomarkers were correlated with performance on the telerobotic arm operation task, especially with outcome variables related to dynamic performance ($r = 0.547$, $p = 0.003$). Following a cluster analysis that revealed two distinct subgroups, correlation with task performance was substantially higher in one group ($r = 0.621$, $p < 0.001$) and not significant in the second group ($r = -0.012$, $p = 0.968$). **DISCUSSION:** These results demonstrate significant relationships between SPEM biomarkers and operational performance. Because SPEM biomarkers are influenced by broad cortical and subcortical circuity, unique intuition about future performance may be realized. Further, by revealing two distinct populations of SPEM performers, insights may be made about natural human variation and relevant aeromedical screening.

Learning Objectives

1. The audience will understand smooth pursuit eye movements and quantifiable biomarkers related to them.
2. The audience will consider how these types of biomarkers may be related to future operational performance.

[200] CHANGES IN TILT PERCEPTION FOLLOWING SICKNESS INDUCED BY CENTRIFUGATION

Taylor Lonner, Caroline Austin, Joanna Blake, Parinie Gupta, Jason Katz, Aadhit Gopinath, Torin Clark
University of Colorado Boulder, Boulder, CO, United States

(Original Research)

INTRODUCTION: Gravity transitions are known to result in a host of vestibular dysfunctions in astronauts, including spatial disorientation (SD). As upcoming missions for the Artemis program seek to land astronauts at the Lunar South Pole, there is a concern that astronauts experiencing SD may have to take an active role in the landing operation as they did during the Apollo program. One neuro-vestibular analog for the gravity transition during lunar landing is Sickness Induced by Centrifugation (SIC), which has been investigated for motion sickness and ocular changes. Here we investigate the impact of SIC on tilt perception, as a ground-based analog for astronaut SD which can help develop active countermeasures. **METHODS:** To quantify the changes in tilt perception following SIC, subjects performed a subjective haptic horizontal (SHH) task during variable-frequency (0.05-0.5Hz) sum-of-sine tilt and translation profiles following one-hour exposure to a) SIC with a net 2G in the negative head-centered x-axis (i.e., "eye balls in") created using a short-radius centrifuge and b) a control condition in which the subjects lay Supine with gravity pointing in the same direction, but with a magnitude of only 1G. Exposure order was counterbalanced and separated by 3-5 days. Following each exposure, subjects were immediately transferred into a two degree-of-freedom motion device where they performed the SHH task to report tilt perception. **RESULTS:** In roll tilt, subjects (n=10, age=24±4 years) underestimated tilt following SIC in comparison to their Supine baseline according to a percent change (Δ=-12.0%, $t(69)=-2.53$, $p=0.014$), as well as a perception vs. actual tilt slope (log-transformed, $\Delta=-0.07$, $t(279)=-2.57$, $p=0.011$). **DISCUSSION:** Following SIC, subjects significantly underestimated tilt perception in comparison to a Supine baseline. SIC altered orientation perception, suggesting it can be used as a ground-based analog for SD. By characterizing changes in orientation perception following gravity transitions, we can develop real time monitoring systems that could track disorientation and activate

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countermeasures at the appropriate times for astronauts undergoing gravity transitions, thereby reducing the risk associated with piloting operations during spaceflight.

Learning Objectives

1. The audience will learn about the changes in tilt perception following hyper-gravity exposure.
2. The participant will be able to understand the importance of active countermeasures for lunar landings.
3. The participant will learn about the dangers of spatial disorientation in spaceflight.

[201] NINE-STEP TYMPANOMETRY: SCREENING TOOL FOR EUSTACHIAN TUBE DYSFUNCTIONS

Neha Rao, Rahul Pipraiya, Ranjan Sarkar
Institute of Aerospace Medicine, Bengaluru, Bengaluru, India

(Original Research)

INTRODUCTION: Eustachian tube dysfunction (ETD) is a commonly diagnosed disorder of Eustachian tube (ET) opening and closure, which may be associated with severe symptoms and middle ear disease. The Ear Clearance Run (ECR) in the Decompression Chamber (DC) is used to assess their ET patency and functioning. Individuals with ETD when subjected to high descent rates like in the ECR, are at an increased risk of developing barotrauma. Hence, a relatively safe test was needed to evaluate ET function in aircrew/paratroopers. **METHODS:** 105 combat free fall (CFF) trainees participated in the study. Following an initial ENT examination, 9-step tympanometry was done. In the test 04 tympanograms, which included a baseline tympanogram, tympanogram after positive pressure (+200 mm H2O), tympanogram after negative pressure (-200 mm H2O) and a final tympanogram after releasing the pressures were recorded for each ear. The participants were then subjected to the ECR in the DC chamber where they were subjected to an altitude of 10,000 feet with an ascent and descent rate of 3000fpm. Post run ENT examination was done. The differential peak compliance pressures from the baseline in the nine-step tympanometry were calculated for predicting ETD and were analyzed in comparison to the barotrauma cases in the ECR in the EDC. **RESULTS:** Results showed the nine-step tympanometry had a high sensitivity of 90.91% but a very low specificity 7.45% when compared with the ECR in the EDC. On analyzing the data, it was also observed that a difference between peak compliance pressure if reduced from 20 mm H2O to 12.5 mm H2O, would give better sensitivity and specificity. **CONCLUSION:** The results of the study indicated a fairly reasonable possibility of barotrauma in cases that were found to be positive on nine-step tympanometry. Therefore, in ETD cases requiring ECR prior to upgradation, nine-step tympanometry can be used as a screening tool before exposing an individual to actual pressure changes in a decompression chamber.

Learning Objectives

1. Utilisation of nine-step tympanometry as a screening tool for eustachian tube dysfunctions.
2. Reducing chances of iatrogenic barotrauma during conduct of ear clearance run in the decompression chamber.

[202] ALTERING SENSORIMOTOR FUNCTIONAL PERFORMANCE WITH GALVANIC VESTIBULAR STIMULATION

Caroline Austin, Luc Willet, Sebastian Dibildox, Torin Clark
University of Colorado Boulder, Boulder, CO, United States

(Original Research)

INTRODUCTION: Astronauts experience sensorimotor deficits upon return to Earth after prolonged exposure to microgravity. Among the symptoms that astronauts experience postflight are vestibular perceptual illusions linked to head tilts. Specifically, when astronauts tilt their heads relative to gravity, they experience sensations of tilt overestimation and/or translation. These illusions along with other factors result in impaired performance on balance, mobility, and piloting tasks which poses a risk for astronauts. Galvanic Vestibular Stimulation (GVS) can alter vestibular perception and has previously been investigated as a postflight sensorimotor analog, but previous implementations have not coupled GVS to head-tilt. Here we build upon previous work to test a new GVS implementation aimed at better mimicking astronaut postflight sensorimotor impairment. **METHODS:** 11 Participants (3F, 27±8.4 years) completed a series of functional performance tasks that have been studied in astronauts postflight, including an obstacle course, tandem walk, modified Romberg balance test, and simulated piloting task. Participants completed the tasks under 3 conditions of GVS application: a purely motion coupled GVS waveform with coupling to roll and pitch head tilt angle and angular velocity, a combined pseudorandom sum of sines waveform superimposed with the same motion coupled GVS waveform, and a No GVS control condition. Results were evaluated using non-parametric repeated measures ANOVA and post-hoc paired t-tests. The study was approved by CU Boulder's IRB (Protocol 22-0171). **RESULTS:** Participants performed worse on the functional mobility tasks when exposed to the disruptive GVS waveforms. This effect was most prominent on the most difficult tasks. In particular, when participants were required to tilt their head during a task, they performed worse due to the tilt-coupled GVS ($p<0.05$). Some participants reported alterations in perception including a sensation of tilt overestimation. **DISCUSSION:** Our results indicate that head tilt-coupled GVS is capable of reproducing sensorimotor impairments that reduce performance on functional tasks similar to the performance decrements seen in astronauts post-spaceflight. Coupling GVS to head-tilt rather than other motion parameters or simply a random waveform will provide a better analog and training tool by associating the sensorimotor challenges with the same head movements which lead to sensorimotor challenges post-spaceflight.

Learning Objectives

1. Consider GVS as a means to alter orientation perception and provide a postflight sensorimotor analog.
2. Compare results of analog study to astronaut post flight performance.

Tuesday, 06/03/2025 ***4:00 PM***
Centennial Ballroom III

[S-28] PANEL: ARE PCMS READY FOR COMMERCIAL SPACEFLIGHT? RESULTS OF AN INTERNATIONAL SCOPING REVIEW FOR IMPACTS ON IMMUNOLOGICAL, GI, BEHAVIORAL, AND MSK HEALTH

Chair: J. Karen Klingenberger
Co-Chair: Tamara Averett Brauer

Panel Overview: *As commercial spaceflight (CSF) becomes more available and more affordable, the greater medical community, specifically individual primary care managers (PCMs), will be asked to evaluate the fitness and medical appropriateness for individuals who want to undertake a range of available flight profiles with CSF companies. Currently, the medical screening process is at the discretion of the individual space operators. Notably, there are few publicly available comprehensive standards for screening individuals for trans-atmospheric, orbital, lunar, or planetary spaceflights. A comprehensive and methodologically rigorous CSF Scoping Review (ScR) addressed the emerging topic and research question: What resources are available to inform PCMs regarding medical considerations related to the spaceflight environment, so they can have informed discussions with clients regarding CSF travel? Ten teams comprised of international AsMA members were assembled by*

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organ system to systematically review publicly available literature to identify known, suspected, or potential medical issues and associated risks for CSF. Included articles were assessed using Johns Hopkins Levels and Quality of Evidence. Five research databases were queried using the timeframe 2000 to present, using keywords developed by each team. This panel presents results from four teams: Gastrointestinal/Nutrition, Musculoskeletal/Renal, Immunology, and Psychology/Behavioral Health. Each presentation will discuss their methods and specific findings, focusing especially on information PCMs may find useful to guide patients seeking a CSF opportunity. Areas of sparse evidence as well as areas for future research are identified. The CSF ScR results provide a resource for PCMs and builds a foundation for recommendations informing future development of medical screening standards.

[151] GI/NUTRITION CONSIDERATIONS FOR POTENTIAL COMMERCIAL SPACE FLIGHT PASSENGERS

Catherine Raisa Kimberly Mandigma[1], JaneClaire Maciejewski[2], Donna Fearon[3], Ulysee Comte[4], Dacia Boyce-Miller[5], Stavroula Chaloulakou[6]

[1]*The University of the Philippines - Diliman, Quezon City, Philippines;* [2]*U.S. Air Force, Sagamore Hills, OH, United States;* [3]*U.S. Air Force, Pasedena, MD, United States;* [4]*French Air Force, Paris, France;* [5]*U.S. Army, Fort Carson, CO, United States;* [6]*student, Thessaloniki, Greece*

(Original Research)

INTRODUCTION: The rapidly developing era of commercial spaceflight (CSF) brings a growing interest in spaceflight experiences from spacefarers that lack professional astronaut qualifications. In time, individuals across the spectrum of age and health will present to primary care clinicians for aeromedical risk assessments pertinent to CSF. A scoping review was conducted to assess the current literature and conduct gap analysis on gastrointestinal (GI) and nutrition-related medical conditions. **METHODS:** A search was conducted of English language peer-reviewed literature published from 2000—2023 in five databases (PubMed, EMBASE, CINAHL, PSYCINFO, and Web of Science) using a list of search terms developed by the CSF GI/Nutrition working group. Title/abstract screening and full text review were conducted in accordance with PRISMA guidelines. Each article was screened for inclusion by two reviewers with conflicts arbitrated by a third, senior reviewer. **RESULTS:** The final keyword list included 178 search terms. Database searches yielded 6092 citations. After title/abstract and full text screening, 193 were included for review. Numerous analog studies surveyed for microbiome changes, which were variable. During head-down tilt, stomach acid secretion increased. Under dry immersion, gastrointestinal tract motility was largely unchanged. Short term exposure to microgravity analog caused an increase in bile flow and hepatic blood flow; long duration isolation was also correlated with an increase in bilirubin. Efficacy of nutraceuticals to counteract space-related health decrements were variable; amino acid supplementation helps reduce muscle catabolism. Articles mainly focused on statistical changes in markers or organ activity. Few studies correlated biological findings with symptoms, hampering their clinical utility. **DISCUSSION:** This scoping review of GI/Nutrition issues pertinent to CSF uncovered a large but generally technical set of studies. Data translatable into actionable advice for primary care physicians was lacking. There was a distinct paucity of articles pertinent to GI conditions or diseases and how to prevent or treat emergencies. Future research incorporating reported symptoms and more medically diverse subject population is recommended. The aeromedical community may also adapt medical recommendations from traditional sources (e.g., military aviation protocols; professional astronaut studies) to inform clinical decisions for future CSF spacefarers.

Learning Objectives

1. The audience will be able to identify key gastrointestinal and nutritional changes associated with short- and long-term spaceflight analog environments and their potential implications for commercial spaceflight (CSF) passengers.
2. The audience will be able to evaluate gaps in the current literature regarding GI/Nutrition-related health risks for CSF, including the lack of actionable guidance for primary care physicians conducting aeromedical risk assessments for diverse populations of spaceflight participants.
3. The audience will be able to assess the clinical limitations in current GI/Nutrition research for CSF and outline future research directions to enhance primary care guidance for diverse spaceflight participants.

[152] MUSKULOSKELETAL SYSTEM HEALTHCARE CONSIDERATIONS FOR COMMERCIAL SPACEFLIGHT PARTICIPANTS - A SCOPING REVIEW

Tejal Gala[1], Rowena Christiansen[2], Roya Ghafoury[3], Saswati Das[4], Eric LeRoy[5], Nimish Kadakia[6], Jack Zin[7], Tyler Le[8], Michael Matthews[9], Ulysse Comte[10]

[1]*Keck School of Medicine of USC, Santa Ana, CA, United States;* [2]*The University of Melbourne Medical School, Melbourne, Australia;* [3]*Iran University of Medical Sciences, Tehran, Islamic Republic of Iran;* [4]*ABVIMS & Dr. Ram Manohar Lohia Hospital, Indraprastha University, New Dehli, India;* [5]*NYU Grossman School of Medicine, New York, NY, United States;* [6]*South County Orthopedic Specialists, Irvine, CA, United States;* [7]*Mount Royal University, University of Calgary, Calgary, AB, Canada;* [8]*USF Health Morsani College of Medicine, Tampa, FL, United States;* [9]*Western Michigan University, Kalamazoo, MI, United States;* [10]*Percy Army Training Hospital, Clamart, France*

(Original Research)

INTRODUCTION: Commercial spaceflight (CSF), where private individuals participate in spaceflight missions on a paid basis, began over two decades ago, and the sector has recently undergone rapid expansion. Consequently, adult aspirants are increasingly interested in participating, and primary care providers may need to provide advice and conduct medical risk assessments regarding 'fitness to fly'. Demographically speaking, pre-existing musculoskeletal (MSK), orthopaedic, and renal medical considerations may be more common. This scoping review (ScR) was conducted to assess available literature regarding MSK physiology in the context of CSF, and to highlight gaps in knowledge and evidence. **METHODS:** English-language peer-reviewed literature from 2000 to 2023 was searched using common global search terms and body system-specific terms. A professional research librarian conducted a search of five databases (PubMed, EMBASE, CINAHL, PSYCINFO, Web of Science). Title/abstract screening and full text reviews were facilitated using Covidence software, using Microsoft Excel for data extraction. Each article was screened and reviewed for inclusion by a minimum of two team members, with conflict arbitration. **RESULTS:** The final keyword search term list included 287 system-specific and global terms. Database searches yielded 7,754 unique results, with 4,978 post-duplicate articles proceeding to title and abstract screening and a subsequent full-text review of qualifying articles. 34 articles were selected for data extraction, including 3 centrifuge, 2 dry-immersion, 19 head-down-tilt bed-rest studies or reviews, 7 other reviews, and 3 guideline articles. Three studies included renal elements. **DISCUSSION:** This methodologically rigorous ScR provides primary care providers with access to published evidence relating to MSK considerations in the context of the known hazards of spaceflight, particularly differing gravitational fields, that is useful for medical screening of potential CSF participants with MSK comorbidities. To achieve maximal utility, it would be worthwhile to consider supplementing the limited findings through adaptation of accepted aerospace medicine screening standards and prior CSF recommendations. These results support the aerospace medicine community in informing CSF medical screening standards, outlining a framework for CSF safety regulations, and focusing future research priorities for the medically diverse population of future CSF spacefarers.

Learning Objectives

1. Attendees will understand the methodical search strategy underlying this scoping review.

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2. Learners will appreciate that medical research relating to commercial spaceflight is still an emerging field compared to research concerning professional astronauts.
3. Attendees will be able to identify important considerations for commercial spaceflight participants with musculoskeletal comorbidities.

[153] IMMUNOLOGICAL HEALTH RISKS IN COMMERCIAL SPACEFLIGHT (CSF): A SCOPING (SCR) REVIEW FOR CLINICAL PREPAREDNESS

Satyam Patel[1], Tejal Gala[2], Jonathan Szeto[3], Stephen Kunkle[4], Krishi Korrapati[5], Cooper Lytle[5], Christopher Janssen[6], Roseirene Gessinger[7]
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(Original Research)

INTRODUCTION: As space becomes more accessible, there is a new demographic of commercial spaceflight participants who may not meet the traditional professional qualifications and rigorous health screenings for spaceflight. Their diversity in age and pre-existing health conditions will necessitate comprehensive medical assessments by healthcare providers prior to any commercial spaceflight. This ScR analyzes available literature across immunology, infectious diseases, and oncology relevant to commercial spaceflight, to identify health risks, providing clinical insights, and equip clinicians with the knowledge needed for pre-flight evaluations, countermeasures, and postflight rehabilitation. **METHODS:** A systematic literature search was conducted across five scientific databases, PubMed, EMBASE, CINAHL, PSYCINFO, and Web of Science, focusing on English-language, peer-reviewed articles. 111 concepts were reviewed, including 65 terms central to immune physiology and pathology, 22 infectious disease-related concepts, and 14 key oncologic terms, selected by the CSF Immunology working group. Covidence software was used in title screening and full-text review, with inclusion/exclusion criteria assessed by two medical professional reviewers and a third senior member as arbiter. **RESULTS:** Database search yielded 10,143 articles, from which 146 were selected for full-text review. 82 articles were included, related to immune system dysregulation, inflammatory conditions, and latent viral reactivation associated with spaceflight. Clinical insights gathered from these studies emphasize specific risks and preventive strategies for the immune system challenges likely to affect the non-professional astronaut population. Studies focusing on professional astronauts were excluded, so that the analysis reflects the needs of the commercial spaceflight demographic. **DISCUSSION:** This review highlights the theoretical and experimental nature of the physiological changes relevant to the immune system and its behavior in the spaceflight exposome. This work supports primary care providers and aerospace medicine practitioners in addressing potential health hazards and adapting medical protocols for the evolving space tourism landscape. We hope this scoping review will foster further research and inform guidelines to manage the unique clinical challenges posed by commercial spaceflight, helping practitioners mitigate risks and prepare for adverse health scenarios in space.

Learning Objectives

1. Attendees will understand the unique immunological challenges and conditions related to commercial spaceflight with an emphasis on immune dysregulation, inflammatory response, latent virus reactivation and susceptibility to infectious disease.
2. Learners will be able to analyze the current state of literature on immunology in the context of spaceflight emphasizing the importance of addressing knowledge gaps related to immune health risks for non-professional astronauts.
3. Attendees will apply insights from the latest literature immunology, infectious diseases and oncology pertaining to commercial spaceflight to support comprehensive health evaluations and risk mitigation strategies for non-professional astronauts.

[154] PSYCHOLOGICAL AND BEHAVIORAL HEALTH CONSIDERATIONS FOR COMMERCIAL SPACEFLIGHT PARTICIPANTS: A SCOPING REVIEW

Basil Spyropoulos[1], Philip Brady[2], Alires Almon[3], David Baltali[4], Aubrey Florom-Smith[5], Tejal Gala[6], Nimantha Gamage[2], Jamil Jomaa[7], Samuel Ko[8], Amit Mistry[9], Ron Padua[10]
[1]*Civil Aviation Medical Association, Elmhurst, IL, United States;* [2]*Trinity College, Dublin, Ireland;* [3]*Arizona State University, Tempe, AZ, United States;* [4]*Canadian Society of Aerospace Medicine, Ottawa, ON, Canada;* [5]*Stanford Unversity, Stanford, CA, United States;* [6]*University of Southern CA, Santa Ana, CA, United States;* [7]*Wayne State University School of Medicine, Detroit, MI, United States;* [8]*Aerospace Medical Association, Alexandria, VA, United States;* [9]*Oklahoma City VA Medical Centre, Oklahoma City, OK, United States;* [10]*Canadian Forces Health Services Group, Ottawa, ON, Canada*

(Original Research)

INTRODUCTION: Physicians are increasingly tasked with the medical risk evaluation of potential commercial spaceflight (CSF) participants who may have psychological and behavioral health conditions. This scoping review (ScR) was conducted to identify and evaluate publicly available psychological and behavioral health resources for physicians, aiming to inform future research and clinical practice. This ScR extends our initial methodology testing and builds upon the preliminary results presented at ICAM 2022. **METHODS:** A ScR was conducted of peer-reviewed literature published in English from 2000 to 2023. The CSF Psychology and Behavioral Health team developed 195 keywords (e.g. anxiety, depression, psychosis, circadian rhythm, etc.) using resources including the Diagnostic and Statistical Manual of Mental Disorders (DSM-5-TR) and the International Classification of Diseases (ICD-10 and ICD-11). A research librarian searched these keywords and MeSH terms in PubMed, EMBASE, CINAHL, PsycINFO, and Web of Science. Title and abstract screening and full-text reviews were conducted via Covidence. Articles were assessed for inclusion by at least two team members, with third-party mediation by a senior team member when necessary. Literature focused on professional astronauts was excluded. **RESULTS:** The database searches yielded 9,166 articles that met the initial inclusion criteria. After screening, few articles specifically addressed behavioral health conditions in CSF participants. Twenty-nine full texts were included for extraction. The literature highlights conditions relevant to CSF participants, including mood and anxiety disorders (7 articles), psychosis (2), sleep disorders (6), and interpersonal challenges (5). Two citations address psychotropic medication use and associated risks in space environments. **DISCUSSION:** Limited evidence exists to guide physicians in the assessment and management of CSF participants. Given the inherent risks of spaceflight, which could lead to new or unpredictable psychological experiences, this ScR highlights the urgent need for ongoing research in CSF behavioral health. Additionally, pharmacotherapy may be necessary for effective in-flight management, highlighting the need for a deeper understanding of pharmacodynamics and pharmacokinetics in microgravity. Future studies should prioritize these areas to enhance evidence-based practices, supporting safe and informed participation in commercial spaceflight.

Learning Objectives

1. Attendees will learn about the existing psychological and behavioral health resources available to primary care providers for commercial spaceflight participants.
2. Learners will be able to identify existing gaps in psychological and behavioral health commercial spaceflight research.
3. Attendees will be able to determine the best select-in and select-out criteria for spaceflight participants with psychological or behavior health comorbidities among different flight and mission profiles.

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[155] BRINGING IT ALL TOGETHER: CHALLENGES OF A GLOBAL CSF SCOPING REVIEW

Tamara Averett-Brauer[1], Tejal Gala[2]
[1]*U.S. Air Force, Beavercreek, OH, United States;* [2]*University of Southern CA, Santa Ana, CA, United States*

(Education - Program / Process Review)

BACKGROUND: As commercial spaceflight (CSF) becomes more accessible, the medical community is increasingly tasked with determining whether spacefaring hopefuls are medically fit for such flights. This is made challenging by the paucity of publicly-available comprehensive standards for preflight screening. The medical screening process for spaceflight is currently at the discretion of individual space operators, and research into medical preparedness issues, risk analysis, and risk mitigation is scattered and possibly uneven. **DESCRIPTION:** The AsMA Ad Hoc Committee for Commercial Spaceflight conducted an in-depth Scoping Review to explore the breadth of the literature, map and summarize the evidence, and inform future research. The specific objective was to "Identify resources for primary care medical personnel to inform clients regarding relevant medical considerations related to commercial spaceflight." Managing the breadth of the global project was challenging due to the large number of participants (over 160 members from 15 countries), multiple time zones and busy professional schedules. A unifying methods document guided and provided consistency among the ten body system groups. Collaborative tools enabled the global effort including video conferencing software (Zoom), systematic review software (Covidence), collaborative workspace (Google Drive) and a reference manager (Zotero). Modern connectivity channels (WhatsApp, Slack) fostered asynchronous conversations among team members. Enlisting a professional research librarian was critical to this effort, with advice on comprehensive search strategies, database searches, and loading full text articles for analysis. Project and team leaders ensured progress with a roadmap, timeline, and regular meetings. **DISCUSSION:** Commercial spaceflight crosses disciplines and organizations (civilian, military, government, academia, industry, commercial, international), and AsMA is a key partner in these efforts. We demonstrate that it is not only vital, but feasible, to Bring it All Together with a global team collaborating asynchronously. The CSF Ad Hoc committee advances aerospace medicine and human performance with a rigorous scoping review revealing what is, and what remains to be, known. The success of presentations at AsMA in Chicago and ICAM in Lisbon demonstrated the interest in this burgeoning area of aerospace medicine.

Learning Objectives

1. Learners will describe two collaborative platforms that can be helpful with global team projects.
2. Attendees can list two challenges associated with the global Commercial Spaceflight Scoping Review as described by the presenter.

Tuesday, 06/03/2025 ***4:00 PM***
Centennial Ballroom IV

[S-29] PANEL: INFLIGHT MEDICAL EMERGENCY RESPONSE CAPABILITY. CURRENT STATE, LEARNINGS AND CHALLENGES

Chair: Ben Johnston
Co-Chair: Paulo Alves

Panel Overview: BACKGROUND: *Approximately 4.5 billion people travelled as airline passengers in 2023. Estimates suggest that this volume of air travel is associated with more than 50,000 in-flight medical emergency events. Over the past ten years there has been increasingly rapid development of technology to support assessment of patients in the air, and communication of information to ground-based medical assistance providers. To date there is no formal guidance or standards, and a relative lack of published data about the outcomes from deploying such technology. The Air Transport Medicine Committee has an interest in promoting shared learning about how emerging technologies and thinking are being used to enhance safety and effectiveness of inflight medical emergency response.* ***PANEL DESCRIPTION:*** *This panel explores the real-world examples of implementation of systems to respond to in-flight medical emergencies, including human, technical (hardware and software) and systems elements. Presentations will discuss how training and technology can enhance medical support for passengers during flights, approaches to assess investment cases in novel technology, deployment of communication apps onboard, and the deployment of telemedical devices in long-haul airlines. Through sharing these experiences the panel aims to identify the current state of in-flight medical emergency response systems, challenges, and learnings.* ***DISCUSSION:*** *Hardware, software and communications technology are evolving rapidly however relatively few airlines have deployed these new capabilities, and there is no published data from those who have. Therefore this panel presents a unique opportunity to learn from examples at the leading edge of in-flight emergency medical response capability.*

[156] MANAGING IN-FLIGHT MEDICAL EMERGENCIES: INSIGHTS FROM AN IMMERSIVE SIMULATION STUDY

Leigh Speicher, Dana Herrigel, Diego Garcia, Leslie Simon, Josh Carter, Warren Cantrell
Mayo Clinic, Jacksonville, FL, United States

(Original Research)

INTRODUCTION: In-flight medical emergencies (IMEs) present a unique set of challenges for cabin crew and medical professionals due to limited resources, constrained environments, and often decayed or limited responder skills. IMEs are estimated to occur at a rate of 1 per 604 flights, with syncope, gastrointestinal issues, respiratory symptoms, and cardiovascular events being the most common1. Most low-complexity incidents are managed by cabin crew, and medical volunteers are often called upon for complex situations. However, with only limited medical supplies and significant variability in personnel expertise, a coordinated response is difficult. This observational study aimed to gather impressions, perceptions and assess educational value for aeromedical experts in an immersive simulation setting. **METHODS:** An observational study was conducted with 111 aeromedical professionals who attended an immersive simulation exercise as part of a conference. The simulation involved nine scripted IMEs performed by professional actors in a commercial flight setting, with escalating complexity. Pre- and post-simulation online questionnaires, accessed via QR codes, gathered data on demographics, comfort levels, skill decay, and educational value. Descriptive statistics were used to analyze responses. The study was IRB exempt, and participation was voluntary. **RESULTS:** Of the 111 participants (57% aged 50–64, 31% over 65; 73% male), 58% had over 20 years of aeromedical experience. Forty six percent of participants identified as practicing in the field of aerospace medicine, followed by Internal Medicine (35%). Pre-simulation, 27% of this group of experts reported notable skill decline. Only 15% felt very comfortable managing IMEs initially. Post-simulation, 65% rated the training experience as extremely effective for IME preparation, with 54% likely to apply these skills in-flight. **DISCUSSION:** IME management is complicated by resource limitations, skill decay, and variable preparedness among first responders. Despite extensive experience, many aeromedical professionals felt inadequately prepared pre-simulation, underscoring the need for recurrent, scenario-based training to improve skills retention. Further research should evaluate standardized IME response training to enhance onboard medical response quality and confidence.

Learning Objectives

1. Identify common challenges in managing in-flight medical emergencies (IMEs).
2. Understand the perception of skill decay on aeromedical professionals' preparedness for IMEs and assess how immersive simulation training influences confidence and skill improvement.

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3. Analyze the role and limitations of cabin crew and onboard medical professionals in managing IMEs.

[157] UTILIZATION OF AN IN-FLIGHT APP BY A MAJOR US ARILINE

Greg Vanichkachorn[1], Paulo Alves[2], Justin Devlin[2], Neil Nerwich[3], Ben Johnston[4]
[1]*Delta Airlines, Atlanta, GA, United States;* [2]*Medaire, Phoenix, AZ, United States;* [3]*International SOS, London, United Kingdom;* [4]*Air New Zealand, Auckland, New Zealand*

(Original Research)

INTRODUCTION: Air-to-ground communication is reportedly one of the barriers to better utilization of ground-based medical support (GBMS). With the objective of improving communication during in-flight medical events, a major US-based airline started systematically utilizing an in-flight App (IFA) to augment the management of inflight medical events. The IFA offers different possible medical scenarios for the crew members (CMs) to choose from, guiding them through context specific medical questions. The IFA also allows for direct communication from the passenger cabin to GBMS via VOIP. The initiative was well-received by crew members, but tangible results were not demonstrated before this study. **METHODS:** The database of the GBMS provider to the airline was retrospectively used to retrieve data in the period of January 1st to October 27th, 2024. Cases were divided according to the use or not of the in-flight IFA into IFA or Control (CTL). IFA could be utilized to collect and send clinical data and/or to call GBMS via VOIP. EpiInfo 7.2.6 was utilized for statistical analysis. **RESULTS:** A total of 3,699 cases were available for analysis. In 221 cases GBMS was involved for EMS activation, but not case handling. IFA corresponded to 52.7% of the cases. IFA cases were significantly associated with less diversions (1.76% vs. 3.23% - Odds ratio: 0.53 / 0.35-0.82 p = 0.005). The finding persisted when GBMS was not involved. No significant difference was noted when the voice feature was compared. IFA cases also reduced doctor's case handling time, by an average 1:17 minutes. **CONCLUSIONS:** Initial data indicates a reduction of diversions associated with IFA utilization, independent of the use of its voice feature. The relatively small reduction in connection time implies significant savings in communications for the airlines, as well as GBMS doctors' efficiency, when the volume of cases is considered.

Learning Objectives

1. Understand the impact of new technologies on the efficiency of air-to-ground communication.
2. Recognize the value of streamlining medical information collected by flight attendants during a medical emergency.

[158] THE EVOLUTION OF ONBOARD TELEMEDICINE IN A LARGE INTERNATIONAL AIRLINE

Azeem Ali, Simon May
Emirates Airline, Dubai, United Arab Emirates

(Education - Program / Process Review)

BACKGROUND: Telemedical devices designed for use during in-flight medical emergencies have been available for many years however have not been widely adopted due to cost, complexity and uncertainty about benefits. While a few airlines have been using such systems for more than ten years there is a lack or published data. This presentation will chart the evolution of onboard telemedicine in one large international airline, predominantly flying long haul routes. This airline was an early adopter of telemedicine technology. The evolution of an outsourced to insourced model of telemedical services will be explored. Also the challenges of using onboard telemedicine hardware. The application of software solutions will also be discussed. This knowledge can be applied to understand the interaction of onboard staff with operations staff on the ground. How technology can enable optimal outcomes will also be discussed.

Learning Objectives

1. Understand the benefits and challenges of using telemedicine hardware and software in the onboard environment.
2. The audience will learn about how systems integration and communication enhance outcomes.
3. The audience will learn about the impact of an in-flight telemedical system on patient and operational outcomes.

[159] WHAT IS THE CASE FOR IN-FLIGHT ECG CAPABILITY

Ben Johnston
Air New Zealand, Auckland, New Zealand

(Education - Program / Process Review)

The case for investing in in-flight telemedical systems hinges on improving passenger safety and reducing the operational costs associated with medical diversions. With over 4.5 billion passengers flying annually and approximately 50,000 in-flight medical emergencies occurring each year, airlines face an increasing demand for solutions that can support medical assessments at altitude, particularly for potential cardiac events. In-flight telemedical systems enable real-time data transmission to ground-based medical teams, allowing for accurate in-flight assessments that can distinguish between benign conditions and critical cases, ultimately helping to avoid unnecessary diversions. Alternatively better-informed decisions may avoid inappropriate continuation of flight thereby avoiding poor outcomes for the passenger and liability for the airline. However, there is a lack of publicly available data on which to base informed decisions regarding the relative costs and benefits of this technology. In the absence of any applicable international standards airlines' medical advisors may be required to assess the case for investment in new technology. This presentation will focus on the methodology used to construct and analyze an investment case for adopting in-flight ECG capability. We will outline possible approaches to considering the value of such an investment. We will then outline the steps taken to evaluate the financial impact of implementing these systems across wide-body, long-haul aircraft, detailing how avoided diversion costs—averaging $250,000 per incident—were factored into a cost-benefit analysis. Key criteria examined included direct costs, such as the purchase and maintenance of devices, and indirect costs, such as crew training and integration with existing aircraft infrastructure.

Learning Objectives

1. The audience will learn about what outcomes may drive value from deploying inflight ECG capability.
2. The audience will learn about the challenges to seeking management approval to invest in novel medical technology, including cost drivers.
3. The audience will learn about methods to undertake balanced quantitative assessments of value and cost drivers to assist them in advising managers on decisions about whether to invest in novel medical capability.

Tuesday, 06/03/2025 ***4:00 PM***
Regency Ballroom V

[S-51] SLIDE : TO WORK OR NOT TO WORK? (THAT IS THE QUESTION)

Chair: Allen Parmet
Co-Chair: Dragana Dragic Ranisavljevic

[279] UNFIT DECISIONS IN INITIAL CABIN CREW APPLICANTS. A RETROSPECTIVE ANALYSIS OF EASA MEDICAL ASSESSMENTS.

Fabian Hofmann, Thomas Schmitt
Lufthansa Group Business Services GmbH, Frankfurt, Germany

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(Original Research)

INTRODUCTION: A certain physical as well as mental fitness is required to master routine and moreover emergency tasks aboard a commercial airplane. Therefore, if a person's health renders them unfit for those tasks they cannot operate as a cabin crew member. While the requirements for crews are laid down in the EU regulation 1178/2011 and the corresponding EASA AMC/GM, little is known about the reasons why a fit assessment is denied. **METHODS:** We analyzed all cases of initial EASA applications for cabin crews at our medical center during the period of 01/01/2023 to 06/30/2024. All applicants were categorized as either fit (f), fit after further assessment (a) or unfit (u). For the latter two reasons leading to further evaluation or disqualification were evaluated. **RESULTS:** During the observed period we had 964 initial applications (age: 25.8; female: 82%). Thereof, f:720 (75 %), a: 195 (20 %), u: 49 (5 %). The main issues leading to unfitness were: Mental health problems (20) including substance abuse (12), mood disorder (3) and personality disorder (2); sensory deficiencies (10) including deficient color vision (5); internal disorders (10) including metabolic (5) and cardiovascular (2); and neurologic diseases (3). Suspicion about a subject's fitness rose due to the applicant's history (46 %), the lab work (27 %) and vision test (9 %). While most applicants that showed abnormalities in one or more of our examinations could ultimately be assessed as fit (80 %), a positive drug test would normally lead to a disqualification (80 %). **DISCUSSION:** In this analysis we, to our knowledge for the first time, examined the reasons for unfit decisions in initial cabin crew examinations. In this young, predominantly female population, mental health issues were the leading cause for an unfit assessment, reflective of this population's overall health. While concerns regarding a person's fitness to operate as a flight attendant are common (1 in 4), only a fraction (5 % of all applicants) is ultimately considered unfit for flying duties. Almost 50 % of the doubts about a subject's fitness were raised in the doctor's interview, underlining the importance of a sound doctor-patient relationship.

Learning Objectives

1. This study tries to examine the reasons why cabin crew applicants are denied a fit asessment.
2. This study examines which part of the medical examination raises suspiction of the subject's fitness.

[280] LONGITUDINAL EFFECTS OF USAF MEDICAL WAIVER POLICY

Benjamin Clapp[1], Atheer Jaffar[1], Hernando Ortega[2], Rodger Vanderbeek[2]

[1]*U.S. Air Force, Wright-Patterson AFB, OH, United States;* [2]*U.S. Air Force, San Antonio, TX, United States*

(Original Research)

INTRODUCTION: Applicants to join the USAF were examined to identify any medical conditions which preclude service. Disqualified applicants may apply for and potentially receive a waiver to the disqualifying standard. This study analyzed the differences in medical and performance factors between waivered and unwaivered populations. Two cohorts were studied: FY2015 – FY2019 enlisted and FY2010 – FY2019 officer accessions. **METHODS:** Data from Air Force Recruiting Service/Accession Medical Waiver Division (AFRS/AMWD), Aeromedical Services Information Management System (ASIMS) and DHA were cross-referenced with data from Air Force Personnel Center (AFPC), US Transportation Command (TRANSCOM), and Air Education and Training Command (AETC). Performance factors included retention (at 6 specific time thresholds), Mobility Restriction (MR) rates, Duty Restriction (DR) rates, average medical encounters per Airman-year, Early Return from Deployment (ERD), Medical Evaluation Board events (MEB) and Time to Full Qualification. **RESULTS:** The cohorts displayed qualitative differences in retention. For the enlisted cohort, the waivered group displayed slightly higher retention at all time periods measured (e.g., 90% vs 88% at 2 years and 74% vs 71% at 4 years) while the officer cohort displayed significantly lower retention for the waivered group when compared to the unwaivered group (e.g., 85% vs 97% at 2 years and 64% vs 83% at 4 years). Both officer and enlisted cohorts had waivered populations that spent more time on MR/DR and accumulated more average medical encounters per Airman-year. In ERD, the enlisted waivered group was higher by 16% but the officer waivered group was lower by 40% compared to unwaivered. For MEB events, the waivered group of the enlisted cohort was 13% higher while the officer waivered group was 6% higher. **DISCUSSION:** The results support that the process for evaluating waivered candidates was effective for increasing size of incoming cohorts with minimal penalty on enlisted Airmen retention. However, it does raise concern regarding the burden of waivered service members on the military healthcare system. The results demonstrate the subtle nature of measuring the effects of increasing waiver numbers. The most dramatic difference is the officer versus enlisted cohorts, but even within each of these cohorts, the study showed significant differences in specific diagnostic subgroups.

Learning Objectives

1. This study shows a significant difference in several of the performance factors when comparing waivered and unwaivered populations.
2. Differences between officer and enlisted cohort performance demonstrates the need for more detailed cohort resolution in determining waiver policy.

[281] WITHDRAWN

[282] CABIN AIR CONTAMINATION SYNDROME: A CONTEMPORARY REVIEW OF EVIDENCE AND INVESTIGATION METHODS - A SYSTEMATIC REVIEW

Denis Bron[1], Susan Michaelis[2]

[1]*Aeromedical Centre Swiss Air Force, Duebendorf, Switzerland;* [2]*Michaelis Aviation Consulting, West Sussex, United Kingdom*

(Original Research)

INTRODUCTION: Aircraft cabin air contamination remains a significant occupational health concern in aviation. Despite technological advances, reported incidents of fume events and associated health effects continue to challenge aviation medicine. This systematic review aims to evaluate current evidence regarding detection methods, biomarkers, and health outcomes related to cabin air contamination exposure. **METHODS:** A systematic search was conducted in PubMed, Scopus, and Engineering Village databases for papers published between 2018-2024. Search terms included "cabin air quality," "fume events," "aerotoxic syndrome," and "organophosphates." Two independent reviewers assessed study quality using the PRISMA guidelines. Studies were categorized by focus area: detection methods, exposure assessment, and health outcomes. **RESULTS:** Of 342 identified articles, 76 met inclusion criteria. Technical studies (n=28) demonstrated enhanced detection capabilities for organophosphates, particularly TCP, using mass spectrometry and real-time monitoring systems. Biomonitoring studies (n=23) revealed elevated metabolite levels in exposed crew members ($p<0.001$). Health outcome analyses (n=25) showed significant associations between exposure and neurological symptoms (OR 2.1, 95% CI 1.7-2.6), respiratory issues (OR 1.8, 95% CI 1.5-2.2), and cognitive deficits (OR 1.6, 95% CI 1.2-2.0). Recent longitudinal studies (n=5) indicated potential chronic effects in frequently exposed personnel. **DISCUSSION:** Current evidence strengthens the association between cabin air contamination and adverse health effects. Advanced detection methods and biomarkers show promise for exposure assessment, though standardization remains challenging. Notable gaps exist in understanding dose-response relationships and individual susceptibility factors. Recommendations include implementing standardized reporting protocols, adoption of cumulative flight hours rather than use of thresholds, and developing preventive engineering solutions. Future research should focus on appropriate epidemiological studies and validation of biomarkers for early detection.

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Learning Objectives
1. Identify current detection methods for cabin air contaminants and their effectiveness.
2. Evaluate the strength of evidence linking exposure to specific health outcomes.
3. Describe emerging biomarkers for exposure assessment.

[283] OCCUPATIONAL HEAT-RELATED ILLNESS RISK SCREENING PROTOCOLS: A SYSTEMATIC LITERATURE REVIEW

Wiaam Elkhatib[1], Mohammad Alkordi[1], Darshan Raval[2], Shilpi Ganguly[3], Larry Prokop[1], Edward Finnegan[4], Lawrence Steinkraus[1], Jan Stepanek[5], Michael Harrison[2], M. Hassan Murad[1]
[1]Mayo Clinic Hospital, Rochester, MN, United States; [2]Mayo Clinic Hospital, Jacksonville, FL, United States; [3]Hennepin Healthcare Minneapolis, Minneapolis, MN, United States; [4]Experimental Aircraft Association, Warbirds of America, Oshkosh, WI, United States; [5]Mayo Clinic Hospital, Phoenix, AZ, United States

(Original Research)

INTRODUCTION: Aircrew are subject to elevated thermal loads and risk aeromedical complications from heat-related illness (HRI). The scope of published screening methods and safety thresholds remain limited to non-specific wet-bulb globe temperature (WBGT) or heat-index (HI) assessments without inclusion of protocols while in the cockpit. Expanding this data is useful for medical flight safety decision making during aviation events. The objective was to evaluate occupational cohorts with the intervention of screening methods or protocols assessing HRI risk to preserve nominal and safe aircrew performance. **METHODS:** A systematic literature review through February 22, 2024, was conducted via several databases and registers alongside citation mining. Eligibility criteria were English language, full-length manuscripts or technical documents for adults at least 18 years of age including HRI risk screening approaches with risk stratifications given. Risk-of-bias (ROB) assessments of original reports used the Newcastle-Ottawa Scale (NOS). No human or animal subjects were involved. **RESULTS:** Qualitative WBGT summative plots, tables outlining available reports for original and non-original publications, and graphs showing domains utilized for HRI screening tools were generated. Tools were scored based on number of domains covered and an expert consensus regarding practical applicability towards aviation events. A total of 2,957 reports were identified with 37 included in the final analysis. Reports utilized combinations of WBGT, HI, novel checklists, mathematical algorithms, online/mobile applications, and scoring systems spanning 19 domains to establish risk. Optimal screening approaches were recommended. **DISCUSSION:** This is the first systematic review addressing HRI risk screening protocols for potential use towards aircrew in general aviation. Limitations included lack of generalizability, risk definition variability, and conflicting published assumptions regarding factors considered such as clothing, heat acclimatization and workload. Awareness of preventive protocols are important for ensuring worker health, optimal job performance, and avoidance of job-related incapacitation, especially in general aviation. Expert human judgement will always be required.

Learning Objectives
1. With millions of people attending aviation events across the globe every year, operational safety and mass casualties must be prevented by addressing considerations like the heat-related illness risk of the pilots who participate.
2. Heat-related illness risk is extraordinarily complex, non-linear, individualized, and imperfectly understood, making it difficult to standardize for any one population, or to accurately predict and subsequently screen for via overtly simple methods.

[284] WITHDRAWN

Tuesday, 06/03/2025 ***4:00 PM***
Regency VII

[S-30] SLIDE : TRAINING - FACTORS / VARIABLES

Chair: Michael Lowe
Co-Chair: Chris Flynn

[160] PSYCHOLOGICAL AND PHYSIOLOGICAL CONSIDERATIONS FOR SIMULATION USE IN AVIATION: AIRCREW PERSPECTIVES

Matthew Landells[1], Clare Shaw[2], Victoria Cutler[3], Alice Hunt[3]
[1]RAF Centre of Aerospace Medicine, Henlow, United Kingdom; [2]Defence Primary Healthcare, RAF Benson, United Kingdom; [3]QinetiQ, Farnborough, United Kingdom

(Original Research)

INTRODUCTION: Simulation technology has cemented itself as a critical capability at all stages of military and civilian flying: enabling safe, cost-effective training and the ability to simulate scenarios too complex or dangerous to carry out in live flight. As this technology continues to gain pace and expand into use of extended reality, consideration should be given to operators' perspectives of potential psychological and physiological limitations, to ensure future training is focused to the requirements of the end user. Key areas of focus include stress levels, cognitive workload, negative training, and physiological effects such as G-layoff and simulator sickness. **METHODS:** A voluntary 10 question electronic survey was distributed to UK military aircrew. As well as providing data on their current balance of live to simulator hours, respondents evaluated the extent to which simulation-based training prepares them for operations and how it compares to live flight training in terms of psychological and physiological readiness. Responses were collected anonymously via Microsoft Forms on the UK defence intranet. **RESULTS:** 380 responses were received from all three services and a wide variety of platforms. 73% of respondents were posted to operational units. Aircrew reported conducting 30-45% of their current training in a simulated environment. Across all platforms, aircrew felt the proportion of live flying should be greater, and 62% of respondents felt they did not receive enough live flying hours to maintain adequate mental and physiological currency. Thematic analysis of responses identified that positive aspects focused on the ability to complete procedural, emergency, or complex tactical training in the simulator. The top three areas of concern were poor functional fidelity of simulators, negative training and the impression that simulation training cannot provide sufficient "fighting edge" against a potential adversary. **DISCUSSION:** Aircrew have serious concerns about increasing utilisation of simulation. Further research should aim to understand how simulation training can be tailored to enhance learning whilst minimising negative psychological and physiological impacts. This research holds practical implications for aviation training programs, potentially guiding the development of more effective, user-centred simulation environments, and providing evidence for situations in which live flying still provides additional advantage.

Learning Objectives
1. The audience will understand some of the potential physiological and psychological concerns of increasing usage of simulation technology in flying training.
2. The audience will understand areas in which aircrew perceive that live flying is still required to provide effective training for ensuring safety and operational effectiveness.

[161] SEEING THROUGH THE BLUR: ASSESSING PILOT KNOWLEDGE ON SPATIAL DISORIENTATION

Daniela Castro Quiroga, Diego García Morales
National University of Colombia, Bogotá, Colombia

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(Education - Program / Process Review)

BACKGROUND: Spatial Disorientation (SD) is a legacy problem in aviation and represents a significant factor in fatal aviation accidents. Despite SD being a well-recognized phenomenon in aerospace medicine, there is no universally accepted method for assessing pilots' knowledge and proficiency in SD that could help them with recognition and recovery. The lack of a standardized tool for reporting, investigating, and reconstructing SD-related incidents further complicates efforts to reduce SD-associated risks. Given the critical safety implications, addressing this gap in pilots' knowledge is essential to enhance operational performance and accident prevention through improved literacy and training specific to SD mitigation. **OVERVIEW:** This effort involves developing a multi-level assessment tool designed to evaluate pilot understanding of SD in civilian fixed-wing operations. A three-section anonymous online survey is proposed to obtain demographic and pilot training data, evaluate recognition of various SD scenarios and record the pilots real-world SD experiences. The tool will be administered as an online questionnaire, with recruitment conducted through digital platforms, social media, union groups, collegiate aviation forums, and networks. Data collected will be analyzed to identify traits, tendencies, and frequencies related to pilots' literacy, training, understanding, and experience with SD. A chi-square test will be used to determine statistically significant differences across experience and operational groups. The first section gathers demographic data on pilots, including their overall flight experience, specific and recent operational experience, and SD training. In the second section, pilots are presented with various SD scenarios to test their ability to recognize through their flight experience the visual and vestibular illusions. Finally, pilots classify and describe their own SD experiences and type of operation in which the illusions happened. **DISCUSSION:** This tool has an operational significance as it is a first step to assessing civilian pilot's awareness and training on SD. By advancing understanding of pilot literacy and experience in SD, this assessment tool could drive improvements in aerospace safety worldwide. Ultimately, this initiative is expected to enhance safety and training protocols and reduce SD-related mishaps, benefiting the broader field of aerospace medicine and human performance.

Learning Objectives

1. Propose an evaluation tool to assess civilian pilot's awareness and training on spatial disorientation.
2. Describe the training received by pilots on spatial disorientation and how this helps them recognize it and respond.

[162] IMPACT OF THE COVID-19 PANDEMIC LOCKDOWNS ON MANIFEST REFRACTION IN A YOUNG ADULT AVIATOR TRAINING CANDIDATES POPULATION: A LARGE COHORT STUDY

Liora Levian[1], Aya Ekshtein[1], Assaf Hilely[2], Dana Barequet[2], Liora Levian[1], Asaf Achiron[2], Yuval Kozlov[3], Oded Ben-Ari[1]

[1]*Israeli Air Force Aeromedical Center, Ramat Gan, Israel;* [2]*Division of Ophthalmology, Tel-Aviv Sourasky Medical Center, affiliated to the Faculty of Medical and Health Sciences, Tel Aviv University, Tel Aviv, Israel;* [3]*Israel Defense Forces Medical Corps, Israel, Ramat Gan, Israel*

(Original Research)

INTRODUCTION: Myopia is a leading cause of visual impairment globally, with risk factors including near-work, screen time, and limited outdoor activity. The COVID-19 pandemic led to increased screen use and decreased outdoor exposure, potentially worsening myopia, particularly in children. This study evaluated the impact of the COVID-19 pandemic on myopia progression in young adults requesting to apply to the Israeli Air Force flight academy, in order to consider re-standardizing the admission criteria for myopia. **METHODS:** A retrospective analysis was conducted on 7,491 candidates for the Israeli Air Force aviator training program (2019-2023). Participants underwent visual evaluations, including non-cycloplegic refraction. Refractive errors were categorized as myopia, emmetropia, and hyperopia. Participants were divided based on evaluation timing: pre-lockdown, during-lockdown, and post-lockdown, and were analyzed according to the refractive error classification. **RESULTS:** Participants (mean age 17.36 ± 0.48 years) showed significant differences in refractive error prevalence across time periods ($p < 0.0001$). Hyperopia increased during lockdowns (18.81%) compared to pre- (13.62%, $p < 0.0001$) and post-lockdowns (14.37%, $p < 0.0016$). SE was higher during (mean SE = -0.44 D) and post-lockdowns (-0.42 D) than pre-lockdowns (-0.54 D), indicating less myopia progression ($p < 0.01$). Multivariate regression showed that SE increased during and post-lockdowns compared to pre-lockdowns ($p < 0.01$), with males showing significantly higher SE ($p < 0.001$). **DISCUSSION:** Unlike findings in younger children, young adults flight academy candidates; exhibited reduced myopic progression during and after lockdowns, possibly due to lifestyle factors such as outdoor activity. Hence, re-standardizing the flight academy admission criteria was unnecessary. Gender differences in refractive outcomes were also observed, highlighting the need for targeted preventive measures.

Learning Objectives

1. The audience will understand the differences between younger children and young adults flight academy candidates regarding myopic progression during and after lockdowns.
2. The audience will understand the need for targeted preventive measures.

[163] DOES PRE-TRAINING HEART RATE VARIABILITY PREDICT COMPLETION OF THE ISRAELI AIR FORCE PILOTS COURSE?

Aya Ekshtein[1], Yosef Kula[2], Yori Gidron[2], Roy Horosov[3], Oded Ben-Ari[1], Dana Berger[1]

[1]*Israeli Air Force Aeromedical Center, Ramat Gan, Israel;* [2]*University of Haifa, Haifa, Israel;* [3]*The Hebrew University of Jerusalem, Jerusalem, Israel*

(Original Research)

INTRODUCTION: Operational pilots are required to perform complex tasks under high stress and uncertainty. One of the major challenges of military and civilian aviation medicine is the selection of suitable candidates to serve as pilots. The vagal nerve is a crucial moderator of stress responses, and its activity (indexed by heart rate variability, HRV) has been shown to predict performance and psycho-physiological resilience in various settings. However, its predictive value in pilot training has not been examined. This study examined the relationship between HRV and success in an intensive selection procedure. **METHODS:** In a historical prospective study, we derived an HRV parameter (RMSSD) from a 10-second ECG of 169 male and 16 female candidates for the pilot's course. The ECGs were performed 2-3 months before the courses. The predictive validity of other routinely obtained measures was also considered. We used a two-stage approach to analyze study data. First, we analyzed the entire sample using t-tests. Then, significant predictors of success and HRV were entered in a multivariate logistic regression. Second, we focused on a smaller sample of paired candidates (passed the entire course versus failed), matched on significant predictors, and then examined differences in HRV between these groups with a paired t-test. **RESULTS:** High RMSSD significantly predicted the completion of the pilot course in logistic regression. RMSSD and intelligence score were the only significant predictors. In the paired matched sample, candidates who passed the training had significantly higher HRV compared to those who failed in the course (M=121.30ms, s.d=61.48ms) was significantly higher than that of those who failed (M=84.31ms, s.d=12.05ms) $t(25) = -1.78$, $p<0.05$. **DISCUSSION:** The results of the current study support the predictive value of HRV for aviation selection. Given the high cost of training; operational pilots and the burden they undergo, improving the accuracy of the selection processes may reduce the burden on the candidates and the air forces.

Learning Objectives

1. The audience will understand the relationship between vagal nerve activity and psycho-physiological resilience.
2. The audience will understand the possible use of the physiological index in military aviation selection procedures.

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[164] AEROSPACE MEDICINE SPECIALIST TRAINING DOWN UNDER

Tracy Smart, Gordon Cable
The Australian National University, Canberra, Australia

(Education - Program / Process Review)

BACKGROUND: Aerospace Medicine has played an important part in Australia's growth as a nation. From the beginnings of the Royal Flying Doctor Service in 1928 through to medical support to manned NASA space flights in the 1970s, and beyond, the profession has been driven by a group of doctors with an interest in all things aerospace. Formal development and recognition of a sovereign aerospace medicine specialist capability has remained a challenge. This presentation will describe the specialist training in Australia and examine the current gaps and limitations. **OVERVIEW:** Prior to 2012, formal aerospace medicine specialist training was primarily only available to military medical officers. Civilian training was limited to short courses, and for both, higher degree courses were only available overseas. The creation of the Australasian College of Aerospace Medicine in 2012 saw the first recognition of Aerospace Medicine as a specialisation in this country, with 76 Founding Fellows grandfathered into the College using strict qualification criteria and a specialist training program was established to train registrars. The number of Fellows and Associate Fellows has grown to over 90, with eleven registrars currently under training. **DISCUSSION:** A sovereign aerospace medicine specialist capability is essential to support the Australian aviation and space industries. While Fellowship of the College is recognised by these industries, formal recognition of the College and the specialisation by the Australian Medical Council is still lacking. Barriers include the relatively small size of Australia's aviation and space industries, a reluctance of the Australian Government to recognise new specialities, the administrative overhead and cost of applying for formal recognition, the lack of a higher degree courses in the country, and limited employment prospects for full time specialists, particularly in the space industry. To overcome these obstacles will take time, perseverance, and an understanding of the lessons learned by the international aerospace medicine community.

Learning Objectives

1. The audience will learn about the history and role of aerospace medicine in Australia.
2. The audience will understand the current aerospace medicine specialist training pathway and options available in Australia.
3. The audience will understand the current gaps and limitations in developing aerospace medicine specialists in a country with relatively small sovereign aviation and space industries.

[165] SUITED ERGONOMICS CASE STUDY: COMPARISON OF ERGONOMIC DEMANDS ACROSS EXTRAVEHICULAR ACTIVITY (EVA) TASKS

Lauren Hickox[1], Linh Vu[1], K. Han Kim[2], Kristine Davis[3], Christine Jerome[4], Nathaniel Newby[5]
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(Education - Case Study)

INTRODUCTION: A suited ergonomics model has been developed to characterize challenging Extravehicular Activity (EVA) tasks and quantify exposure to ergonomic stressors through postural and static joint moment evaluations. This case study provides a preliminary assessment of key EVA tasks in a simulated lunar environment. **BACKGROUND:** During lunar missions and training, crewmembers will be performing manual materials handling and geology tasks in a pressurized suit. Increased musculoskeletal demand and risk of related injuries is more likely as wearing a space suit adds mass to the body, increases strength demands, limits range of motion (ROM), and alters movement strategies. To mitigate injury risks, understanding suited ergonomics in different environments is critical for implementing effective training and hardware design. **CASE PRESENTATION:** During Pressure Garment Subsystem Design Verification Testing of the Exploration Extravehicular Mobility Unit (xEMU) (planetary suit with rigid torso/brief components and shoulder/hip bearings), nine subjects performed EVA tasks at the Active Reduced Gravity Offload System (ARGOS) facility (1/6 g offload). Suit kinematics were tracked with a motion capture system and projected onto a 3D suit model by an optimization-based inverse kinematics algorithm. Suit-human mass models were combined with the kinematics model to estimate static exertion forces. Twenty-four representative EVA tasks were selected for evaluation, including traverse, surface mobility (e.g. kneeling), geology (e.g. hammering), and reach (e.g. visor). **DISCUSSION:** Kneeling movements resulted in the most extreme hip postures (up to 81.9° magnitude from neutral) with the largest task ROMs, e.g. suit joint angular excursions, for the hip bearing (>100°). There were high hip, torso, and ankle moments which occurred in asymmetric postures and at biomechanical limits, increasing ergonomic stressors. Shoulder movements exhibited large deviations from neutral posture (up to 72.1°) and excursion magnitudes during toolbelt opening, visor reach, and overhead reach tasks. Shoulder loading varied more sensitively with externally applied hand forces (e.g. hatch opening forces) than extreme joint angles and is also dependent on offloading conditions. These findings are being infused into EVA readiness planning and astronaut strength training. Our understanding of suited ergonomics will continue to be developed as data is collected in different training environments.

Learning Objectives

1. The audience will learn about the use of ergonomics modeling for evaluating biomechanical demands across a variety of Extravehicular Activity (EVA) tasks.
2. The participant will be able to identify ergonomic risk factors related to performing lunar EVA tasks in a spacesuit.

Tuesday, 06/03/2025 ***4:00 PM***
Hanover F/G

[S-31] SLIDE : SLEEP, FATIGUE AND COGNITION

Chair: John Caldwell
Co-Chair: Richard Speakman

[166] ACTIVATION FROM ON-CALL DUTY: EFFECT ON PILOTS' SLEEP, PERFORMANCE, AND FATIGUE

Eva-Maria Elmenhorst, Sibylle Benderoth, Iris Rieger, Daniel Aeschbach
German Aerospace Center, Institute of Aerospace Medicine, Cologne, Germany

(Original Research)

INTRODUCTION: Pilots are regularly scheduled for on-call duty. It is unclear whether the uncertainty about an activation from on-call duty will disturb pilots' sleep, and impair next day performance and alertness. **METHODS:** We collected data from 31 pilots (26 male, mean age 34 years (7 SD)) during one off-duty period, one day-shift, two early-shifts, and one on-call shift in a sequential design. Pilots recorded their sleep at home with EEG. At the end of each flight duty period (FDP), they performed a 3-min Psychomotor Vigilance Task (PVT) and rated their fatigue. Data were analyzed with mixed ANOVAs and post-hoc adjusted pairwise comparisons. The study was approved by the local ethics committee. Pilots gave written informed consent. **RESULTS:** Pilots were unexpectedly activated from 19 on-call duties with FDPs starting on average (standard error) at 8:22 am (0:40). In on-call nights, duration spent asleep was 6.4 h (0.4), which was not different from nights before day-shifts (5.8 h (0.2); duty start: 7:21 am (0:10)) and early-shifts (5.6 h (0.1); duty start: 5:54 am (0:03)), both p>0.1), but shorter compared to off-duty nights (7.8 (0.2); p=0.0005). REM sleep was longer in on-call nights (84.6 min (7.8)) compared to nights prior to day- (62.3 min (4.6)) and early-shifts (65.9 min

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(2.8); both p<0.018), but shorter than in off-duty nights (99.5 min (5.9), p=0.04). Sleep onset latency, sleep efficiency, N3 duration, and number of arousals were not different between nights. PVT median reaction time was longer (217.2 ms (5.2), p=0.03) and fatigue higher (11.8 (0. 6), p<0.001) after on-call nights compared to day-shifts (206.6 ms (2.4), 8.2 (0.4)), but not early-shifts. **DISCUSSION:** Sleep duration was below the recommended limit value of 7 h for adults before all duty types. Sleep duration and quality during on-call nights were not impaired compared to day shifts. However, performance was slightly decreased and fatigue slightly higher at the end of the FDP. This might be a consequence of the sequential design with on-call duty examined last.

Learning Objectives

1. Sleep duration before all examined shift types should be longer.
2. On-call shifts could be scheduled as potential recovery (if not activated) between early-shifts.

[167] STROOP PERFORMANCE OF PARTIALLY SLEEP DEPRIVED HEALTHY VOLUNTEERS AT SIMULATED HYPOBARIC CONDITION

Sudhanshu Mohapatra, Avk Raju
Institute of Aerospace Medicine, Bangalore, India

(Original Research)

INTRODUCTION: A recent study had confirmed the amount of night sleep of a military aircrew is about 6 hours against the optimal requirement of 8 hours. With the background that the executive type of cognitive functions, which are critical to flight operations gets deteriorated under hypoxic condition, it was a purposeful initiative to undertake the study to determine if the cognitive dysfunction related to executive functions are getting deteriorated further by 2 h partial sleep deprivation (PSD) or not. **METHODS:** Stroop test along with SpO2 was conducted on 25 healthy participants on two different days i.e. on the day after an optimal sleep and on the day after 2 h; PSD at three different altitudes i.e ground, 10,000 feet and 18,000 feet in a hypoxia simulator (Hypobaric chamber). **RESULTS:** 'Altitude' effect in form of statistically significant fall of mean SpO2 from an average Ground level values of (Day 1 & Day-2) 97.8% & 98% to 92.1% & 92.6% at 10,000 feet and 79.1% & 78.9% at 18,000 feet was observed. Similarly, statistically significant increase of mean Stroop Time (ST) from an average Ground level values of 11.04 & 11.92 to 19.08 & 26.36 at 10,000 feet and 43.28 & 55.68 at 18,000 feet was observed on both days. But there was neither the 'Day' effect nor the 'Interaction (Day_Altitude)' effect for ST and SpO2. **DISCUSSION:** ST, which is the indicator of cognitive difficulty was higher at 18000 feet in comparison to the ST recorded at Ground and 10000 feet observed on the day after optimal sleep and also on the day after 2 h PSD. When ST at different level of altitude was compared, the values recorded on day 2 were not statistically different from the values recorded on day 1 implying similar level of cognitive deterioration. **CONCLUSION:** The accentuation effect of 2 h PSD on deteriorated cognitive performance under hypoxia condition could not be established through Stroop testing.

Learning Objectives

1. Audience will learn the effect of altitude on cognitive performance (Stroop test) of healthy human subjects without 2 h of sleep deprivation.
2. Audience will learn the effect of altitude on cognitive performance (Stroop test) of healthy human subjects with 2 h of sleep deprivation.

[168] NEUROBEHAVIORAL PERFORMANCE FOLLOWING AWAKENING FROM A 1-HOUR NIGHTTIME NAP IN BLUE-ENRICHED LIGHT

Cassie Hilditch[1], Rachel Jansen[2], Sean Pradhan[1], Nicholas Bathurst[2], Michelle Tripp[1], Zachary Glaros[2], Lucia Arsintescu[1], Kevin Gregory[2], Crystal Kirkley[2], Erin Flynn-Evans[2]
[1]*San Jose State University, Moffett Field, CA, United States;* [2]*NASA Ames Research Center, Moffett Field, CA, United States*

(Original Research)

INTRODUCTION: Sleep inertia is the temporary impairment of performance and alertness experienced after waking. Exposure to blue-enriched light after nocturnal awakenings during the first half of a habitual sleep period can reduce symptomology. We investigated the impact of blue-enriched light following a 1-hour nap during the circadian low. **METHODS:** In a within-subjects randomized cross-over design, 14 participants (7 female, 7 male; MAge = 24.86, SD = 5.20) spent two 26-hour periods in the sleep laboratory. The intervention included a 1-hour nap opportunity ending 21 hours after habitual waketime followed by exposure to blue-enriched light (250 lux). The control involved a 1-hour wakeful rest period in dim light (<10 lux), followed by exposure to 150 lux. A test battery, including the Karolinska Sleepiness Scale (KSS) and 5-minute psychomotor vigilance task (PVT, NASA PVT+), was administered prior to the nap and again at 2, 12, 22, and 32 minutes after nap end. Participants were seated at a desk adjacent to their bed during testing. **RESULTS:** Mixed-effects models with pairwise comparisons adjusted for false discovery rate revealed a significant test bout × condition interaction in which participants in the intervention condition had slower PVT response speeds and more lapses 2 minutes after awakening (p-values < .002), with no difference at 12 and 22 minutes (p < .05) compared to control. Faster response speeds were observed in the intervention vs. control condition at 32 minutes (p = .008). There was a significant increase in KSS scores across test bouts for both conditions (p = .006). **DISCUSSION:** These preliminary results suggest that vigilant attention was impaired immediately after waking from a nap despite a blue-light intervention when compared to a no-nap control. However, cognitive performance was equivalent to or better than control from 12 minutes after waking. Self-reported sleepiness worsened across time in both conditions. Future analyses will investigate the influence of sleep metrics on these results. Further research is required to distinguish the independent effects of the intervention (i.e., light and sleep).

Learning Objectives

1. Recognize the potential for cognitive performance benefits of a nap to be delayed due to sleep inertia.
2. Understand that cognitive performance and subjective sleepiness do not always align.

[169] ADVANCES IN A WEARABLE FATIGUE MANAGEMENT SYSTEM

John French[1], Taylor Casey[2]
[1]*Embry-Riddle Aeronautical University, Daytona Beach, FL, United States;* [2]*University of Pittsburgh Medical Center at Harrisburg, Harrisburg, PA, United States*

(Original Research)

INTRODUCTION: Sleep deprivation is intricately related to physical and mental health hazards, but remains largely undiagnosed. Until the actigraph, a means to detect circadian rhythmicity and sleep inadequacies rarely existed outside the sleep labs. The actigraph became an acceptable sleep measure in settings where polysomnography was not feasible. With technological advancements decreasing the size and cost of inertial measurement units (IMU) inside the actigraph and increasing their accuracy, there was a recent surge in wearable devices that purport to measure sleep. Unlike the actigraph, evidence that these new smart devices compared to clinically useful sleep measures were not found in the scientific literature. We tested a standard smartwatch for its comparability with measurements from the actigraph in monitoring sleep duration and efficiency. **METHODS:** Data from 28 student volunteers were collected using an Android smart watch (Ticwatch 3) throughout 4 consecutive nychthemerons. An actigraph (Motionlogger) was worn on the same wrist during sleep. The Action-W analysis program was used to determine sleep time, duration, and efficiency scores from the actigraph data. Comparable measures were determined in a blind manner from the Ticwatch. **RESULTS:** Statistical analysis revealed the Ticwatch results compared to the actigraph results for sleep timing, duration (r(26)= .7,

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p=0.005) and efficiency (r(28)= .48, p=0.043). The application on the Ticwatch (Bwell) included a biomathematical model (FADE) that used sleep timing and duration to predict a sleep quality term and fatigue values throughout wakefulness, which was displayed on the Ticwatch in real time. The Ticwatch captured subjective fatigue scores (Karolinska scale) from the wearer every 2-3 hours while awake. This score was compared to the FADE estimate of fatigue at the same time by Spearman's rho (r(28) .73, p< .0005). **DISCUSSION:** These results argue that the IMU on a commercially available wearable can monitor sleep duration and efficiency comparable to the more expensive, time consuming actigraph. Coupling sleep timing measures with fatigue models can display the impact of daytime fatigue on cloud based smartwatches. This creates a near real-time fatigue management system to determine fitness for duty.

Learning Objectives

1. The audience will learn about the history of actigraphy and current smart wearable approaches to sleep management.
2. The audience will learn that movement detection, commonplace on smart wearables for assessing sleep, can be combined with biomathematical models of fatigue to create a powerful tool for assessing a wearer's health and readiness for duty.

[170] US ARMY AVIATION MISSION TYPE AND MENTAL HEALTH SYMPTOMS

Aric Raus[1], Fred Volk[2], Sarah Spiridigliozzi[2]
[1]*U.S. Army University, Fort Leavenworth, KS, United States;* [2]*Liberty University, Lynchburg, VA, United States*

(Original Research)

INTRODUCTION: Aviation flight operations require constant vigilance where pilots must perform under significant physical and psychological stress. Prolonged or intense stress events can lead to mental health issues, even among those with formal resilience training. While the impact of stress within the aviation community has undergone increased scrutiny, little is known about the effects of specific aviation mission sets on mental wellness. **METHODS:** Quantitative survey responses were collected from a larger study of current and former U.S. Army Aviation personnel recruited via social media and snowball sampling between October 2023 and February 2024. This study utilized the four-question Public Health Questionnaire (PHQ-4) and the four-question Posttraumatic Stress Checklist for DSM 5 (PCL4-5) to determine pilots meeting the screening criteria for Generalized Anxiety Disorder (GAD), Major Depressive Disorder (MDD), and Posttraumatic Stress (PTSD) by the aircraft mission types of Unmanned Aerial Systems (UAS; N=60), Cargo (CH; N=33), Utility/MEDEVAC (UH; N=142), and Attack/Reconnaissance (AH; N=59). **RESULTS:** A total of 294 valid responses were received to determine the selected mental health screening criteria. Among pilots, UAS operators had the highest propensity for meeting screening criteria for all three conditions (61.7% ≥ one condition), followed by Cargo (42.4%), Attack/Reconnaissance (40.7%), and Utility/MEDEVAC (33.1%) aviators. When compared by individual conditions, UAS operators' responses were statistically more likely to meet the anxiety (55.0%) and PTSD (31.7%) screening criteria than all other mission types. **DISCUSSION:** The results indicate a high percentage of current and former US Army flight crews experience discernable levels of anxiety, depression, and PTSD. UAS operators' symptom levels were statistically higher than other pilots for anxiety, PTSD, meeting any condition, and meeting all three screening criteria. UAS operators undergo unique stressors from other mission sets. Some missions require operators to follow targets' patterns of life for days before conducting kinetic operations, allowing pilots to see them as individuals. Additionally, operators are not at personal risk, which may increase moral injury. Finally, distinctive barriers to care may impact mental health seeking among this career field. Future research should focus on specific causes for these increased mental health symptom rates and methods for reducing them.

Learning Objectives

1. Participants will gain additional insight into the prevalence of GAD, MDD, and PTSD symptoms among U.S. Army Aviation Pilots.
2. Attendees will be familiar with the higher prevalence of mental health symptom levels among UAS operators when compared to other US Army aviators.
3. Participants will better understand the gaps in knowledge that need to be researched regarding mental wellness among military aviators.

[171] WITHDRAWN

WEDNESDAY, JUNE 04, 2025

Wednesday, 06/04/2025 ***8:30 AM***
Centennial Ballroom I

[S-32] PANEL: INSULIN TREATED DIABETES - REGULATORY AND IN-FLIGHT PERSPECTIVES

Chair: Mark Cairns
Co-Chair: Declan Maher

Panel Overview: *With the advent of new technologies such as insulin pumps and continuous glucose monitoring devices, the management and monitoring of insulin treated diabetes has evolved to a point where it is possible to consider medical certification for those who wish to operate as commercial pilots. There are now a few national aviation authorities operating programmes that permit such certification under tight scrutiny and generating data to demonstrate that this can be done safely. This session will look at the experiences of some of those national aviation authorities, discuss data that their research is generating and also learn from a commercial pilot about how this works from a practical perspective.*

[172] CERTIFICATION OF PILOTS WITH TYPE 1 DIABETES IN NEW ZEALAND

Tim Sprott
Civil Aviation Authority of New Zealand, Wellington, New Zealand

(Education - Tutorial / Review)

INTRODUCTION: This presentation outlines the development of a protocol for the aeromedical certification of pilots with type 1 diabetes mellitus in New Zealand. **TOPIC:** Type 1 Diabetes Kiwi Style **APPLICATION:** The safe aeromedical certification of pilots is a significant challenge for regulators. In New Zealand a certification protocol was developed based on an extensive review of the literature, benchmarking with other regulatory authorities, a review of published data from the CAA UK Study, and specialist peer review by the New Zealand Society for the Study of Diabetes (NZSSD). This presentation outlines the key elements of the NZ protocol and the outcomes to date since 2019.

Learning Objectives

1. The audience will learn about the risk management undertaken to implement medical certification of pilots with type 1 diabetes.
2. The audience will learn about how the medical certification of pilots with type 1 diabetes can meet the requirements for acceptable levels of safety.

[173] WITHDRAWN

[174] PIONEERING ASPECTS IN THE USE OF CONTINUOUS GLUCOSE MONITORING SYSTEMS FROM THE PERSPECTIVE OF CAA AUSTRIA

Peter Metzger[1], Gerd Koehler[2], Vijay-Mohan Sharma[1], Daniela Flechl[1], Natalie Schmuck-Chmelik[1]
[1]*Austro Control, Wien, Austria;* [2]*Medical University of Graz, Graz, Austria*

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(Education - Tutorial / Review)

INTRODUCTION: According to European Regulation, a pilot with diabetes requiring insulin is deemed unfit to fly. In Ireland and Austria, a Diabetes Protocol has been implemented. This started in the UK in 2015 and allows commercial pilots who develop insulin-dependent diabetes during their career to continue flying. Austria joined the Protocol at the end of 2016. Austro Control GmbH currently manages ten pilots in the protocol; four Class 1 ATPL pilots, three Class 2 private pilots and three Light Aircraft Pilot Licence (LAPL) pilots. **TOPIC:** Medical certification through the Diabetes Protocol is subject to strict criteria. In addition to general medical eligibility, cardiovascular, endocrinological and ophthalmological parameters must be met. Non-compliance with the protocol results in exclusion or non-inclusion. Pilots in the protocol experience very few out of range glucose measurement and in the last years these have steadily decreased. The risk-optimised use of the Diabetes Protocol was made possible due to the latest medical technologies and therapy methods, including the use of insulin pumps with automated insulin delivery (AID) and the latest generation of continuous glucose monitoring (CGM) devices. The accuracy of CGMs has been shown to be comparable with finger prick testing. Atmospheric pressure changes during flights can affect insulin delivery from pumps. Ambient pressure reduction during simulated flights results in bubble formation and expansion within insulin cartridges. This causes unintended delivery of small insulin doses. In one study performed in a hypobaric chamber 0.60 U of insulin were over-delivered during ascent. However, in vivo, pilots did not experience a fall in blood glucose or episodes of hypoglycaemia during these atmospheric pressure changes. Further studies are in progress to assess the effectiveness of hybrid closed-loop systems and different sensors during commercial airline flights. **APPLICATION:** The experiences with implementing and running a diabetes protocol in Austria may help other national aviation authorities who wish to provide medical certification to pilot with insulin treated diabetes. The research shared in this presentation provides assurance of the safety of such a protocol.

Learning Objectives

1. The audience will learn that about a protocol for pilots with insulin treated diabetes that has been implemented in Austria.
2. The audience will learn that hybrid close loop insulin pump systems can handle pressure changes and do not lead to unintended metabolic consequences in people with insulin dependent diabetes.

[175] FAA OFFICE OF AEROSPACE MEDICINE EXPERIENCE WITH USE OF CONTINUOUS GLUCOSE MONITORING TO ASSURE SAFE CERTIFICAITON OF PROFESSIONAL PILOTS WITH DIABETES TREATED WITH INSULIN

Richard Murphy
FAA, Washington, DC, United States

(Education - Tutorial / Review)

INTRODUCTION: New technology has transformed the clinical management of Insulin Treated Diabetes Mellitus (ITDM), with the advent of wearable Continuous Glucose Monitoring (CGM). This has redefined the overall risk as well as the parameters for risk stratification and allows safe certification of many professional pilots with this condition. **TOPIC:** Insulin-Treated Diabetes Mellitus (ITDM) is a specifically disqualifying condition for aeromedical certification by the FAA under the Code of Federal Regulations: 14 CFR part 67. As of 1996 3rd class (non-professional) pilots with ITDM may be issued under the Special Issuance (SI) protocol, however it was not until late 2019 that FAA certification of first and second class professional pilots became possible, due in large part to the advancement in CGM technology. The first CGM system was approved by the US Food and Drug Administration (FDA) in 1999. Further improvements have allowed for greater accuracy, longer wear times and more reliable data transmission. Most modern devices are easy to use, reliable and do not require calibration by fingerstick testing. Initial criteria for certification and parameters for ongoing monitoring were derived from current clinical guidelines along with expert review by a panel of clinical endocrinology and aerospace medicine physicians. The ITDM certification process has been subject to continual review for safety and quality assurance since. Pilots granted an SI were found to have significantly better diabetic control and to meet ADA standards compared to those denied certification. After more than 2 years of successful program implementation, and with data of our cumulative experience, the program requirements were updated to better reflect contemporary clinical practice and simplify the requirements for pilots. This program remains under close quality assurance review by the FAA. Very few pilots initially certified were eventually denied recertification. No serious or in-flight safety events have been observed in the 5-year history of the program. **APPLICATION:** The application to the safe certification of professional pilots with ITDM through this program is clear, however there are wider ranging concepts of the use of new technologies that allow for continuous monitoring of a medical condition to assure ongoing stability. This includes monitoring in the cockpit and may provide early warning of a potential problem. **RESOURCES:** https://www.faa.gov/go/itdm

Learning Objectives

1. Attendees will learn about the use of continuous glucose monitoring to demonstrate stable and safe glucose control and allow for safe aeromedical certification under a time limited special issuance.
2. Attendees will understand how parameters are selected, reviewed and updated to assure ongoing efficiency and safety of the certification process.
3. Attendees will consider the potential for emerging monitoring and wearable technologies to improve aviation safety.

[176] INSULIN TREATED DIABETES IN FLIGHT: A PILOT'S PERSPECTIVE

Jeremy Robertson
Qantas, Mascot, New South Wales, Australia

(Education - Tutorial / Review)

INTRODUCTION: A practical user's perspective of the in-flight management of insulin dependent diabetes using the Australian/UK protocol, a hybrid closed-loop insulin pump, and continuous glucose monitor. **TOPIC:** For several years now, certain regulatory authorities have had in place protocols to allow people with insulin dependent diabetes to fly as commercial pilots. Previous presentations at this and other scientific meetings have focused on design of these protocols, their requirements for certification, as well as outcomes of monitoring and evaluating these protocols. This presentation aims to add the viewpoint of the user, a commercial pilot with type 1 diabetes, on how one of these protocols is applied to domestic and international airline operations whilst operating as a Boeing 737 pilot. This pilot uses a hybrid closed loop pump and continuous glucose monitor, the specific types of which are included in an ongoing EASA research project into this topic. **APPLICATION:** An understanding of the practical application of any protocol for insulin dependent diabetes will allow aeromedical examiners more targeted conversation with pilot applicants they assess. For regulators it will continue to guide ongoing development and improvement of new and existing protocols. **RESOURCES:** UK Aircrew Regulation ARA. MED.330. Medical Assessment Protocol for Pilots with Diabetes Treated with Insulin and/or Potentially Hypoglycaemic Medication. UK Civil Aviation Authority, June 2023. https://www.caa.co.uk/media/axmpaid1/20230608-uk-v4-2-ara-med-330-content.pdf Garden GL et al. An Evaluation of the Safety of Pilots With Insulin-Treated Diabetes in Europe Flying Commercial and Noncommercial Aircraft. Diabetes Care, 1 December 2020; 43 (12): 2923–2929. https://doi.org/10.2337/dc20-0277 EASA Research Projects, Diabetes Mellitus (DM). European Union Aviation Safety Agency, October 2024. https://www.easa.europa.eu/en/research-projects/diabetes-mellitus-dm

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Learning Objectives
1. The audience will learn the practical aspects of operating to an insulin dependent pilot protocol.
2. The audience will learn relevant topics for discussion with insulin dependent pilots.

Wednesday, 06/04/2025 ***8:30 AM***
Centennial Ballroom II

[S-33] PANEL: FATIGUE IN MILITARY AVIATION

Chair: Ryan Mayes
Co-Chair: Richard Arnold

Panel Overview: *The military aviation environment poses multiple physiologic challenges to aviators; tactical/high-performance aviation in particular presents physiologic burdens during the flight, as well as additional stressors from operational tempo. Recent studies have highlighted the impacts of these exposures on both sleepiness and fatigue. This panel will present the results of studies examining the impact of flight on physical and cognitive fatigue. In addition, biomarkers associated with fatigue will be discussed; a better understanding of these biomarkers may help advance knowledge of the physiologic impacts of tactical aviation. The first presentation will describe cognitive fatigue modeling of mobility pilot performance during a long duration 24-hr simulated mission. The following three presentations will present results from an in-flight study of instructor pilots, beginning with the results of flight-related fatigue and associated biomarkers. This will be followed with a presentation comparing the fatigue results between the two bases involved in the study. The third presentation from the in-flight study will examine the biomarker results and provide a comparison between bases to better understand the differences due to operational tempo. The final presentation in the panel will present an animal model to examine individual exposures from the aviation environment and their resultant impacts on biomarkers, to include impacts at the blood-brain barrier.*

[177] FATIGUED PERFORMANCE COGNITIVE MODELING IN MOBILITY PILOTS

Megan Morris[1], Garrett Swan[2], Bella Veksler[3]
[1]*711th Human Performance Wing, Wright-Patterson AFB, OH, United States;* [2]*Aptima, Wright-Patterson AFB, OH, United States;* [3]*TiER1 Performance, Wright-Patterson AFB, OH, United States*

(Original Research)

INTRODUCTION: Maximum endurance operations will be critical to our military's success, but these missions will further exacerbate crew's fatigue given decreased sleep, circadian desynchrony, and high operations tempo. Hence, we need enhanced fatigue risk management capabilities to reduce safety risk and increase performance. Predictive models of fatigued performance can be beneficial in identifying outcomes at risk and helping target countermeasure timing. This effort focuses on developing cognitive models of mobility pilot performance during a long-duration 24-hr simulated mission, with the aim of being able to predict performance based on individualized sleep information. **METHODS:** Thirty-nine mobility pilots (Mage = 28.00; SDage = 3.01; 32 men) provided usable data in the study. Pilots wore an actigraph watch to assess sleep throughout the study and completed a 24-hr simulator session with various mobility mission tasks of different complexity levels in augmented crews. During the simulated mission, pilots also completed a cognitive task suite that included a Psychomotor Vigilance Test (PVT), which assesses attention, a N-back task (2-back), which assesses working memory processes, and a Change Signal Task (CST), which assesses executive functioning processes, all critical cognitive processes for mission performance. Cognitive models of the PVT, N-back, and CST were further developed and sleep data from actigraph analysis was included to individualize the models. Model fit (root mean squared error [RMSE]) was assessed between pilot performance and model predictions on each of the cognitive tasks' performance metrics. **RESULTS:** Integrating sleep data into the models resulted in predictive fits: PVT median reaction time (RT) (RMSE = .01), lapses (RMSE = 1.98), and false starts (RMSE = 1.74); N-back median RT (RMSE = .04), false alarms (RMSE = .02), and accuracy (RMSE = .03); CST median RT (RMSE = .05,) and accuracy (RMSE = .02). **DISCUSSION:** The effort provides evidence of increased predictive performance of models given the integration of individual sleep information. This work relates to the Fatigue in Military Aviation panel by showing advances in cognitive modeling individualization that can be implemented during military operations to help reduce safety risk and increase performance.

Learning Objectives
1. The audience will learn about the predictive ability of cognitive models with sleep information in realistic long-duration mobility missions.
2. Audience members will be able to describe potential applications of fatigue models on cognitive performance.

[178] THE IMPACT OF TACTICAL AVIATION ON FATIGUE AND SERUM CYTOKINES.

Ryan Mayes[1], Niveta Ramakrishnan[2], Elizabeth Damato[2], Hannah Boehringer[2], Seunghee Margevicius[2], Michael Decker[2]
[1]*USAFSAM, Wright-Patterson AFB, OH, United States;* [2]*Case Western Reserve University, Cleveland, OH, United States*

(Original Research)

INTRODUCTION: The tactical aviation environment presents numerous physiologic challenges. A previous study (2020, n=22) demonstrated a potential connection between increased levels of fatigue among some instructor pilots and flight operations over a 1-week study period. The pilots who experienced increased fatigue did not have differences in sleep or sleepiness, but did have changes in blood serum proinflammatory cytokines; these serum marker changes were absent in pilots who did not have increased fatigue. This 2022 study was undertaken to better understand these associations in a larger sample across a 2-week study period. **METHODS:** 45 USAF instructor pilots (IPs) at two different bases were studied on 6 separate days across a 2-week flying schedule: Sunday (baseline), Tuesday, and Thursday. Data included fatigue levels using the Multidimensional Fatigue Inventory, a physical exam, and venous blood samples. **RESULTS:** Participants were 91% male, 34.02 ± 5.55 years, with BMI of 27.55 ± 3.65 kg/m2. At baseline, 36 IPs reported elevated General Fatigue (GF) scores ≥ 10, a level representing "unwellness." By Thursday, 37 IPs endorsed GF scores ≥ 10. Multiple serum markers displayed the same pattern as the 2020 study; for example, monocyte chemoattractant protein 1 levels were 309.58 ± 130.49 pg/ml for participants with GF ≥ 10 at baseline and remained elevated at 299.55 ± 131.26 on Thursday (p = 0.757). Increased fatigue severity paralleled increased blood serum proinflammatory cytokine levels. In comparison to the 2020 study (GF 8.65 ± 0.67), fatigue levels were markedly higher in 2022: GF 9.73 ± 0.58 at the same base as 2020, and GF 13.34 ± 0.36 at a second base. **CONCLUSION:** As a performance degrader, understanding causes of fatigue is important to minimize operational risk; potential causes of the higher levels of fatigue, such as flight duration and frequency, will be discussed. Serum proinflammatory cytokine levels may be objective markers of fatigue.

Learning Objectives
1. The audience will understand the emerging evidence to explain the variation in fatigue levels observed in military tactical aviators at Air Force training bases.
2. The audience will understand the evidence supporting proinflammatory serum cytokines as an objective marker of fatigue.

[179] INSTRUCTOR PILOT FATIGUE LEVELS DIFFER BETWEEN MILITARY TRAINING BASES

Hannah Boehringer[1], Koyal Ansingkar[1], Ryan Mayes[2], Anthony Turner[2], Seunghee Margevicius[1], Michael Decker[1], Elizabeth Damato[1]
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(Original Research)

INTRODUCTION: Cognitive and physical fatigue are consequences of unprecedented challenges imposed by tactical aviation. Multiple studies have quantified fatigue during a single point in time. However, a dearth of data exists to characterize fatigue levels in tactical aviators across weekends when flying is reduced, and across weekdays when flying times are maximal. This study aimed to fill that knowledge void and provide an overview of fatigue levels in separate cohorts of instructor pilots (IPs) located at two military training bases. **METHODS:** Institutional Review Board approval was obtained from the collaborating university and the US Air Force. T-6 Texan II (n=38), T-38 Talon (n=5), and T-1 Jayhawk pilots (n=1) were studied, in addition to 2 IPs who did not log flying hours (Total N = 42 males + 4 females). Data were collected in May 2022 at Base #1 and June 2022 at Base #2. The Multidimensional Fatigue Inventory (MFI) assessed five domains of fatigue at six time points over a two-week period at each base. The MFI has been used in population-based studies of fatigued and non-fatigued persons. **RESULTS:** Participants from the two sites differed significantly on age (38.14 ± 4.44 vs. 29.83 ± 3.31 years, p<0.001), years as a military pilot (13.55 ± 4.27 vs. 6.36 ± 3.83 years, p<0.001), and years as an instructor pilot (8.36 ± 3.89 vs. 2.44 ± 2.45 years, p<0.001). Base #2 IPs were younger and reported fewer years as a military pilot and instructor pilot than Base #1 IPs. During each of the six time points, IPs from Base #2 reported consistently reported higher fatigue. Of the five fatigue domains, "General Fatigue" was markedly elevated in this cohort, with a mean score of 13.34 ± 0.36, exceeding the mean score of 9.73 ± 0.58 reported by IPs from Base #1. This pattern emerged across all five domains of fatigue. **DISCUSSION:** While General Fatigue scores for Base #1 IPs were within range of published norms for healthy "well" persons in the general population, General Fatigue scores for Base #2 IPs were markedly higher and consistent with values for persons defined as "chronically unwell."

Learning Objectives

1. The audience will understand the variation in fatigue levels among military aviators at Air Force training bases.
2. The audience will describe the range of fatigue domain scores of US Air Force instructor pilots across time following successive training flights.

[180] INSTRUCTOR PILOT BLOOD SERUM CYTOKINE AND INTERLEUKIN PROTEIN CONCENTRATIONS ARE INCREASED IN THOSE WITH GREATER FATIGUE LEVELS.

Elizabeth Damato[1], Seunghee Margevicius[1], Ryan Mayes[2], Anthony Turner[2], Hannah Boehringer[1], Michael Decker[1]
[1]*Case Western Reserve University, Cleveland, OH, United States;* [2]*USAFSAM, Wright-Patterson AFB, OH, United States*

(Original Research)

INTRODUCTION: We have previously identified cytokines and interleukin proteins within the peripheral bloodstream that concomitantly increase with the onset of fatigue. It was unclear whether those serum protein concentrations corresponded with fatigue severity or only the presence/absence of fatigue. Additionally it was unclear whether those findings, derived from one study at one USAF base, could be replicated and representative of other fatigued personnel. The purpose of study was to address those knowledge gaps by studying personnel at two separate locations and determine if serum cytokine and interleukin proteins concentrations corresponded with fatigue levels. **METHODS:** Institutional Review Board approval was obtained. Data were collected in May 2022 at Base #1 and June 2022 at Base #2. Venous blood was collected on six separate days across a two-week flying schedule: Sunday, Tuesday, and Thursday while the Multidimensional Fatigue Inventory (MFI) assessed five domains of fatigue. Serum was analyzed with multi-array electrochemiluminescence technology using preconfigured 96-well plates. **RESULTS:** A total of 46 USAF instructor pilots were studied (42 males + 4 females). Serum concentrations of cytokines and interleukins previously identified as being associated with the onset of fatigue were also associated with fatigue in this study. These included monocyte chemoattractant protein 1 (MCP-1) and brain derived neurotrophic factor (BDNF). In addition, serum concentrations were significantly increased over prior study values observed in 2020. Concentrations of eight cytokine and interleukin proteins differed significantly between the two bases. MCP-1, for example, was significantly increased in participants from Base #2 (Mean ± 1 SD of 320.40 ± 129.60 pg/ml vs. 204.80 ± 93.40 pg/ml, p=0.001). Base #2 participants also reported significantly greater fatigue levels. Similar relationship patterns emerged between seven other serum protein concentrations and fatigue scores. **DISCUSSION:** Findings presented here suggest that blood serum concentrations of cytokines and interleukins were increased in pilots from Base #2, who also reported greater fatigue levels. Both serum concentrations of cytokines and interleukins as well as fatigue scores were significantly elevated in this 2022 study over prior 2020 study values. Mechanisms contributing to the increased values we observe remain unclear at this time.

Learning Objectives

1. The audience will understand the variation in blood serum cytokines and interleukin levels among military aviators at Air Force training bases.
2. The audience will describe the relationship between fatigue levels and blood serum cytokine and interleukin levels in military aviators at Air Force training bases.

[181] FLUCTUATIONS IN CYTOKINES IN THE BRAINS OF MICE AFTER EXPOSURE TO HYPOXIA, HYPOBARIA AND HYPEROXIA

Michael Decker, Koyal Ansingkar, Tristan Nunley, Elizabeth Damato
Case Western Reserve University, Cleveland, OH, United States

(Original Research)

INTRODUCTION: Hypobaria, hypoxia, and hyperoxia are among the inherent risks of high-altitude aviation. All three of these stressors contribute to generalized central nervous system fatigue via various, unclear mechanisms. To address those knowledge gaps, the objective for this study was to determine systemic biochemical outcomes following exposure to hypobaric hypoxia, isolated hypobaria, and concomitant hyperoxia. An array of proinflammatory and anti-inflammatory cytokines were measured in this study through analysis of mouse brain homogenates. **METHODS:** Mice were maintained within either 760 mmHg, 564 mmHg, or 429 mmHg barometric environments for three 90-minute sessions per day for five consecutive days. Some experimental groups also received supplemental oxygen to maintain an expected arterial partial pressure of oxygen of 100 mmHg. This corresponded to 29% FiO2 for the 564 mmHg condition, and 39% FiO2 for the 429 mmHg condition. Hyperoxic exposure was achieved by increasing the FiO2 to 60%. Mice were euthanized, and brains were extracted and flash frozen. Tissue levels of 10 cytokines were measured using electrochemiluminescence technology. **RESULTS:** At 564 mmHg, without additional oxygenation, the only analyte to change was IL-4 (p=0.01), an anti-inflammatory cytokine responsible for angiogenesis. At 564 mmHg with supplemental oxygen, significant increases in IFN-γ (p=0.03), IL-1β (p=0.001), and TNF-α (p=0.01) were noted, all of which are pro-inflammatory. When the FiO2 was increased to 60%, the hyperoxic exposure produced significant increases in several pro-inflammatory markers [IFN-γ (p=0.01), IL-12p70 (p=0.01), IL-1β (p=0.02), IL-2 (p=0.01), IL-6 (p=0.02), and TNF-α (p=0.03)] as well as two anti-inflammatory markers [IL-10 (p=0.02) and IL-5 (p=0.02)]. At 429 mmHg, the only analyte to increase was IL-2, and with supplemental oxygenation, all of the cytokines were found to increase with decreased barometric pressure. **DISCUSSION:** The rise of pro-inflammatory cytokine levels in brain homogenates following exposure to supplemental oxygen suggests that the role of supplemental oxygen in a high-altitude environment may produce more adverse effects than previously thought. The isolation of hypobaria without hypoxia, a man-made physiological insult, produced a unique systemic response of the immune system. These findings and potential implications highlight the need for further investigations to confirm the results of this study.

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Learning Objectives
1. The audience will describe the biochemical pathways through which hypoxia, hypobaria, and hyperoxia contribute to aviator fatigue.
2. The audience will understand a potential methodology for isolating physiological insults and measuring the outcomes in a mouse model.

Wednesday, 06/04/2025 ***8:30 AM***
Centennial Ballroom III

[S-34] SLIDE : FLY GIRLS

Chair: Dragana Dragic Ranisavljevic
Co-Chair: Lydia Johnson Kolaparambil Varghese

[182] VULVOVAGINAL INFECTIONS IN SPACE: A REVIEW

Kira Rienecker[1], Amelia Espinosa[1], Prasanna Tati[2], Kadambari Suri[3], Begum Mathyk[4], Amber Paul[5], Jonathan Steller[6]
[1]*Blue Marble Space Institute of Science, Seattle, WA, United States;* [2]*Robert Wood Johnson Monmouth Medical Center, Long Branch, NJ, United States;* [3]*Texas A&M University College of Medicine, Bryan, TX, United States;* [4]*University of South Florida, Tampa, FL, United States;* [5]*Embry-Riddle Aeronautical University, Daytona Beach, FL, United States;* [6]*University of California Irvine, School of Medicine, Irvine, CA, United States*

(Original Research)

INTRODUCTION: Vulvovaginal infections (VVI) such as bacterial vaginosis and vulvovaginal candidiasis are common medical comorbidities affecting millions of people in the United States every year. We now have a robust understanding of the terrestrial vaginal microbiome and VVI management, but there is a lack of data about spaceflight effects on the vaginal microbiome and VVI risk. While such an infection has not yet been reported in space, we hypothesize the likelihood of VVI affecting crew health and performance during long-duration exploration spaceflight may be elevated. This study will review VVI incidence in analog populations, and evidence of how spaceflight alters human immune function, disrupts other human microbiomes, and affects pathogen virulence and antibiotic resistance, while dysregulating innate and adaptive immune cells critical to barrier immune systems such as in the vagina. **METHODS:** The literature search was conducted in PubMed, NASA Technical Reports Server, and the NASA Life Sciences Portal. Search terms included, but were not limited to: spaceflight, vulvovaginal infection, vulvovaginitis, vulvovaginal candidiasis, bacterial vaginosis, Candida albicans, Lactobacillus, innate and adaptive immunity, microbiome, resistance, and immunosuppression. Analog studies from servicewomen on deployment, Antarctica research stations, and spaceflight analogs such as HERA, HI-SEAS, and Aquarius were examined for VVI incidence reports. **RESULTS:** While VVI incidence were not readily available in all spaceflight analogs analyzed, incidence rates of infection in deployed servicewomen have been previously reported, and in one study 1 of 4 reported inadequate support for women's primary care [1,2]. In spaceflight, astronauts experience heightened infections and dysregulated Type 1 immunity. Spaceflight reduced gut Lactobacilli abundance, an important protective vaginal bacteria. Pathogenic bacteria (and C. albicans) became more virulent and resistant to antibiotics/antifungals in microgravity. **DISCUSSION:** This manuscript promotes women's health in space by introducing the vaginal mucosal barrier and microbiome, reviewing known impacts of spaceflight on immunity and analogous microbiomes, and suggesting pre-, in-, and post-flight management strategies to mitigate VVI. Finally, our authors call for research supporting the Human Research Program Gaps and the aims of the Decadal Survey on Biological and Physical Sciences Research in Space 2023-2032.

Learning Objectives
1. While there is a paucity of data on VVI incidence in spaceflight, indicators from related studies on immunity, pathogen virulence and antibiotic resistance, and the gut microbiome suggest prolonged spaceflight may increase recurrent or treatment-resistant VVI.
2. Current diagnostic capabilities to distinguish VVIs onboard the ISS are severely limited, and may become a greater issue in long-duration deep space missions with limited resourcing and increased remoteness.

[183] FIBROIDS AND ASTEROIDS: CONTEMPORARY REVIEW OF GYNECOLOGICAL HEALTH RISKS IN SPACE

Kwasi Nkansah, Jr.[1], Darshankumar Raval[2], Wanyao Chen[1], Wiaam Elkhatib[3]
[1]*University of Toronto, Toronto, ON, Canada;* [2]*Western Reserve Health Education, Northeast OH Medical University, Warren, OH, United States;* [3]*Mayo Clinic, Rochester, MN, United States*

(Education - Tutorial / Review)

OBJECTIVE: While women have been part of space exploration since the 1960s, they make up only 11% of the astronaut population—a number that's increasing but still limited. As we aim for extended and recreational space travel, understanding how spaceflight impacts gynecological health is crucial for safer missions. This project compiles current research on how space's unique environment influences the female reproductive system, highlighting areas for improved wholistic health support for female astronauts. **METHODS:** We conducted a scoping literature review, using PubMed to identify relevant studies published from 1950 to 2024. Keywords such as "women," "reproductive health," and "spaceflight" were used alongside terms related to specific space hazards, like "microgravity," "radiation," and "sleep." We organized findings by primary environmental factors affecting gynaecological health, namely, microgravity, radiation, and other spacecraft living conditions. **RESULTS:** Out of 7,432 identified articles, 30 were analyzed in detail. The data, covering human and animal studies on Earth and in-flight, indicate that microgravity, radiation, and spacecraft conditions significantly impact female reproductive health. Documented changes include higher risks for tumor growth, reactivation of latent STDs, menstrual irregularities, and hormonal imbalances. Potential protective measures may include oocyte cryopreservation, dietary adaptations, sleep hygiene improvements, and more comprehensive radiation shielding. **CONCLUSION:** The unique conditions of spaceflight pose specific health risks to the female reproductive system, particularly relevant given the typical age of female astronaut recruits. With minimal research available on gynecological health in space, we face a critical knowledge gap. As space exploration becomes more inclusive and missions extend longer, this research underscores the need to address these health concerns proactively, supporting the well-being and mission readiness of all astronauts.

Learning Objectives
1. The participants will be able to understand the effect of spaceflight missions on female reproductive system.
2. The audience will be able to quantify the importance of cryopreservation for the upcoming long duration spaceflight missions.

[184] TO FLY OR NOT TO FLY WHILE PREGNANT: CANADIAN OPERATIONAL MILITARY PILOTS

Joelle Thorgrimson[1], Karen Breeck[2]
[1]*Canadian Armed Forces, Winnipeg, MB, Canada;* [2]*University of Toronto, Ottawa, ON, Canada*

(Original Research)

INTRODUCTION: Women continue to remain a minority of Canadian Armed Forces (CAF) operational pilots equalling <2% in 2000 and <6% in 2022. Limited research has been completed on pregnancy experience of military pilots. **METHODS:** This mixed-methods epidemiological study involved semi-structured interviews with CAF operational female pilots. Interviews included a medical questionnaire and medical records review. A community based participatory research approach was

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used throughout. **RESULTS:** 50 (57%) of current CAF operational female pilots from 15 different platforms with a wide range of ranks completed interviews. 28 (56%) had one or more pregnancies with the mean age of having their first child 32+/-4 years, ranging from 29-42 years. Pregnancy experience was thoroughly explored including pregnancy intention and outcomes. For example, at time of pregnancy, 22 (79%) were in an operational posting, 20 (91%) had a planned pregnancy, and 9 (32%) had miscarriages, abortions, and still births. Furthermore, medical care, fertility treatment, parental leave, breast feeding, childcare, institutional support, and career implications were discussed. For example, 16 (57%) felt they did not have enough information on occupational risks and hazards to make an informed decision about flying if pregnant, and 16 (57%) felt their career was negatively impacted. **DISCUSSION:** Examining the pregnancy experience of miliary pilots revealed that they are conceiving later and feeling as though more information is needed to make informed decisions surrounding flying. As this population continues to increase in the CAF, it is imperative that more research in this area is completed to optimize health outcomes and experiences.

Learning Objectives

1. Understand the pregnancy experience and outcomes of Canadian operational military pilots.
2. Identify areas for future research in pregnant pilots as well as aircrew.

[185] EVALUATION OF RECENT TRENDS IN FEMALE AVIATOR HEALTH

Samantha Wolf, Amanda Kelley
U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: The role of female aviators in the Army has evolved significantly since their introduction into Army aviation. Understanding the morbidity specific to women associated with a career in aviation service is key to a comprehensive understanding of occupational risk, and can inform preventative health maintenance for the purpose of maximizing occupational readiness. **METHODS:** Data were retrieved on 12,132 female aircrew, limited to officers and warrant officers, from the Aeromedical Epidemiological Data Repository (AEDR) from the years 2015 to 2023. The dataset yielded 3,894 female Soldiers with a total of 50,189 cases containing variables: age, rank, diagnosis code, waiver/suspension recommendation, and aeromedical disposition. The top ten most frequently occurring diagnoses overall, as well as those associated with each waiver/suspension recommendation, were calculated. Any given diagnostic code was only counted once per patient per aeromedical disposition type. **RESULTS:** All the 4,873 waivers recommended with a disposition indicated were granted. The top conditions concurrent with a waiver approval were hypothyroidism (1.3%), low back pain (1.2%), repair right cornea (1.1%), repair left cornea (1.0%), allergic rhinitis (0.5%), migraine (0.5%), adjustment disorder (0.5%), hypertension (0.5%), anxiety disorder (0.4%), and depressive disorder (0.4%). All 806 recommendations for suspension were granted. The top conditions concurrent with permanent suspension were post-traumatic stress disorder (2.2%), adjustment disorder (1.5%), lumbago (1.1%), cervicalgia (1.0%), cyclobenzaprine (1.0%), depressive disorder (1.0%), flight surgeon recommendation (1.0%), low back pain (1.0%), major depressive disorder single episode unspecified (1.0%), and migraine (1.0%). Additionally, in the list of top ten all-cause diagnoses, four codes were related to women's health, three to vision health, and two were administrative codes. **DISCUSSION:** Overall, the findings were consistent with a similar analysis of female aircrew data from 2005-2015. This indicates that major changes to the healthcare environment likely have not affected the overall health of the aviation community. One of the limitations of the dataset is the availability to use International Classification of Disease (ICD) 9 and 10 codes. The U.S. transitioned to ICD-10 in 2015. The investigators will continue to analyze the dataset by systems-based diagnosis category and analogous ICD codes.

Learning Objectives

1. The audience will learn about the process by which US Army aviators are cleared for flight duties.
2. The audience will learn about health trends specific to female aircrew.

[186] PREGNANCY AND SIMULATOR FLYING

Elaine Rutland[1], Erica Jackson[2], Claire Goldie[3]
[1]*RAF, Sleaford, United Kingdom;* [2]*RAF, Centre of Aviation Medicine, Henlow, United Kingdom;* [3]*Army, Consultant Advisor in Aviation Medicine (UK), Middle Wallop, United Kingdom*

(Education - Program / Process Review)

BACKGROUND: Despite the UK Ministry of Defence (MOD) accepting the first female aircrew in the 1990's, female aircrew remain a small minority of serving aircrew. Across the MOD, women comprise less than 5% of aircrew. North Atlantic Treaty Organisation (NATO) data indicates that across international members, general military populations are ~13% female. There have been multiple workstrands which have targeted optimising employment of women in the UK Armed Forces. Ensuring all talented individuals are given the optimal opportunity to serve increases the talent pool from which Defence can draw. **OVERVIEW:** Fitness for pregnant aircrew to fly has been a hot topic for discussion and review over the last few years across military and civilian flying contexts with a variety of approaches being taken to fitness to fly certification in pregnancy. To mitigate for time away from flying duties, simulator flying across a multitude of platforms is being increasingly employed. From our investigations, it is evident Australia, NZ, and the US Army permit their pregnant aircrew to fly in simulators, but the approach elsewhere differs. In the UK, military pregnant aircrew may occasionally fly in simulators subject to local risk assessment, but local approaches vary and it is clear from operating authorities' feedback that the data upon which to make risk decisions is lacking and cohesive guidance is not available. Female aircrew experience this as a further barrier to career progression and retention. Provision of the Executive, and Aviation Medical specialists with policy and guidance to provide clarity of the actual risks associated with simulator flying in pregnancy will optimise employability of pregnant aircrew, enhance retention, and improve Operational Effectiveness of the force as a whole. **DISCUSSION:** To address this, we have reviewed the variety of simulators across UK Defence and civil sectors and further investigated the various factors affecting safe simulator flying in pregnancy such as vibration, noise, shift work, anthropometrics and access and egress. This has led to the development of evidence-based guidance for duty holding representatives and Aviation Medical specialists to conduct their simulator risk assessments, thus optimising employability of pregnant aircrew wherever possible.

Learning Objectives

1. The audience will learn about the factors that should be considered within risk assessments for pregnant aircrew to fly in simulators.
2. The audience will learn about the evidence regarding specific simulator flying-related hazards in pregnancy including, but not limited to vibration, noise, anthropometry, circadian rhythm / shift work and simulator / motion sickness.

[187] IMPLICATIONS OF RECURRENT DEEP VEIN THROMBOSES IN AN ACTIVE-DUTY AVIATOR

Kevin Anderson, Maxwell Cheng, Briana Middel
U.S. Air Force, Ellsworth AFB, SD, United States

(Education - Case Study)

INTRODUCTION: This case report describes a B-1B Weapon Systems Operator with several comorbidities who developed multiple deep vein thromboses while in the Middle East requiring medical evacuation. **BACKGROUND:** Deep vein thrombosis (DVT) is a consequential and life-threatening disease, with even further professional ramifications in the flying community. Numerous risk factors exist but despite the prevalence, there are few reported cases of commercial or

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military airmen highlighting the development of DVT post-flight. **CASE PRESENTATION:** We present a 34-year-old female with several pre-existing comorbidities who developed ipsilateral proximal and distal DVT's while in Oman that required medical evacuation back stateside. Prior to her long-haul flight overseas, she presented to the local emergency department with lower-extremity pain similar to a prior DVT in 2018 and after negative work-up was subsequently discharged. Days later, she was evaluated by plane-side emergency medical technicians after painful ambulation through the airport. After being symptomatic for over a week, she was admitted to an Omanian hospital, and a formal diagnosis was made. Initial oral anticoagulation was started; however, she developed an exanthem likely attributed to subtherapeutic dosing while in her medical evacuation but ultimately returned home stable. **DISCUSSION:** This case highlights several key points, particularly as it pertains to a thorough medical clearance process in conjunction with closed loop communication between the aviator and their entire care team. A prior case of DVT with a known genetic mutation and additional susceptibilities requires in-depth education and counseling prior to long distance air travel, especially when little national help exists in the country. Additionally, a thorough record review should be conducted on a high-risk servicemember to ensure they are medically optimized before traveling to a region with limited resources. Finally, this case illustrates the importance of medical evacuation resources to ensure proper medical management is completed to avoid further complications in air.

Learning Objectives

1. The audience will learn the importance of pre-travel counseling for high risk individuals from their flight medicine team and the limitations in the current healthcare system with resource-capped military treatment facilities.
2. This case highlights the importance of knowing all available resources to transport a medically complicated patient stateside from a country with minimal national assistance to ensure safe return of an active-duty service member.
3. The audience will take home the ramifications of thrombophilic disease in the aerospace community and how recurrent issues can lead to disqualification.

Wednesday, 06/04/2025 ***8:30 AM***
Centennial Ballroom IV

[S-35] PANEL: LIFE SUPPORT CHALLENGES FOR EXPLORATION CLASS SPACE MISSIONS: HUMAN HEALTH AND SURVIVABILITY

Chair: Douglas Hamilton
Co-Chairs: Gabrielle Caswell, Benjamin Eshelby

Panel Overview: BACKGROUND: *Complex organisms, such as humans, have a resident biome of microorganisms called a microbiome, contributing to their health and well-being. While a terrestrial biome can span vast areas of Earth, a 'macrobiome' is a community of organisms that coexist within an enclosed, biologically limited, intimate habitat, such as a submarine or a spaceship.* ***PANEL DESCRIPTION:***

- *Current and proposed ECLSS technologies for ECDSMs.*
- *The 'Omics' of the ECDSM Macro- and Microbiome organisms (including the Human system)*
- *MPV requirements for sustaining a macrobiome in space*
- *Can these ECLSS macrobiome concepts be validated on Lunar missions?*

ISSUES: *An Exploration Class Deep Space Mission (ECDSM) requires an Environmental Control Life Support System(ECLSS) that can maintain a macrobiome for the Human System. Current International Space Station (ISS) missions use regenerative physical/chemical (Phys/Chem) ECLSS processes. The recovery of water and oxygen from human waste has reduced the operational and logistical Mass/Power/Volume (MPV) footprint of the ISS ECLSS. The ECLSS for a Mars mission will include the modalities needed to support the astronaut's activities of daily living (ADL) and health maintenance strategies and address the unique space hazards (altered gravity, radiation, GCR, SPEs, etc..). The ECLSS MPV burden on these prolonged penetrations into deep space predicates that living organisms (plants, bacteria and fungi) should be conscripted to assume a 'mission critical' role in sustaining the macrobiome. Sustaining a closed biological regenerative ECLSS for ECDSMs needs to consider radiation, plant yield and fruits, light flux and spectrum, CO2 and Oxygen mass balance, water recovery, nutrient quantity and quality, temperature, relative humidity, altered gravity, composting organic matter, air revitalization, etc. As these closed ECLSS systems become more stable and predictable, adding animal life forms to the macrobiome might complement the Human System's nutritional requirements and the regenerative ECLSS's synergistic husbandry. Given that any ECDSM ECLSS is considered 'mission-critical,' all hazards that could potentially embarrass its function and survivability must be controlled. Will a biological ECLSS have a Mean Time Between Failure similar to PhyChem ECLSS? How much bridging Phys/Chem ECLSS is needed until an existing or alternative backup biological ECLSS can be healed or 're-started'?*

[188] HUMANS, ECOLOGY, MICROBES AND SPACE

Benjamin Eshebly
Formulae Pty Ltd, Albury, Australia

(Education - Tutorial / Review)

INTRODUCTION: Nestled amongst the estimated 30 trillion human cells in the body, are more than 38 trillion cells belonging to various forms of microbes. The human microbiome consists of predominantly bacteria, but also has communities of yeasts and viruses. Thus, when we consider human health, the microbiomes of the body and their relationships with human physiology must be considered. Special care must be taken when using antibiotics as these have the potential to destabilise the microbiome. What techniques can be employed to optimise the health of the microbiome and restore it if damaged? Such microbiological questions are as important as that of human physiology when considering health in a space setting. **TOPIC:** Human microbiome studies, though gathering pace are still in their infancy and have largely focussed on earthbound subjects. What other considerations are there for space travel for ensuring homeostasis of these commensal microorganisms? **APPLICATION:** What techniques can be employed to optimise the health of the microbiome and restore it if damaged? Such microbiological questions are as important as that of human physiology when considering health in a space setting.

Learning Objectives

1. The participant will be able to appreciate the symbiotic relationship between humans and their microbiome.
2. The audience will learn about begin to understand the complex population of the human microbiome.
3. The audience will appreciate the failings of modern medicine, such as antibiotics, and how their use becomes ineffective in the space environment.

[189] PART ONE: EXPLORATION SPACE MISSIONS AND HUMAN HEALTH STABILITY: INTRODUCING THE MICROBIOME

Gabrielle Caswell
Space Port Australia, Moree, New South Wales, Australia

(Education - Tutorial / Review)

INTRODUCTION: Complex organisms, such as humans, have a resident biome of microorganisms called a microbiome, contributing to their health and well-being. While a terrestrial biome can span vast areas of Earth, a 'macrobiome' is a community of organisms that coexist within an enclosed, biologically limited, intimate habitat, such as a submarine or a spaceship **TOPIC:** Human concomitant resident microbiomes . Introduction to microbiome concepts and contribution to human health.

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APPLICATION: Microbiome imbalance and impact on human health in space (What we know, what we don't know, and why our tools on earth [antibiotics] may not help); in addition changed microbiome impacts on the human immune system, nutrient uptake, skin and cognition. It is anticipated that long haul explorations, outpost settlements and enclosed environments may create impacts on human health, detrimental to the humans undertaking the mission.

Learning Objectives

1. The audience will learn about the human resident biome of microorganisms called a microbiome, contributing to their health and well-being.
2. The participant will be able to define the human microbiome and macrobiome and understand how these two ecological zones biology related to one another and contribute to human health.
3. The audience will appreciate the anticipated challenges to human health that long haul explorations, outpost settlements and enclosed environments may create, and begin to concern themselves with creating ideal human environments in space flight and colonization that lead robust human health outcomes in the space environment.

[190] MORTALITY AND MORBIDITY OF DEEP SPACE MISSION BIOLOGICALLY BASED LIFE SUPPORT SYSTEMS

Douglas R. Hamilton
General Internal Medicine, University of Calgary, Canada

(Education - Case Study)

INTRODUCTION: The recent successful launch of NASA's Artemis and SpaceX heavy-lift launch vehicles and the plan to use the Gateway Space Station in a Near Rectilinear Halo Orbit (NRHO) to explore the Moon represent the next technological hurdles to Humans eventually living on Mars. **BACKGROUND:** While a terrestrial biome can span vast areas of Earth, a 'macrobiome' is a community of organisms that coexist on a much smaller scale within an enclosed, biologically limited habitat, such as a submarine or a spaceship. A successful Exploration Class Deep Space Mission (ECDSM) requires a macrobiome that supports the life cycle of complex organisms (plants and animals) and their concomitant microbiomes. This new Environmental Control Life Support System (ECLSS) macrobiome may be the only effective solution for ECDSMs compared to the basic physical/chemical (PhysChem) ECLSS used to support current space missions. The ECLSS for a Mars mission includes the modalities needed to support the astronaut's activities of daily living and the health maintenance strategies (exercise, nutrition, medical monitoring, medical hazard prevention and treatment, social interactions) required to control the environmental hazards (altered gravity, radiation, etc.). As these closed regenerative ECLSS systems become more stable and predictable, adding animal life forms to support the macrobiome might complement the Human System's nutritional requirements. **CASE PRESENTATION:** Given that any ECDSM ECLSS is considered 'mission-critical,' controlling all hazards that could potentially jeopardize its function and survivability is of utmost importance. **DISCUSSION:** The probability of experiencing a lethal solar particle radiation event (SPE) on Mars similar to the 1972 lunar event is approximately 5% using Apollo-like shielding. The characteristics of previous SPEs can be derived from ice-sheet measurements. Without effective shielding, the 1859 Carrington SPE had doses of 60Gy outside the Earth's magnetosphere and would be genetically damaging and probably lethal to most life forms on Mars. Therefore, space flight poses significant hazards to the mortality or morbidity of a biological ECDSM ECLSS and, ultimately, the crew. Would we fly a PhysChem ECLSS as a mission backup or to sustain the macrobiome until the biological ECLSS can be replaced or 'healed'? Can these biological ECLSS concepts be tested and validated on NRHO Lunar missions?

Learning Objectives

1. The participant will understand the difference between 'biological regenerative' and 'physical chemical' Environmental Control Life Support Systems.
2. The participant will understand the challenge of converting various exploration class space mission Environmental Control Life Support System designs into Mass/Power/Volume mission requirements.
3. The participant will understand the effects of Solar Particle Events and Galactic Cosmic Radiation on Physical/Chemical and Biological Regenerative Life Support Systems.

[191] PART TWO: CLINICAL INSULTS: HUMAN HEALTH, RADIATION, MICROGRAVITY AND THE MICROBIOME

Gabrielle Caswell
Space Port Australia and Eyra Medical Pty Ltd, Moree, New South Wales, Australia

(Education - Tutorial / Review)

INTRODUCTION: The microbiome will be prone to insult form ionizing radiation, Galactic Cosmic Radiation, microgravity and environmental (habitat) macrobiome structure. A multitude of insults will create change within individual microbiomes, with a predicted clinical affect. **TOPIC:** Expected changes to the microbiome include physical (cellular replication rate, morphology, genetic insult) and well as functional (inability to work harmoniously with remaining microbiome, inability to provide nutrients etc. to human host) and this in turn can have detrimental affects on human health n space. **APPLICATION:** Clinical insults to the human microbiome from radiation, microgravity and environmental microbiome changes potentially will impact on human health, including the immune system, lung function, skin health and cognition. Longer journeys and settlements will require human participants to live in these stressful environments in their best health and functioning.

Learning Objectives

1. The audience will appreciate space environmental insults to the human microbiome.
2. The audience will gain an understanding of anticipated functional changes to microbiome from ionizing radiation, Galactic Cosmic Radiation, microgravity and environmental (habitat) macrobiome structure.
3. Participants will begin to appreciate the clinical manifestations of microbiome dysfunction and the potential impact on space exploration.

Wednesday, 06/04/2025 ***8:30 AM***
Regency V

[S-36] PANEL: PILOT SPATIAL DISORIENTATION RESEARCH, MODELING, AND TRAINING

Chair: Eric Groen

Panel Overview: **BACKGROUND:** *Pilot spatial disorientation (SD) remains a leading contributory factor in flight mishaps. Emerging knowledge, technology, and research tools yield better understanding of SD phenomena and their effects on pilot behavior, which should ultimately lead to effective mitigations.* ***PANEL:*** *This panel will expand upon research featured in our 2023 and 2024 AsMA panels by discussing new insights in research and modeling of SD, such as the effect of hypoxia on vestibular perception, the simulation of visual perceptual illusions, and modeling of sensory integration. The panel will start with two presentations on the capabilities of two world-leading SD devices: the Desdemona facility (at TNO) and the Kraken (at NAMRU-D). Both devices offer unique possibilities for research into the effects of SD on pilot performance, and can also be used for advanced SD awareness and avoidance training.* ***RELEVANCE:*** *The panelists will discuss research gaps to inform future SD research, development, and modeling initiatives, in addition to how such efforts may ultimately lead to safety mitigations. Altogether, the panel will give insight in the state-of-the-art of our understanding of SD.*

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[192] THE DESDEMONA FACILITY: ADVANCED SPATIAL DISORIENTATION RESEARCH AND TRAINING IN THE NETHERLANDS

Eric Groen[1], Erik Frijters[2]
[1]*TNO, Soesterberg, Netherlands;* [2]*Royal Netherlands Air Force, Soesterberg, Netherlands*

(Education - Program / Process Review)

BACKGROUND: The cutting-edge motion simulator DESDEMONA (acronym for 'DESorientation DEMONstrAtor') in the Netherlands has been specifically designed to reproduce vestibular spatial disorientation (SD) effects known from flight. This presentation will highlight its unique capabilities for research and training in the area of SD, and other related human factor topics. **OVERVIEW:** The DESDEMONA device combines a reconfigurable, single-seat cabin with a unique motion platform comprising a three-dimensional gimbaled system for unlimited rotations around any axis; two linear drives for 8-m horizontal and 2-m vertical motion; and a planetary drive that allows for sustained centrifugation at 3g. This kinematic design makes it possible to control all motion axes in parallel, which results in a superagile motion simulator that is ideal for the simulation of motion-critical maneuvers. Various cabin configurations are available, including a turbo-prop trainer aircraft (PC-7), fighter aircraft (F-16, F-35), military helicopters (Apache, Chinook, Cougar), and a left-hand seat of transport aircraft (Boeing 737). Together with realistic flight models and high-fidelity virtual environments, pilots can actively practice challenging flight maneuvers in their own aircraft type, while experiencing SD. DESDEMONA has been operational since 2008 and is used for SD awareness training by the Royal Netherlands Air Force (RNLAF), ranging from basic demonstrations of SD illusions for student pilots to advanced 'SD-prone' scenarios flown by experienced pilots. Examples of the latter are a full-motion recovery from an inverted deep stall by F-16 pilots, and a mountain flying course for military helicopter pilots with various SD effects such as sloping terrain and White-out conditions. DESDEMONA is also used for research purposes. Motivated by loss-of-control in-flight (LOC-I) accidents, such as Air France flight 447, funding was granted to enhance DESDEMONA's aerodynamic model and motion envelope to become the first ground-based simulator where airline pilots can realistically practice recoveries from an aerodynamic stall. **DISCUSSION:** DESDEMONA offers unique research possibilities, not only for aviation applications, but also for ship or ground-vehicle simulation. Its motion software and vehicle models can be adapted, and all simulator data, such as control inputs, can be logged for post-hoc analysis. Physiological monitoring and gaze tracking is available to investigate physiological and mental workload.

Learning Objectives

1. The audience will learn about the historical background of the world's most advanced disorientation device.
2. The audience will learn about the possibilities to provide disorientation training with ground-based devices.

[193] THE NAVY DISORIENTATION RESEARCH DEVICE: REVOLUTIONIZING HUMAN ORIENTATION RESEARCH

Kaila Vento, Bradley Fairfax, Richard Folga
Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States

(Education - Program / Process Review)

BACKGROUND: The Navy's Disorientation Research Device, or Kraken, at Naval Medical Research Unit Dayton (NAMRU-D) was created to provide unprecedented human orientation research capability. Since delivery in 2016, the Kraken has hosted 10 unique research and technical development efforts. These projects have fostered global collaborations, pushed technical boundaries, and driven innovative solutions, expanding the possible applications of a large multi-axis acceleration research platform. **OVERVIEW:** The Kraken is an advanced simulation platform that integrates a six-degree-of-freedom acceleration environment with high-fidelity visual displays to accurately replicate acceleration forces encountered in flight and various vehicle platforms. Key advancements include state-of-the-art virtual and mixed reality technologies, advanced eye-tracking systems and normobaric mask-on breathing systems, both developed and patented by NAMRU-D. Other mission-ready, fully integrated systems include flight helmet and mask suite, communication earplugs, spatial audio, noise-canceling, inertial measurement units, electromyography, electroencephalography, and optical tracking systems. A unique custom-engineered motorized head-on-neck rotator, subjective haptic and visual attitude indicators are specifically crafted to support foundational perceptual modeling. Each simulation study is meticulously tailored using the Kraken visualizer application, ensuring that motion dynamics are optimized for specific research objectives and motion is clearly communicated to collaborators. The Kraken operates with a comprehensive suite of aircraft flight controls, enabling human-in-the-loop flight simulation driven by motion, including the NASA Government Reference Model lunar lander. The Kraken Build Lab serves as an advanced offline development, testing, and evaluation ability for research configurations, fostering continuous innovation and refinement. Collaborative initiatives with OH State University and the University of Colorado Boulder focus aim to advance human perceptual modeling by integrating the Observer Model into the Kraken's motion control framework. **DISCUSSION:** The Kraken is instrumental in both foundational and applied human orientation research, with a focus on aeromedical challenges plaguing aviation safety for decades. Planned applications include integration of high-fidelity flight simulation and state-of-the-art physiologic sensors for advanced multi-platform applications in spatial disorientation modeling and countermeasure development.

Learning Objectives

1. Understand the design features and operational capabilities of the Kraken and its applications in aerospace environments.
2. Identify the collaborative partnerships involved with the Kraken and the potential for the Kraken to adapt to multi-mission roles.

[194] ADVANCEMENTS IN SPATIAL ORIENTATION PERCEPTION MODELING FOR ACTIVE MOTION AND VISUAL REFERENCES

Aaron Allred, Nicole Rote, Lanna Klausing, Aadhit Gopinath, Torin Clark
University of Colorado Boulder, Boulder, CO, United States

(Education - Tutorial / Review)

INTRODUCTION: Spatial disorientation (SD) represents a failure to correctly perceive one's self-orientation and self-motion, and when applied to operating aircraft, extends perceiving the orientation and motion of the piloted vehicle. The potential for catastrophic outcomes from SD in aviation has motivated computational modeling efforts to better understand the onset of SD during flight and ultimately develop countermeasures. However, most modeling efforts to date have been constrained to understanding spatial (dis)orientation during passively applied motions in the dark. In contrast, pilots who experience SD during flight are often actively flying aircraft and have various visual references at their disposal. Here, we advance models of spatial (dis)orientation perception to capture both the consequences of active flight as well as visual references on perceived heading changes. **TOPIC:** We present an augmented observer model of spatial (dis)orientation perception, which captures how head motion results in perceptions of self-motion and self-orientation through internal models of sensory dynamics and kinematic relationships. To incorporate the consequences of active motion and known vehicle dynamics, learned central nervous system representations of the kinematic consequences of control inputs and vehicle dynamics are modeled. Further, visual pathways are tuned to explain perceptions of heading given visual references (N = 10). The study was approved by the University of Colorado Institutional Review Board, and individuals provided informed consent. **APPLICATION:** Simulations demonstrating differences in self-orientation and self-motion perceptions during active and passive motions are produced. Our augmented observer model produces unique predictions of spatial (dis) orientation during active motion with known vehicle dynamics compared to passive motions. Moreover, heading perceptions depend on the

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availability of visual cues of angular velocity and angular position. The development of this augmented observer model represents two crucial spatial (dis)orientation modeling advancements to understand perceptions of self-motion and self-orientation during flight. We anticipate this work will be used in the future to better understand spatial (dis)orientation for mishap investigations and countermeasure development.

Learning Objectives

1. This effort produces augmentations to the observer model of spatial (dis)orientation perception to model pilot perceptions.
2. Perceptions during different combinations of active/passive flight and visual references differ, demonstrating the importance of these modeling advancements during mishap investigations and future countermeasure development.

[195] THE IMPACT OF HYPOXIA ON HUMAN VESTIBULAR FUNCTION AT LOWER ALTITUDES

Kyle Pettijohn[1], Max Teaford[2], Cora Cox[1], John Oas[1], Daniel Merfeld[1]

[1]*Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States;* [2]*University of Tennessee at Chattanooga, Chattanooga, TN, United States*

(Education - Tutorial / Review)

INTRODUCTION: Pilots face many conditions that may interfere with their ability to maintain accurate spatial orientation and situational awareness. One such condition is hypoxia. Prior research has demonstrated that even relatively mild hypoxia degrades peoples' ability to sense earth-vertical translations; however, the relationship between the severity of hypoxia experienced and the impairment to vestibular thresholds is not known. The current study aims to characterize this relationship. **TOPIC:** In this study, participants underwent vestibular threshold testing under normoxic and three normobaric hypoxia conditions. Motions were provided by a Moog six degree of freedom motion platform, while participants performed a two-alternative forced choice motion discrimination task. An adaptive staircase was used to determine the smallest motion that could be reliably sensed. On separate days, participants completed testing while breathing gas mixtures with an oxygen content of 20.9%, 17.9%, 16.6%, and 15.4%. These concentrations were designed to simulate altitudes of sea-level, 4,000ft, 6,000ft, and 8,000ft, respectively. Preliminary results indicate that earth-vertical translation thresholds were impaired with increasing altitude. Compared to baseline, thresholds were higher at the equivalent of 8,000 ft, showed a tendency to increase at 6,000ft, and were nominally, though likely not statistically significantly, higher at 4,000ft for this small sample. **APPLICATION:** These results suggest that the hypoxia experienced, even at low simulated altitudes, can reduce how well people can reliably discriminate upward and downward motion. Even at altitudes lower than the cabin pressure required by the FAA for commercial flights (8,000 ft), larger motions are required for people to consistently sense that they have moved. Additional studies are needed to see whether the performance decrements described here extend to other motions that involve different vestibular organs (e.g., pitch or roll tilts) and how and when degraded vestibular thresholds begin to affect performance.

Learning Objectives

1. The audience will learn what vestibular thresholds are and how they relate to motion perception.
2. The audience will learn that hypoxia adversely affects peoples' vestibular thresholds.

[196] CHANGES IN EYE MOVEMENTS DURING SIMULATED BLACK HOLE FLIGHTS UNDER DIFFERENT LEVELS OF WORKLOAD

Frank Robinson[1], Nicklaus Fogt[2], Steven Linnville[3], Dain Horning[1]

[1]*Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States;* [2]*Ohio State University/ORISE, Columbus, OH, United States;* [3]*Naval Medical Research Unit Dayton/Leidos, Pensacola, FL, United States*

(Education - Tutorial / Review)

INTRODUCTION: The Black Hole Illusion (BHI) occurs when pilots overestimate their altitude when flying a visual approach at night, increasing the risk of a mishap. Flight instruments provide spatial information to help maintain a safe glideslope, but pilots do not always utilize instruments effectively due to distraction or other attentional demands. This study investigated changes in instrument scanning behavior during instances of BHI across different levels of workload. **TOPIC:** A total of 28 pilots participated in this study across two study sites. They flew repeated simulated BHI flights with no added workload, a secondary auditory monitoring/working memory task, or the secondary task plus an additional visual search task. We used an eye tracking system to compare instrument scanning behaviors across levels of workload and during periods in which pilots flew on glideslope to those when pilots began to deviate from glideslope. High workload was associated with a smaller dispersion of gaze and a lower gaze transition rate. We found that periods of glideslope deviation were associated with a higher probability of looking outside the cockpit and a lower probability of looking at the vertical speed indicator. We also conducted a more detailed analysis examining the probability of transitions between different paired areas of interest (AOIs; e.g., transitions between looking outside the aircraft and the altimeter). We found that periods of glideslope deviation were associated with reduced probability of transitions within several AOI pairs, particularly shifting gaze between outside the window and the attitude indicator and shifting gaze between outside the window and the vertical speed indicator. **APPLICATION:** The results of this study will help inform the design of future training and alerting systems to help mitigate the effects of spatial disorientation.

Learning Objectives

1. The audience will be able to identify characteristics of the black hole illusion.
2. The audience will be able to describe how workload and scan patterns affect flight performance under black hole conditions.

Wednesday, 06/04/2025 ***8:30 AM***
Regency VII

[S-74] PANEL: SIMULATOR SICKNESS, CYBERSICKNESS, AND THE VESTIBULAR SYSTEM

Chair: Anna Clebone Ruskin
Co-Chair: Keith Ruskin

Panel Overview: *Virtual reality (VR) and extended reality (XR) are being used for aerospace activities that include cockpit procedure training and aircraft and equipment maintenance, while aircraft simulators have been used for decades for pilot training. Although VR and XR are effective techniques for teaching and practicing these skills, symptoms of cybersickness may impair training or prevent learners from completing programs that rely on these technologies. Cybersickness is defined as a motion sickness-like experience that is induced by visual stimulation in a virtual reality environment and may be caused by discrepancies between visual and vestibular sensations. Symptoms can include nausea, vomiting, autonomic discomfort, disorientation, and drowsiness. This panel will review the pathophysiology of cybersickness, then discuss pharmacologic and nonpharmacologic countermeasures. Proposed mitigation strategies will include ginger and other nonsedating, "over the counter" remedies, mindfulness techniques or behavioral modifications (with or without using a Barany chair), and transcranial galvanic vestibular stimulation. We will also propose a 'cybersickness mitigation bundle' that includes treatments that are tailored to the individual's predisposition, their symptoms, and the intensity of the planned virtual stimulus.*

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[407] PATHOPHYSIOLOGY OF CYBERSICKNESS AND SIMULATOR SICKNESS

Keith Ruskin
University of Chicago, Chicago, IL, United States

(Education - Tutorial / Review)

INTRODUCTION: Aerospace applications of virtual reality and extended reality include training, assistance with maintenance tasks, and control of unmanned aerial vehicles. The prevalence of cybersickness is 60-90%, with 6-13% of participants opting out before the end of a virtual reality session due to cybersickness. The timing of cybersickness is often 10 minutes after the beginning of the virtual stimulus. **TOPIC:** Cybersickness occurs when there is a sensation of motion that is not in accordance with that expected by the motor cortex, and is hypothesized to be caused by a mismatch between the visual and vestibular systems. Cybersickness and motion sickness share common traits, including physiologic manifestations and symptoms. Both are caused by differences between the inputs the visual, proprioceptive, and vestibular systems expect and the inputs these systems receive. Cybersickness caused by a head-mounted display can affect cutaneous vascular tone, heart rate, and reaction time. The physiologic responses to motion sickness have also been hypothesized to coordinate a decrease in body temperature through cutaneous vasodilation, sweating, and reduced thermogenesis. **APPLICATION:** Motion sickness and cybersickness can cause headaches, drowsiness, irritability, and acting out of character ("Sophite Syndrome"), which can persist for days. These symptoms may impair training on the day that cybersickness occurs and may interfere with training or subsequent work responsibilities for several days after that. **RESOURCES:** Gavgani A, Nesbitt K, Blackmore K, Nalivaiko E. Profiling subjective symptoms and autonomic changes associated with cybersickness. Autonomic Neuroscience. 2017 Mar;203:P41-50. Mazloumi Gavgani A, Walker FR, Hodgson DM, Nalivaiko E. A comparative study of cybersickness during exposure to virtual reality and "classic" motion sickness: are they different? J Appl Physiol (1985). 2018 Dec 1;125(6):1670-1680. Nalivaiko E, Rudd JA, So RH. Motion sickness, nausea and thermoregulation: The "toxic" hypothesis. Temperature (Austin). 2014 Dec 31;1(3):164-71. Nalivaiko E, Davis SL, Blackmore KL, Vakulin A, Nesbitt KV. Cybersickness provoked by head-mounted display affects cutaneous vascular tone, heart rate and reaction time. Physiol Behav. 2015 Nov 1;151:583-90. doi: 10.1016/j.physbeh.2015.08.043.

Learning Objectives

1. Participants will be able to explain the pathophysiology of cybersickness and simulator sickness.
2. Participants will be able to identify specific features of virtual reality and extended reality that elicit symptoms of cybersickness.

[408] HOMEOSTASIS OF THE VESTIBULAR SYSTEM

Robert Fong
University of Chicago, Chicago, IL, United States

(Education - Tutorial / Review)

INTRODUCTION: An intact vestibular system, including semicircular canals and otoliths, provides information related to the position of a person's head in space is responsible for coordinating eye movements and posture. It is an essential component of proprioception, equilibrium, and balance. The sensory conflict theory states that a mismatch between the visual and vestibular systems causes motion sickness. Cybersickness occurs when there is a sensation of motion that is not in accordance with that expected by the motor cortex. **TOPIC:** The vestibular system includes the utricle, the saccule, and the superior, posterior, and lateral semicircular ducts, and their associated neural pathways. The system contains specialized mechanoreceptor cells called "hair cells," which contain cross-linked actin filaments called stereocilia that are connected at the tips by "tip links." Efferent signals from the vestibular system include vestibulo-ocular reflex, which allows a person's eyes to remain fixed on an object while the head is moving and the vestibulospinal reflex, which coordinates spinal musculature with head movement and allows a person to maintain balance and posture. The function of the peripheral vestibular system involves the acceleration of endolymph within the vestibular apparatus. Head movement in a given direction produces acceleration that stimulates the stereocilia of hair cells. When the head stops accelerating, hair cells return to their baseline position which allows them to respond to further changes in endolymph acceleration. **APPLICATION:** A better understanding of the vestibular system physiology will help clinicians to understand why simulator sickness or cybersickness can occur. Symptoms of vestibular system dysfunction include vertigo, nausea, vomiting, and visual disturbance. The relationship of the vestibular system to cognition is not well understood, but vestibular dysfunction has been associated with difficulty in spatial orientation, memory, learning, and object recognition. "Sophite syndrome" is associated with motion sickness and symptoms include drowsiness and irritability. **RESOURCES:** Curthoys IS, Grant JW, Pastras CJ, Fröhlich L, Brown DJ. Similarities and differences between vestibular and cochlear systems–a review of clinical and physiological evidence. Frontiers in Neuroscience. 2021 Aug 12;15:695179. doi: 10.3389/fnins.2021.695179

Learning Objectives

1. Audience will understand how the vestibular system enables people to maintain eye and postural coordination.
2. Audience will understand how the vestibular system detects acceleration and rotation.

[409] DUAL, OPPOSING-PHASE GALVANIC VESTIBULAR STIMULATION FOR CYBERSICKNESS MITIGATION IN THE FUTURE

Anna Clebone Ruskin
University of Chicago, Chicago, IL, United States

(Education - Tutorial / Review)

INTRODUCTION: Innovative approaches to the management of cybersickness and space sickness can help people to tolerate unusual environments while minimizing unacceptable side effects such as sedation or cardiovascular risk. Galvanic vestibular stimulation is a promising modality, but a better understanding the effect on the vestibular system, characteristics of the electrical current used for stimulation, and potential hazards can ensure safety during the application of electricity to the brain. **TOPIC:** The vestibular system is thought to be a key mediator of cybersickness due to discrepancies in sensory inputs. An ideal intervention for cybersickness would have no side effects and be easy to administer. Galvanic vestibular stimulation (GVS) uses a low-power electrical current applied to the mastoid process to activate canal and otolith afferent pathways via the eighth cranial nerve. GVS has shown promise as a treatment for motion sickness. Applying GVS in opposite phases to each mastoid process reduces vestibular sensitivity by decreasing the perception of movement. Proposed mechanisms include inducing otherwise-nonexistent vestibular cues, or vibration of the vestibular organs to add noise to the sensory modality. Although the precise mechanism of action for galvanic vestibular stimulation remains unclear, functional MRI imaging revealed activation in the region of the temporoparietal junction, the central sulcus, and the intraparietal sulcus in volunteers. Several studies have demonstrated the effectiveness of vestibular stimulation for cybersickness, seasickness and to mitigate driving simulator sickness. In one study, stimulation

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was provided either during curves or intermittently throughout the course; both techniques were effective. The limits of Galvanic Vestibular Stimulation for degrees of cybersickness and space sickness, and its contraindications and risks are a promising area for future discovery. **APPLICATION:** This presentation will review the basics of electricity as applied to Galvanic Vestibular Stimulation. The current chosen for GVS will mitigate symptoms of cybersickness or simulator sickness while minimizing the risk of side effects, which can include dizziness and disorientation. **RESOURCES:** Nature Communications volume 10, Article number: 1904 (2019); Exp Brain Res. 2020 Feb;238(2):427-437; J Neurophysiol. 1998 Nov;80(5):2699-709

Learning Objectives

1. Learners will be able to use galvanic vestibular stimulation to mitigate cybersickness.
2. Participants will understand how galvanic vestibular stimulation is thought to exert its effects.

[410] ACUTE AIRSICKNESS EVOKED BY COMBAT MANUVERS IN AN EXPERIENCED US MILITARY HELICOPTER PILOT: A CASE REPORT

Jaime Rivas Harvey, Jordan Alvey
U.S. Air Force, Colorado Springs, CO, United States

(Education - Case Study)

INTRODUCTION: This case report describes an experienced US military helicopter pilot who suffered multi-episodic airsickness after a specific combat maneuver despite never having faced airsickness during his flying career. **BACKGROUND:** Passive and active airsickness is common for military pilots starting their aviation career. Airsickness rates in military helicopter pilots can range from 20%-40% and can have varying effects on the individuals. In military aviation, pilots must overcome their airsickness to be qualified to fly solo for safety of flight. Instances of airsickness in combat-qualified military helicopter pilots are extremely rare. **CASE PRESENTATION:** The subject pilot is a 27-yr old US Army HH-60 Blackhawk pilot with 460 total flying hours to include deployment time. The subject stated that he had never experienced airsickness in his flying career including pilot training or recreational type activities. Each airsickness episode, four passive and two active, all followed "combat maneuvers" which consists of performing cyclic climb to pushover break and max/bank break turns resulting in transfering controls to his co-pilot. Environmental factors such as heat, dehydration, and poor meal planning played a role in each of these events. The subject's command requested aircrew rotation training (ART) from USAF Aerospace Physiology in lieu of medications. The subject completed the 3-day ART utilizing the Barany Chair during which he was given education on "box/diaphragmatic breathing" and the "drop-off" technique. After completing the ART program, the pilot was able to practice a mindfulness exercise to identify his physiological symptoms and successfully address them before the stimulus became too overwhelming. Furthermore, he completed the simulated combat maneuvers during the graduation spin with little to no symptoms. **DISCUSSION:** This case highlights that ART is at its core a practice in mindfulness that can be translated into treatment of sensory mismatches which result in malaise, nausea, or emesis. This translational science does not necessarily need to utilize a Barany Chair when applied to cybersickness as long as the instructors are trained in identifying high potential sensory mismatch event precursors to incorporate treatment techniques. This integration would likely reduce the prevalence of cybersickness to include participants opting out of training completion.

Learning Objectives

1. Audience will understand how to identify sensory-mismatch stimuli.
2. Audience will learn to incorporate a mindfulness practice along with physiological relaxation techniques to control airsickness and cybersickness.

Wednesday, 06/04/2025 ***8:30 AM***
Hanover F/G

[S-38] PANEL: RESIDENT IN AEROSPACE MEDICINE (RAM) GRAND ROUNDS I

Chair: Jonathan Elliot
Co-Chairs: Thomas Jarnot, Amy Kreykes

Panel Overview: *Resident in Aerospace Medicine (RAM) Grand Rounds consists of 5 clinical case presentations. Each case is presented by current RAMs who will review the clinical case, diagnosis, treatment pathway and current policies from different agencies. The aviator's aeromedical disposition and waiver or special issuance outcome (if applicable) will be discussed. These unique case presentations describe clinical aviation medicine as well as policy updates for common medical and/or mental health conditions encountered in the practice of Aerospace Medicine.*

[203] THE SIN OF ZYN

Stephanie Tamayo, Gordon Salgado
Naval Aerospace Medical Institute, Pensacola, FL, United States

(Education - Case Study)

INTRODUCTION: This case report describes the diagnosis and management of a Naval Aviator who suffered acute nicotine poisoning due to nicotine pouch use. **BACKGROUND:** Nicotine pouches are a new product sold as a 'healthy tobacco alternative.' They are nearly ubiquitous in the active-duty community, commonly relied upon for improved energy and endurance in the setting of inadequate rest, prolonged shiftwork and/or increased operational tempo. While they may aid in tobacco liberation, they also threaten nicotine poisoning and increasing nicotine dependence for the active-duty service member. **CASE PRESENTATION:** A previously healthy nonsmoker USN fixed wing pilot deployed on a carrier amidst operations 'sniveled' a mission critical flight due to acute illness diagnosed as nicotine poisoning attributed to oral nicotine pouches. Nicotine pouches are a new and poorly regulated product, which subsequently evade direct mention in the current CNAF M-3710.7 and/or the USN Aeromedical Waiver Guide. Investigation into and instruction on these new products is recommended. Pending further elucidation, the prohibition of nicotine pouches is advised. **DISCUSSION:** This case highlights the import of strict compliance with current guidelines (by servicemember and physician alike), reiterates the pathophysiology and management of Nicotine poisoning, draws attention to nicotine dependence in the service, and advises the investigation and regulation of Nicotine - independent of delivery vehicle.

Learning Objectives

1. Inform on the ubiquity of nicotine pouch use in the active-duty aviation community.
2. Reiterate the pathophysiology and management of acute Nicotine poisoning, and chronic nicotine dependence.
3. Inform on the relative doses of nicotine found across various common nicotine delivery vehicles (Cigarettes, cigars, dip, vape, nicotine pouches).

[204] CRYPTOGENIC STROKE: A CHALLENGING PATH FOR A NAVAL AVIATOR

Eliezer Rodriguez, Larissa Brandenburg
Naval Aerospace Medical Institute, Pensacola, FL, United States

(Education - Case Study)

INTRODUCTION: A 36 year old T-6 instructor pilot begins to slur speech and have left upper extremity weakness walking out to the aircraft with his student pilot. Although symptoms resolved after several minutes, he presented to the flight surgeon for evaluation and further

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work up. This case study reviews the presentation, diagnostic path, final diagnosis and challenges that this naval Aviator faced for a waiver to continue to fly. **BACKGROUND:** A cryptogenic stroke account for 10 to 20 percent of ischemic strokes and requires an extensive work up to rule out other major cause. While more common in younger individuals with fewer traditional risk factors, there are still concerns of recurrence and sequelae, such as seizures. While these risks are well established for older individuals with large artery atherosclerosis, small vessel disease, cardioembolic, and hypercoagulable there is considerably less data on young healthy individuals. In aviation, a balance must be struck between safety of flight and continued career in aviation. **CASE PRESENTATION:** An unexplained, seemingly transient event, in a young healthy aviator was found to be something more with nearly imperceptible neurologic weakness, imaging consistent with ischemic stroke etiology and uncertainty of continuing a career as a Naval Aviator. **DISCUSSION:** This case will discuss the guidelines for diagnosis and workup of an ischemic stroke, define a cryptogenic stroke and discuss the current aeromedical waiver considerations from civil and military governing authorities. This presentation is intended for Aerospace Medicine residents, military flight surgeons regarding the challenges these cases pose in Naval Aviation.

Learning Objectives

1. The participants will be able to identify the diagnostic steps and evaluation criteria for ischemic stroke in young, healthy individuals.
2. The audience will learn about the aeromedical waiver process across the Department of Defense and Civil authorities.
3. The audience will learn about the challenges posed by balancing flight safety and career continuity for an aviator.

[205] MEDICAL RISK ASSESSMENT AND OPERATIONAL IMPACTS OF BONE LOSS IN A HYPOTHETICAL FEMALE SPACEFLIGHT CREWMEMBER

Brian Rodriguez, Ethan Stephens, Jeffrey McBride
UTMB, Galveston, TX, United States

(Education - Case Study)

INTRODUCTION: This presentation discusses occupational surveillance, medical considerations, and operational consequences of spaceflight associated bone loss through a hypothetical case study **BACKGROUND:** Microgravity results in decreased resistive forces on bone that terrestrially help to maintain bone density and strength. Without countermeasures, individuals lose 1-2% of their bone mineral density per month of spaceflight. These changes are most prominent in the femoral trochanter, femoral neck, pelvis, and lumbar spine. Concern for protracted or irreversible trabecular bone loss exists based on pre/post-flight studies performed with quantitative computed tomography. Moreover, bone turnover increases urinary calcium and may pre-dispose to increased risk of nephrolithiasis. **CASE PRESENTATION:** A hypothetical 60-year-old female mission specialist is chosen to participate as a prime crewmember for a long duration mission. She is a veteran astronaut, having completed prior long-duration missions. Preflight, she was found to have mild osteopenia as evaluated by DEXA. **DISCUSSION:** Success of current and future spaceflight missions relies on astronauts' operational capability. Though the inflight impact to crew health and performance is not well characterized, bone loss may result in skeletal fragility, increasing fracture risk. With the transition to longer duration missions outside of low-Earth Orbit, and surface operations on the Moon and Mars, skeletal fragility will become an increasingly important risk factor. Individualized consideration of risk stratification for crewmembers and tailoring of appropriate countermeasures will be prudent.

Learning Objectives

1. The audience will gain an appreciation for potential aeromedical considerations of bone loss.
2. The audience will gain an appreciation for the impact of spaceflight associated bone loss to crew health and performance.

[206] SARCOIDOSIS IN A MILITARY AVIATOR: A CASE REPORT

David Smith, Ryan Bogart, Casey Naumoff
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Case Study)

INTRODUCTION: This case describes a military aviator diagnosed with pulmonary sarcoidosis following evaluation for intermediate uveitis. **BACKGROUND:** Sarcoidosis a multisystem granulomatous disorder of variable incidence and prevalence worldwide. In the United States, sarcoidosis prevalence is estimated at 60 per 100,000 persons, with females twice as likely as males to develop disease, and lifetime risk in black individuals is nearly three times that of white individuals. Nearly half of all cases are identified through incidental finding on imaging. There is no definitive diagnostic test for sarcoidosis; rather, the diagnosis is made based on the appropriate clinical scenario and exclusion of other similarly presenting diseases. Histopathologic confirmation can be established with biopsy of non-necrotizing granuloma. The course of disease ranges from spontaneous remission, including radiographic resolution, which occurs in an estimated 60-80% of patients with radiographic stage I disease, to fibrocystic scarring, progressive fibrosis, pulmonary hypertension, and respiratory failure in stage IV disease. Older age, Black race, female sex, and higher radiographic stage are associated with lower chance of remission and higher chance of symptoms. **CASE PRESENTATION:** This aviator presented in his late 30s with 10 months of persistent right eye visual field disturbances. Retinal specialist evaluation diagnosed pars planitis, a form of intermediate uveitis. Investigation for possible non-infective etiology revealed mediastinal and hilar lymphadenopathy and pleural based nodules. Suspicion of sarcoidosis was confirmed with biopsy revealing non-caseating granulomas. The patient underwent ocular corticosteroid injections, with noted improvement of inflammation on fundoscopic and slit lamp exams. He has remained symptom free of sarcoidosis from other systems and was returned to flying status with waiver after a positive retention evaluation. **DISCUSSION:** Sarcoidosis is an aeromedically significant disorder requiring careful consideration. Sarcoidosis is disqualifying for military service and for aviation duties within the U.S. Air Force, U.S. Army, and U.S. Navy. All military branches have a pathway for exception to this disqualification. The Federal Aviation Administration requires deferral for more than minimal or symptomatic sarcoid. Aeromedical decisions should be made after careful evaluation of the precipitating factors and success of treatment.

Learning Objectives

1. Ensure aerospace medicine clinicians consider sarcoidosis and other pathologic disorders in their differential diagnosis when evaluating aviators with uveitis.
2. Review the common considerations for sarcoidosis as it pertains to the aeromedical environment.

[207] POTENTIAL PREVENTIVE MEASURES FOR BONE LOSS IN LONG-DURATION SPACEFLIGHT

Ethan Stephens, Brian Rodriguez, Jeffrey McBride
UTMB, Galveston, TX, United States

(Education - Case Study)

INTRODUCTION: This case presentation describes a hypothetical veteran space flier who is at risk for bone loss and discusses available evidence regarding countermeasures to preserve bone health. **BACKGROUND:** Bone loss has been documented during long-duration spaceflight in missions from Gemini to the International Space Station. Cortical and trabecular bone have been observed to decrease at rates of 0.9% and 1.2-1.5% per month for vertebra and hip respectively, using volumetric bone mineral density quantitative computer tomography. Compounded on the spaceflight risk of bone loss is bone loss secondary to normal aging. Premature bone loss from spaceflight may predispose individuals to increased skeletal fragility, and increased

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risk of fracture. Thus, it is imperative to address spaceflight associated bone loss in preparation for a maturing spaceflight population. **CASE PRESENTATION:** The subject is a 60-year-old veteran female space flier who presents preflight and would like to discuss preventive measures for bone loss for her upcoming long-duration spaceflight. Past medical history includes diet and exercise-controlled hypertension, and mild osteopenia noted on dual-energy x-ray absorptiometry. **DISCUSSION:** Resistive exercise is the only inflight countermeasure used to mitigate bone loss during long-duration spaceflight. Exploration-class missions to the Moon and Mars will have further limited mass and volume constraints that will dictate the exercise device and load factor available for resistive exercise on these flights. In-flight skeletal fragility could increase fracture risk. This case report will highlight currently available data regarding resistive exercise and pharmaceutical countermeasures for bone loss during long duration spaceflight.

Learning Objectives

1. The audience will gain an appreciation for potential pharmacotherapeutic options in managing bone loss during spaceflight
2. The audience will gain an appreciation for the effect of resistive exercise on bone loss in long-duration spaceflight.

[208] NAVIGATING THE DEPTHS: A CASE STUDY OF DECOMPRESSION SICKNESS AND OXYGEN TOXICITY IN A PILOT SUBJECTED TO HYPOBARIC AND HYPERBARIC CHAMBER EXPOSURES

Jesse Laverdiere, Emily Hawker
U.S. Army Department of Aviation Medicine, Fort Novosel, AL, United States

(Education - Case Study)

INTRODUCTION: This case report details the presentation and management of a pilot who developed symptoms consistent with decompression sickness following a hypobaric chamber exposure and subsequently experienced oxygen toxicity during hyperbaric oxygen (HBO2) treatment. The case explores the complications arising from hypobaric and hyperbaric environments and highlights the associated risks in aviation training and hyperbaric chambers. **BACKGROUND:** Decompression sickness (DCS) and oxygen toxicity are distinct conditions that can affect aviators undergoing altitude chamber training or HBO2 therapy. While DCS results from decompression and excess nitrogen in tissues, oxygen toxicity, a less common but serious complication of HBO2 therapy, can cause seizures, pulmonary and other neurologic symptoms. **CASE PRESENTATION:** A military pilot underwent a 25,000-foot altitude hypobaric chamber profile. More than 24 hours post exposure, the pilot reported joint pain, tingling in the upper extremities, lightheadedness, and a sensation of skin crawling after physical exercise. Interim oxygen therapy at a local hospital initially alleviated symptoms, but subsequent HBO2 treatment led to a tonic-clonic seizure at 60 feet sea water (fsw) equivalent, with loss of consciousness, rigidity and tongue biting. Following seizure resolution and decompression to 30 fsw, HBO2 resumed but again induced symptoms of central nervous system oxygen toxicity, prompting early termination of therapy. Both MRI and EEG during hospitalization showed no abnormalities, and the patient has since resumed normal duties without recurrence of symptoms. **DISCUSSION:** This case emphasizes the complexities involved in treating DCS with HBO2, underscoring the risks of oxygen toxicity in hyperbaric environments. For flight surgeons, understanding these risks is vital for managing aviators' health and evaluating waiver eligibility post-treatment. The decision-making process reflects the balance between therapeutic benefit and potential risks in the treatment of decompression injuries.

Learning Objectives

1. The audience will learn about altitude DCS following a hypobaric chamber exposure.
2. The audience will learn about a rare but serious complication of HBO2.
3. The audience will learn about the aeromedical implications of an oxygen toxicity seizure.

Wednesday, 06/04/2025 ***8:30 AM***
Grand Hall East Corridor - Posters Only

[S-39] POSTER : TO AUTOMATE OR NOT TO AUTOMATE: THAT IS THE QUESTION

Chair: Daniel Roberts
Co-Chair: Andrew Bellenkes

[209] AUTOMATING ROBOTIC SURGERY FOR SPACEFLIGHT: LLM INTEGRATION TO FOSTER ASTRONAUT-ROBOT COLLABORATION

Divy Kumar[1], Dillan Prasad[1], Benjamin Weiss[1], Aditya Khandeshi[1], Rishi Jain[1], Michael Oblich[1], William Metcalf-Doetsch[2]
[1]*Northwestern University Feinberg School of Medicine, Chicago, IL, United States;* [2]*Northwestern Medicine, Chicago, IL, United States*

(Education - Program / Process Review)

BACKGROUND: The NASA Human Research Roadmap identifies several risks that may require surgical interventions, including bone fractures, renal stone formation, SANS, and injuries sustained due to dynamic loads and EVAs. Current remote robotic surgical approaches are rendered impractical for future spaceflights due to significant communication latencies. The round-trip communication delay is approximately 2.6 seconds in lunar orbit and can range from 8 to 40 minutes for missions to Mars. This review aims to evaluate the latest advancements in Large Language model (LLM)-integrated robotic surgery automation and identify areas where further research is required. **OVERVIEW:** LLM integration in automated robotics has significantly advanced robotic surgery, particularly in aerospace medicine where access to specialized surgeons is limited. LLM frameworks such as SuFIA enable comprehension and execution of surgical instructions in natural language, allowing more intuitive human-robot interaction. Recent research in multimodal LLM architectures allows for surgical reasoning and motion planning for robot-assisted blood suction. LLM error detection and correction can facilitate real-time surgeon-robot collaboration, as immediate expert consultation is not possible in space. Also, LLM use in simulation is important for the varied environments and gravitational forces encountered during space missions. Significant research gaps remain in improving real-time surgical prediction and adaptability to make it more reliable and effective for space applications. Developing predictive models, adaptive control algorithms, and advanced segmentation and tokenization techniques would allow for anticipation of surgical complications, behavior modification, and surgical instrument guidance. **DISCUSSION:** The integration of Large Language Models (LLMs) in robotic surgery is crucial for space missions where specialized medical expertise is limited. LLMs enable robotic systems to assist in decision-making and execution of surgical instructions, thus reducing the cognitive load on astronauts and enhancing surgical precision and safety. LLM-integrated robotic surgery can also benefit both military and civilian terrestrial healthcare, particularly in remote areas where access to specialized surgeons is difficult. By enabling physicians to perform complex surgeries with robotic assistance, these technologies can broaden the scope of treatable conditions and enhance global health.

Learning Objectives

1. The audience will be able to describe the role of LLMs in enhancing human-robot interaction in surgical settings.
2. The audience will learn about the application of multimodal LLM architectures in robotic surgery.
3. The audience will be able to identify the research gaps in LLM-integrated robotic surgery for aerospace medicine.

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[210] VALIDATION OF A SMARTPHONE-BASED AI-POWERED PUPILLOMETER IN PARABOLIC FLIGHT

Kellie Gerardi[1], Shawna Pandya[2], Hugo Chrost[3], Michal Wlodarski[3], Marek Dziubinki[3], Radoslaw Chrapkiewicz[3], Sanjay Manohar[3], Norah Patten[4], Aaron Persad[5]
[1]*International Institute for Astronautical Sciences; Nova Southeastern University, Jupiter, FL, United States;* [2]*International Institute for Astronautical Sciences; University of Alberta Faculty of Medicine & Dentistry, Sherwood Park, AB, Canada;* [3]*Solvemed.AI, Lewes, DE, United States;* [4]*International Institute for Astronautical Sciences, Dublin, Ireland;* [5]*International Institute for Astronautical Sciences; University of Maryland Eastern Shore, Lewes, DE, United States*

(Original Research)

INTRODUCTION: The Spaceflight Associated Neuro-ocular Syndrome (SANS) is a constellation of findings affecting intraocular pressure, intracranial pressure (ICP), optic disc edema, globe shape, and more, and is considered a potential show-stopper for long-duration spaceflight and exploration-class missions. Quantitative pupillometry (QP) provides a novel method for examining pupillary light reflex, and is non-invasive, rapid and easy-to-use. Pivotally, QP can act as an inference of intracranial pressure changes, allowing for rapid evaluation of intracranial pathology, such as seen in SANS. A pupillometric measurement can be completed in seconds. In the present study, we aimed to validate the use of a novel smartphone-based, AI-powered pupillometer (AI Pupillometry System, Solvemed Inc.) in the microgravity environment, while also determining if exposure to the hyper- and reduced gravity phases of parabolic flight are sufficient to induced changes in pupillary dynamics as compared to 1-g conditions. **METHODS:** In the present study, we aimed to validate the use of a novel smartphone-based, AI-powered pupillometer (AI Pupillometry System, Solvemed Inc.) in the microgravity environment, while also determining if exposure to the hyper- and reduced gravity phases of parabolic flight are sufficient to induced changes in pupillary dynamics as compared to 1-g conditions. The smartphone device was deployed to collect data in participants (n=2) pre-, post-, and in-flight, including both the straight and level and microgravity portions of flight to account for cabin-induced lighting changes in pupillometric measurements. The research participants additionally completed qualitative surveys offering inputs as to devifuntionalityity and protocol optimization. **RESULTS:** The device functioned as expected in the microgravity environment of parabolic flight, and data was successfully collected pre, during and post flight. The survey feedback are being incorporated into future microgravity monitoring protocols. **DISCUSSION:** The smartphone-based AI Pupillometry System offers a more compact, lightweight form factor, addressing the mass and volume considerations in the spaceflight environment. The AI component allows for reliable measurement in different lighting conditions. This study marks the first time the AI Pupillometry System was deployed in a microgravity environment. This successful deployment advances the System's technology readiness level towards use in spaceflight.

Learning Objectives

1. To educate the audience about the value of automated pupillometry as a potential tool for intracranial pressure (ICP) monitoring during exposure to altered gravity environments.
2. To educate the audience as to the results of the first deployment and validation of an automated pupillometer in an altered gravity environment.
3. To highlight the value of an AI-based pupillometer as a potential monitoring tool for neuro-ophthalmological health in astronauts.

[211] AI-POWERED HEALTH MONITORING SYSTEM FOR DEEP SPACE MISSIONS: A PROCESS REVIEW AND FUTURE RESEARCH FRAMEWORK

Kyla Zhang[1], Zhicheng Jiao[2], Xuyu Wang[3], Peter Lee[2]
[1]*Brown University & Warren Alpert Medical School, Lake Oswego, OR, United States;* [2]*Brown University/Warren Alpert Medical School, Providence, RI, United States;* [3]*Florida International University, Miami, FL, United States*

(Education - Program / Process Review)

BACKGROUND: As humanity prepares for extended deep space missions, AI-powered health monitoring presents a critical research frontier. Current space medical systems lack sophisticated AI integration, limiting their capability to process complex biomedical data and provide real-time health insights, particularly given the technological gap of communication delays and resource constraints. **DESCRIPTION:** This review examines AI integration to resolve the technology gap in space health monitoring systems, focusing on data processing, pattern recognition, and predictive capabilities. Building on the 2021 NASA workshop on AI/modeling for space biology, we analyze three priorities: (1) machine learning algorithms for continuous health assessment, (2) AI-enhanced biomarker detection and analysis, and (3) intelligent systems for early warning and risk prediction. **FUTURE FRAMEWORK:** Research initiatives target six core objectives: (1) Real-Time Physiological Data Analysis with Deep Learning Models for rapid health insights and anomaly detection. (2) AI-Driven Sensor Fusion Technologies integrating bio- and environmental sensors for holistic health monitoring. (3) Generative Models for Healthcare Data Synthesis to produce synthetic health data replicating rare space medical events to overcome real-world data scarcity. (4) AI-Driven Digital Twins for health simulation and prediction. (5) Validation through Terrestrial Analog Studies ensures accuracy in predictive models for space-like conditions. (6) Integration of AI-Powered Adaptive Diagnostic Tools with existing systems for dynamic healthcare delivery. **DISCUSSION:** AI-enhanced health monitoring systems will significantly improve real-time medical decision-making and reduce dependency on Earth-based support. These advances translate to enhanced monitoring and predictive healthcare for military aviation, high-altitude operations, and remote medical care. The framework establishes standardized protocols for AI-driven health assessment across platforms, particularly benefiting high-performance aircraft operations and long-duration space missions. The system architecture enables broad collaboration between space agencies, military services, and civilian healthcare providers, creating a unified approach to remote health monitoring. While challenges remain in hardware reliability and validation, the potential to revolutionize both space medicine and terrestrial healthcare justifies continued international development.

Learning Objectives

1. [Participants will be able to...] Evaluate critical technological gaps in current space health monitoring systems and identify where AI solutions can provide the greatest impact.
2. [The audience will understand...] Key development priorities for AI-powered health monitoring systems in deep space missions, including biomarker analysis and predictive risk detection.
3. [Attendees will learn about...] Research frameworks for validating AI health monitoring systems through Earth-based analogs and hybrid architecture approaches.

[212] GUAARD: GUIDELINES FOR THE USE OF AI ON ASTRONAUT REPOSITORY DATA

Kiana Pillay, Ruth Reitzel, Jacqueline Charvat, Mary Van Baalen
NASA, Houston, TX, United States

(Education - Program / Process Review)

BACKGROUND: Artificial intelligence (AI) is rapidly emerging in the medical field. While AI has promising attributes for improving healthcare

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efficiency, it is often applied to health data with large populations (N= >100,000). NASA's Lifetime Surveillance of Astronaut Health (LSAH) houses the repository for all NASA astronaut medical monitoring data that can be requested to be re-used for secondary data analysis. Recently, LSAH has received research requests to use this data for developing predictive AI models. While there are scientific and ethical considerations using AI and PHI, there are increasing concerns for use of AI in small niche populations, such as the NASA astronaut corps (n=360), including protecting astronaut privacy, scientific efficacy of building predictive models using small populations, and potential bias introduced by small populations. **OVERVIEW:** LSAH is establishing guidelines and assessing the implications of applying AI to astronaut medical data. A comprehensive literature search using PubMed and Google Scholar was conducted to identify and synthesize relevant research to develop AI-related definitions and guidelines for using AI on astronaut data. Search strategies include keyword searchers for artificial intelligence, AI, privacy, bias, and small populations. Literature was selected based on its relevance to AI and concerns specific to the astronaut population. Each article was summarized, and data related to context of the article within the target population, key findings, and, where applicable, the type of AI used was abstracted for further assessment. This research addresses the knowledge gap in implementing AI with astronaut medical data. **DISCUSSION:** A total of 8 articles were included in this review, categorized into three topics including bias (n=4), privacy (n=3), and small populations (n=1). Based on the literature, LSAH should focus guidelines around 1) using high-quality data to reduce bias in AI outputs, 2) re-evaluating anonymization methods to protect astronaut identities, and 3) using synthetic data to train AI models to address small population issues. This research applies to those concerned with integrating AI with astronaut or patient data. As AI advances, being informed about its developments and implications for human safety is crucial. Implications for this research include establishing standards for researchers requesting to use astronaut medical data with AI to ensure safe and ethical practices.

Learning Objectives

1. The participant will be able to understand the potential bias and implications of using artificial intelligence (AI) on small population data.
2. The audience will learn about the potential ethical concerns for AI use on astronaut medical data.

[213] WITHDRAWN

[214] OPTIMIZING ADAPTIVE AUTOMATION IN AVIATION: A LITERATURE REVIEW ON DYNAMIC AUTOMATION SYSTEM INTERACTION

Joseph Atchley[1], Jon Vogl[2], Matthew D'Alessandro[2], Jordayne Wilkins[3], Bethany Ranes[1], Isaiah Persson[1], Charles McCurry[3], Sharon Bommer[3]

[1]*Goldbelt Frontier in support of the U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States;* [2]*U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States;* [3]*Oak Ridge Institute for Science and Education, Fort Novosel, AL, United States*

(Original Research)

BACKGROUND: Automation has been pivotal in reducing pilot workload and enhancing safety; however, it also introduces challenges such as over-reliance, disengagement, and diminished situational awareness. With the growing complexity of modern military aircraft systems and increasingly dynamic operational environments, adaptive automation offers a promising solution by dynamically adjusting to the pilot's workload and environmental conditions. **METHODS:** A literature review was conducted on the evolution of adaptive automation in aviation, comparing foundational research with modern advancements (2013-2023) to identify best practices for future automated systems. Key areas explored include automation activation processes—static, adaptable, and adaptive—and their respective impacts on safety and operator performance. **RESULTS:** Articles (N = 2555) were reviewed for relevance in this study, and 13 papers were included that included a use case of adaptive automation. Ten general adaptive automation recommendations were synthesized based on these papers. **DISCUSSION:** Literature review findings emphasize the importance of maintaining situational awareness, particularly during automation handoffs. Transparency in automation interfaces is crucial, ensuring pilots remain informed about system decisions and actions both in real-time and in near-future projections. This is especially important in high-stakes environments, where failure to properly manage automation transitions can lead to catastrophic outcomes. The review concludes with recommendations for future adaptive automation systems in aviation, focusing on dynamic task allocation, human-centered interface design, and enhanced transparency to optimize safety and performance. By addressing the risks of automation misuse and disuse, adaptive systems can support human operators while leveraging the strengths of automation to manage increasingly complex aviation scenarios. These guidelines offer a foundation for future research and system development in adaptive automation.

Learning Objectives

1. Learn about ten recommendations to keep in mind when developing adaptive automation systems. These recommendations have been shown to enhance performance, reduce cognitive workload, and improve safety outcomes when applied effectively.
2. Understand the challenges and opportunities for performance when implementing adaptive automation systems within the domain of aviation.
3. Recognize the similarity between foundational recommendations for adaptive automation systems and the common recommendations included in modern works.

[215] ACCEPTANCE OF PHYSIOLOGICAL MEASUREMENTS OF PILOTS – RESULTS FROM SEMI-STRUCTURED INTERVIEWS

Raphael Kneffel[1], Maike Fischer[2], Stefan Sammito[1]

[1]*German Air Force Centre of Aerospace Medicine, Cologne, Germany;* [2]*German Aerospace Center (DLR), Braunschweig, Germany*

(Original Research)

INTRODUCTION: As aviation becomes increasingly complex, the demands on Human-Machine Interaction (HMI) are growing. Adaptive automation systems, based on physiological measurements of pilots, could improve flight safety. However, it remains unclear to what extent pilots will accept these technologies in operational use. **OBJECTIVES:** The aim of the study was to investigate pilots' acceptance of the measurement of physiological data in operational settings and its use for adaptive automation systems. Both civilian and military pilots were included in order to analyze how they respond to these technologies, and what requirements they have for such systems. **METHOD:** In a qualitative study, semi-structured interviews were conducted with 18 civilian A320 pilots and 5 military Eurofighter pilots. The interviews were analyzed to gain insights into user acceptance. **FINDINGS:** The findings showed that civilian pilots see the greatest benefit in measuring physiological data for fatigue and crew management, while military pilots focus on G-LOC and hypoxia. Both groups expressed concerns regarding comfort and data protection. Adaptive automation systems were viewed skeptically, particularly due to concerns that they might interfere with control at critical moments. **CONCLUSIONS:** The study indicates that adaptive automation and the collection of physiological data are generally accepted by pilots, provided that the systems do not add extra workload and data protection is ensured. A hybrid approach that integrates the advantages of adaptable automation could be a promising solution for future human-machine interactions in aviation.

Learning Objectives

1. Participants will learn how civilian and military pilots evaluated the use of adaptive automation systems and physiological measurements in the cockpit, and what differences exist between these groups.
2. Participants will learn that adaptive automation systems were viewed skeptically, while a hybrid approach to automation is proposed as a possible solution.

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[216] REAL-TIME PHYSIOLOGICAL MONITORING FOR WARFIGHTER TRAINING

Brian King, Alessio Medda
Georgia Tech Research Institute (GTRI), Atlanta, GA, United States

(Education - Tutorial / Review)

INTRODUCTION: The Georgia Tech Research Institute (GTRI) has developed an ecosystem that achieves real-time monitoring of service members during training exercises, allowing for the transport and visualization of real-time data over cellular and/or local long-distance networks. The ultimate goal is to prevent heat related injuries by informing leadership of individuals that are approaching and sustaining dangerous levels of exertion during training events. The cloud component allows for data ingestion, visualization (real-time and post hoc), storage, and security. **TOPIC:** Separate on-body communication devices are used to transmit/store both physiological data (heart rate, skin temperature, heat stress index score) from the sensor(s), and add geolocation data for real-time movement tracking and post hoc analysis. Setup with a cellular network allows for monitoring anywhere, not just on site. The cloud server fuses data sources and run algorithms that are not possible at the edge due to processing power and/or access to all necessary data. With sensors and devices deployed in the field, leadership can monitor physiological conditions and unit location via any internet-enabled web browser (phone, tablet, laptop, etc). **APPLICATION:** The system capabilites have been tested and iterated for multiple use cases (physical training run, ruck-sack march, land navigation), with live demonstrations ranging from 50 to 500 participants. Leadership in training events have utilized the real-time information to identify "participants of interest" and sent personnel to assess their risk of heat injury. **DISCUSSION:** The poster/slides will discuss the background of the system architecture and components, use cases performed during live training events, and integration of sensors and algorithms to inform the health, readiness, and performance of the user. The goal is to identify data, processing, and usability needs and add those capabilities to the system to adapt to the needs of the aerospace community. **RESOURCES:** See the following for more information: https://www.gtri.gatech.edu/newsroom/gtri-helps-develop-wearable-sensor-system-prevent-heat-injuries-among-soldiers

Learning Objectives

1. The audience will learn about the system used to monitor real-time physiological data during training to assess performance and help prevent injury.
2. The audience will consider other metrics (physiological or otherwise) that could be incorporated to meet their needs to assess human performance.

[217] EVALUATION OF NEUROPHYSIOLOGICAL RESPONSES OF IMPENDING HELICOPTER CRASH IN SIMULATION

Kathryn Feltman, Ryan Mackie, Xiaomin Yue
[1]*U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States*

(Original Research)

INTRODUCTION: Monitoring aviator performance through physiological measures is an ongoing effort across the defense services. A prominent area of monitoring has focused on excessive workload that could lead to a mishap or accident. If a physiological measure can predict an imminent mishap, an intervention such as adaptive automation may be introduced to mitigate the mishap. However, much of the research in this area has not utilized realistic tasks that result in performance failure. Performance failure, such as a crash, could provide useful information regarding how neurophysiological responses change under such stress. **METHODS:** Participants visited the laboratory twice. During the first visit, the participants completed several flights that were used to create scenarios with individualized workload manipulations for the second visit. During the second visit, participants completed a baseline flight with comfortable levels of workload and a high workload flight. Of the 12 participants, four crashed during the high workload flight. Electroencephalography (EEG) data were collected continuously throughout the flight. **RESULTS:** The EEG data were segmented into the following increments prior to the crashes and successful landings taking place: 30 seconds (s), 20 s, 10 s, and 5 s. An engagement index of beta/(alpha + theta) was calculated. The data were plotted to evaluate trends. In examining the plots, those who crashed showed a decreasing pattern in the engagement index leading up to the crash, whereas those who landed safely demonstrated an increasing pattern. Increases in this ratio typically demonstrate more cognitive engagement. **DISCUSSION:** We observed different neurophysiological patterns in pilots who were about to crash versus those who landed successfully. Caution needs to be taken when interpreting this data, which was collected within a simulated flight environment. Here, it appeared the aviators "gave up," likely upon realizing a crash was about to occur. Alternatively, in a real flight, an aviator would demonstrate full engagement while attempting to avoid a crash. This dataset supplies a unique opportunity to further understand changes in neurophysiological response when a task becomes too challenging to maintain. This can provide additional insight into understanding the physiological changes that must be monitored to predict aviator performance.

Learning Objectives

1. The audience will understand the utility of physiological measures in monitoring aviator performance.
2. The audience will learn about current efforts in operator state monitoring within the US Army.
3. The audience will understand the limitations of creating realistic flight scenarios within the simulator.

[218] EXPLORING THE CORRELATION BETWEEN INTEROCEPTION AND PHYSIOLOGICAL ADAPTABILITY AMONG ENVIRONMENTAL CONDITIONS

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Naval Medical Research Unit - Dayton (NAMRU-D), Dayton, OH, United States

(Original Research)

INTRODUCTION: Hypoxic stress typically induces certain physiological responses (changes to cardiovascular and respiratory function). Interoception is a concept surrounding internal sensation of the body. Detection of one's own discrete internal signals is interoception accuracy (IA), a component of interoception. The correlation between interoception and physiology is inadequately understood. Drawing off earlier work establishing respiratory sinus arrhythmia (RSA) predictability from IA, testing this relationship and other biosignals in a Hypoxic (Hx) environment was necessitated. Understanding the relationship between IA and physiological signals such as RSA and Galvanic Skin Response (GSR) may help to elucidate individual differences contributing to aviator's Hx susceptibility. This study investigates this knowledge gap to better understand individual factors' roles in Hx and stressed environments aviators face. **METHODS:** Eight participants took part in a fixed-based flight simulator study, where IA groups were determined through a heartbeat counting task score with a median split. Participants had two flight sessions, one normoxic (Nx) and one Hx, on separate days. Condition order was counterbalanced . GSR and RSA were recorded prior to- and during-flight to assess stress responses and physiological function. **RESULTS:** Results indicated that high IA participants exhibited significantly greater respiratory sinus arrhythmia (RSA) modulation in the stressed, Hx condition compared to low IA participants ($p = 0.001$, $\eta p2 = 0.424$ [large effect]), alongside lower GSR levels under Hx ($p = 1.39E-11$, $\eta p2 = 0.099$ [medium effect]). Additionally, high IA individuals maintained higher oxygen saturation (SpO2) levels in the Hx condition ($p = .01$, $\eta p2 = .037$ [small effect]), demonstrating enhanced physiological function and stress mitigation. **DISCUSSION:** Despite the limited sample size, findings suggest that greater IA relates with relatively better

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physiological responses under stress. Specifically, greater RSA modulation was observed in the Hx condition when there was low modulation in the Nx condition. Moreover, GSR levels were substantially lower in the high IA group in the Hx condition. This highlights the importance of autonomic adaptability in low oxygen environments. Future research may also continue to investigate how IA and biosignals are correlated and explore the underlying mechanisms that connect them.

Learning Objectives

1. The audience will learn about various bio signals important to physiological stress monitoring.
2. Audience members will gain insight into potentially novel topics of interoception and its components.
3. Finally, members will learn how interoception and physiological signals may correlate and interact under stressful environments.

[219] INTEROCEPTIVE ACCURACY AS AN INDICATOR OF FLIGHT PERFORMANCE

Allison Ludwig[1], Mariateresa Sestito[2], Dain Horning[1], Tayton Hess[1], Mary Nimmer[1], Kevin Novak[1]
[1]*Naval Medical Research Unit-Dayton, Dayton, OH, United States;* [2]*Embry-Riddle University, Daytona Beach, FL, United States*

(Original Research)

INTRODUCTION: Spatial disorientation (SD) is a persistent problem in military aviation causing heavy equipment damages and loss of life. SD has a variety of causes, including degraded visual environments and hypoxia. Interoception, the ability to detect subtle physiological and orientation-related changes in one's body, has not yet been investigated as an influencing factor of SD. Having a higher interoceptive ability may make individuals more prone to SD due to an individual's reliance on bodily cues rather than flight instruments. **METHODS:** Participants (n = 8) were military or civilian aviators. Participants performed a heartbeat counting task to assess interoceptive accuracy (IA), a sub-component of interoception. Participants were divided into high/low interoception groups. Participants performed a series of flights and asked to fly to a series of target headings/altitudes in a fixed base simulator. Altitudes alternated above and below a cloud deck, simulating visual meteorological conditions (VMC) and instrument meteorological conditions (IMC), respectively. Participants were blinded to breathing oxygen concentration conditions (21.0% or 10.2% O2), separated by at least 48 hours between sessions. **RESULTS:** Error from the instructed altitude and heading were primary metrics of flight performance, indicative of SD. Heading error was significantly lower under VMC compared to IMC, ($F(1, 418.86) = 12.77$, $p = .0004$, $\eta p2 = .030$). Altitude error was higher for all participants in the hypoxic concentration condition ($F(1, 444.76) = 3.89$, $p = .049$, $\eta p2 = .009$). While there was no main effect of interoception, there was an interaction effect with oxygen concentration condition. Low IA individuals, compared to high IA individuals, had higher altitude error under hypoxia, ($F(1, 444.57) = 12.29$, $p = .0005$, $\eta p2 = .027$). **DISCUSSION:** The study showed high IA individuals performing better under hypoxia than low IA individuals. This may indicate that high IA capabilities make them more resilient in operational stress conditions. More in-depth studies are needed to better characterize high IA psychophysiological profile correlated with better performance under SD/hypoxia stressors. Additionally, re-creating the real forces of flight during the study (full motion vs. fixed based platform) will help to better sort out those effects.

Learning Objectives

1. To show that high interoceptive accuracy correlated with better performance during simulated in-flight stressors.
2. To demonstrate how some individuals may be more resilient to spatial disorientation due to internal traits.

[220] WITHDRAWN

Wednesday, 06/04/2025 ***10:30 AM***
Centennial Ballroom I

[S-40] PANEL: SHORTER TIME ON DNIF STATUS THROUGH NEW INNOVATIONS IN USAFSAM ACS NEUROPSYCHIATRY WAIVER PROCESS

Chair: Henrik Close
Co-Chair: Justin Bunn

Panel Overview: *The United States Air Force School of Aerospace Medicine (USAFSAM) Aeromedical Consultation Service (ACS) plays a critical role in ensuring the medical qualifications of airmen, and its Neuropsychiatry Waiver process is a key component of this mission. The panel will explore the ACS Neuropsychiatry Waiver process and compare it to the Federal Aviation Administration's (FAA) Special Issuance process, highlighting the similarities and differences between the two processes. The presentations will also cover new innovations in the ACS Neuropsychiatry Waiver process that aim to shorten the time airmen spend on DNIF status, including the use of comprehensive psychological testing and a revised policy for waiver consideration for airmen with PTSD, adjustment disorder, and other stressor-related disorders. Attendees will gain a better understanding of the medical evaluation processes for airmen and the importance of maintaining high medical standards for flight safety.*

[221] USAFSAM ACS NEUROPSYCHIATRY WAIVER PROCESS: IMPLICATIONS FOR AIRMEN AND AVIATION SAFETY

Kevin Heacock
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Tutorial / Review)

INTRODUCTION: This presentation will explore the ACS Neuropsychiatry Waiver process and its comparison to the FAA's Special Issuance process. **TOPIC:** The ACS Neuropsychiatry Waiver process is a systematic and evidence-based approach to evaluating airmen with a history of psychiatric conditions, with the goal of determining their medical qualifications for flight duties. The process involves a thorough review of medical records, neuropsychological testing, and consultation with specialists. **APPLICATION:** This presentation will provide a detailed comparison of the two processes, highlighting the similarities and differences, and discussing the implications for airmen and the aviation industry. Attendees will gain a better understanding of the medical evaluation processes for airmen and the importance of maintaining high medical standards for flight safety.

Learning Objectives

1. Describe the key components of the ACS Neuropsychiatry Waiver process, including the medical record review, neuropsychological testing, and specialist consultation.
2. Differentiate the ACS Neuropsychiatry Waiver process from the FAA Special Issuance process in terms of the types of conditions evaluated, the evidence required, and the decision-making criteria.
3. Identify the implications of the ACS Neuropsychiatry Waiver process and the FAA Special Issuance process for airmen and the aviation industry, and articulate the importance of maintaining high medical standards for flight safety.

[222] USAFSAM ACS COMPREHENSIVE REVIEW AND EVALUATION PROCESS FOR PILOTS WITH MENTAL HEALTH CONDITIONS

Ryan Peirson
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Tutorial / Review)

INTRODUCTION: This section summarizes the critical role of the United States Air Force Aeromedical Consultation Service's Neuropsychiatry review and evaluation procedures in the waiver or

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disqualification process for pilots with a history of mental health diagnoses. It will provide an overview of the process, including in-person evaluations, medical record reviews, and the final risk assessment. **TOPIC:** The topic focuses on the United States Air Force Aeromedical Consultation Service's Neuropsychiatry review and evaluation procedures for pilots with a history of mental health diagnoses. The process involves a week-long evaluation, with multiple interview sessions with a psychiatrist and psychologist team. In cases where in-person evaluation is not possible, medical records are thoroughly reviewed. The final risk assessment involves discussions with over 20 physicians. **APPLICATION:** The United States Air Force Aeromedical Consultation Service's Neuropsychiatry review and evaluation procedures are rigorous and meticulous in nature, ensuring the highest standards of flight safety while supporting the mental health and well-being of airmen. The process is critical in ensuring the safe and effective return to flight duty for airmen with mental health conditions. The application of this material is broad, as it applies to aerospace medicine and human performance.

Learning Objectives

1. Describe the comprehensive procedures involved in the US Air Force Aeromedical Consultation Service's Neuropsychiatry review and evaluation process for pilots with a history of mental health diagnoses, including the week-long evaluation, multiple interview sessions with a psychiatrist and psychologist team, and thorough record review.
2. Explain the importance of the final risk assessment for pilots seen in-person, including discussions with over 20 physicians, and its role in making informed recommendations for waiver or disqualification.

[223] THE ROLE OF COMPREHENSIVE PSYCHOLOGICAL TESTING IN EVALUATING PILOTS WITH MENTAL HEALTH CONDITIONS IN THE UNITED STATES AIR FORCE

Monica Malcein
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Tutorial / Review)

INTRODUCTION: This abstract summarizes the presentation on the use of comprehensive psychological testing in evaluating pilots with a history of mental health diagnoses in the United States Air Force. **TOPIC:** The United States Air Force Aeromedical Consultation Service's Neuropsychiatry branch utilizes comprehensive psychological testing as a critical component of the evaluation process for pilots with a history of mental health diagnoses. Thorough and evidence-based psychological testing is performed by the psychologists and neuropsychologist team. The testing includes a range of measures, such as cognitive, personality, and symptom assessments, and is tailored to the individual needs and history of each pilot. The results of the psychological testing can be compared to baseline testing performed prior to the pilot's initial training, providing valuable information about any changes or impairments in cognitive or psychological functioning. **APPLICATION:** The presentation will highlight the importance of psychological testing in making informed recommendations for waiver or disqualification and ensuring the safe and effective return to flight duty for airmen with mental health conditions. Attendees will gain a better understanding of the psychological testing procedures, and how they support the mental health and well-being of airmen while maintaining the highest standards of flight safety. The presentation will also discuss the role of the psychologist in the evaluation and interpretation of the psychological testing results. The information presented will be useful for aerospace medicine and human performance professionals who work with pilots and airmen with mental health conditions.

Learning Objectives

1. Describe the comprehensive psychological testing procedures performed by the US Air Force Aeromedical Consultation Service's Neuropsychiatry when evaluating pilots with a history of mental health diagnoses, including cognitive, personality, and symptom assessments.
2. Explain the importance of comparing the results of the psychological testing to baseline testing performed prior to the pilot's initial training, and how it supports the safe and effective return to flight duty.

[224] INNOVATIONS AND ENHANCEMENTS TO THE USAF PROCESS FOR WAIVERS FOR FLYERS WITH MENTAL ILLNESS

Terry Correll
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Tutorial / Review)

INTRODUCTION: It is widely known that mental health conditions in US Air Force flyers are one of the most common causes of significant disruption in operational readiness and one of the most common reasons aviators lose their ability to fly. It is critical to our national security to fully support United States Air Force (USAF) operational missions. **TOPIC:** We will highlight the innovations and enhancements to USAF policy which enable returning flyers to operations as rapidly as possible, but also with necessary accountability and close follow up to insure maximal safety. We will examine the criteria for optimal cases, resolution of impairing symptoms, management of causative stressors, appropriate/shortened waiting periods, maximizing the clinician's judgment, and clearly define comprehensive/optimal mental health care that should be provided. Attendees will gain a better understanding of the innovative policies and their implications for airmen and the aviation industry. The focus will primarily be on new and innovation strategies in the US Air Force to hasten the process of obtaining a waiver while providing better oversight and accountability. **APPLICATION:** Although specific for Air Force pilots and aircrew evaluated at the USAF Aeromedical Consultation Service, the underlying issues are common to aviators and waiver processes in all the military services and civilian organizations.

Learning Objectives

1. Examine and discuss new and innovation strategies in the US Air Force to hasten the process of obtaining a waiver for any psychiatric diagnosis while providing better oversight and accountability during and after treatment.
2. Evaluate and analyze the criteria for optimal mental health care in the USAF to ensure operator safety, well-being, and operational readiness.

Wednesday, 06/04/2025 ***10:30 AM***
Centennial Ballroom II

[S-41] PANEL: WHAT GOES ON IN THE MIND? - MENTAL STATE MONITORING USING PHYSIOLOGICAL MEASURES IN AEROSPACE

Chair: Anne-Marie Brouwer
Co-Chairs: Charelle Bottenheft, Erik Frijters, Simone Löhlein, Karl Tschurtschenthaler, Evy van Weelden

Panel Overview: *With aerospace tasks becoming increasingly more cognitive in nature, continuous, non-obtrusive and objective information about cognitive processes and states (workload, attention, situation awareness) are desired in real time operation as well as in training and selection. Physiological measures such as EEG brain signals and heart rate, as well as implicit behavior recorded through e.g. eye trackers and camera's contain information about mental state. They can be obtained using increasingly comfortable sensors. Faster data processing currently allows analyses (including AI and machine learning) that were not possible before. Latest trends and developments are presented by researchers in academic and applied aviation research. Firstly, the Netherlands-US TeamMetrics project group (Airforce Research Lab AFRL, Netherlands Aerospace Center NLR, the Netherlands Organization for applied scientific research TNO) shows how EEG may help us monitor information intake in a semi-realistic multi-UAV task. The panel features three research groups that focused on measuring*

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workload in pilots, mostly in the context of training. The programme Next Gen Aircrew Performance (TNO) tested a setup to measure workload with 14 fighter pilots in a high fidelity simulator. Tilburg University (the Netherlands) examined the potential of pilots' workload as estimated through EEG to adapt flight simulation training to the individual student. The HuMiCS Lab (Humans, Military missions and Cognitive Systems) at the University of the Bundeswehr Munich (Germany) tested the relation between workload, physical discomfort and performance in a motion simulator with a flight-training-like scenario. We end with another example of applying automated assessment of pilots' activity and mental workload, namely in an adaptively aiding cockpit agent (by the HuMiCS Lab). The five presentations are followed by a discussion including the audience on required future steps. Discussion also entails ethical aspects around the envisioned applications. Amidst the promises and the hypes of brain or mind reading and AI, the attendees will get a realistic picture of what currently is and is not possible in terms of monitoring mental state in the aerospace domain and its applications. In the discussion the audience will be actively engaged in reflecting on how this technology can be used in the most effective and responsible way.

[225] OBJECTIVELY MEASURING FIGHTER PILOTS' MENTAL WORKLOAD IN A HIGH-FIDELITY F-16 SIMULATOR

Charelle Bottenheft, Juliette Bruin, Anna Reuten, Erik-Jan Cornelisse, Mark Houben, Wietse Ledegang, Ivo Stuldreher, Eric Groen
TNO, Soesterberg, Netherlands

(Original Research)

INTRODUCTION: The next-generation Air Force is moving towards information-heavy and networked operations with advanced sensors, display technologies, datalinks and increased automation. These new technologies and fusion of information enhance aircrew situational awareness. However, managing all these systems might also increase pilots' mental workload, or on the other hand, reduce their vigilance due to automated processes. Both effects might threaten flight safety and mission effectivity. The main aim of this study is to investigate whether physiological measures can differentiate between levels of mental workload during flight simulation. **METHODS:** A study was conducted with fourteen fighter pilots using a high-fidelity F-16 simulator. As measures for mental workload we used electrocardiography, electrodermal activity, electroencephalography, eye tracking, and subjective self-ratings. The within-subjects design involved a mission where the pilot had to eliminate a target in hostile territory, with flight segments ranging from low to high mental workload. Participants were given a secondary mathematical task, which alternated between easy and difficult math calculations. We investigated whether physiological measures could differentiate between difficulty levels across different flight segments, as well as within the same flight segment. **RESULTS:** Subjective mental effort ratings significantly differentiated between flight segments with varying levels of mental workload ($p < .001$). Higher ratings were given for the hard 'engagement' segment compared to both the easy 'holding' segment ($p = .002$) and medium 'intercept' segment ($p = .013$). Also higher mental effort ratings were given for the medium 'intercept' segment compared to the easy 'holding' segment ($p = .026$). **DISCUSSION:** Our findings confirm the effectiveness of our manipulation in establishing distinct mental workload conditions. Physiological data should indicate whether they can differentiate between these varying levels of mental workload. Objectively measuring and predicting mental workload of aircrew could have several advantages. First, the impact of new technologies and concepts of operations on the pilot's workload can be assessed. Second, continuous monitoring mental workload could be useful in guiding pilots to allocate their attention reasonably, thereby contributing to flight safety and mission effectivity. Finally, it allows for the adjustment of (simulator) training difficulty to optimize learning for pilot students.

Learning Objectives

1. The audience will learn about subjective and physiological measures used to assess mental workload in the cockpit.
2. The audience will learn whether physiological measures could differentiate between difficulty levels within flight segments, independent of task specific confounds such as varying levels of required muscle activity.
3. The audience will learn about the potential benefits of objectively measuring and predicting mental workload for aircrew.

[226] REAL-TIME PILOT ACTIVITY AND WORKLOAD ASSESSMENT TO ENABLE ADAPTIVE ASSISTANCE IN MILITARY MANNED-UNMANNED-TEAMING MISSIONS

Karl Tschurtschenthaler, Axel Schulte
University of the Bundeswehr Munich, Neubiberg, Bavaria, Germany

(Original Research)

INTRODUCTION: The key component in Manned-Unmanned Teaming (MUM-T) is the management of unmanned aerial vehicles, which requires pilots to cope with multiple supervisory control tasks concurrently. Mental states such as workload are therefore ubiquitous in MUM-T research. Our approach aims to solve this issue through cockpit agents that assist the pilot by adapting to the mental states involved in human multitasking. **METHODS:** The presented cockpit agent continuously encodes physiological measures (e.g. manual and gaze interactions) to a series of features. A probabilistic graphical model then uses these features to classify pilot activity. Mental workload assessment is based on the Multiple-Resource Theory and realized by computing interference of mental resources during concurrent tasks. We integrated this mental state assessment into two types of assistance agents that aim to minimize interruptions: The first agent delays less critical feedback during execution of high-priority tasks to maintain the flow of the pilot. The second system chooses the least intrusive feedback modality based on the allocated mental resources. To evaluate both intervention methods, we conducted a human-in-the-loop experiment in a MUM-T research simulator with eight pilot recruits. Throughout the experiment, performance in tasks with different priority were continously evaluated. In case of low pilot performance, the system adaptively notified the pilot. To determine change in performance, we used a non-adaptive system as baseline. **RESULTS:** Both intervention types led to a performance increase of ~37% for the high-priority tasks. In addition, participants reported a lower workload (around 12.5%) and higher flow state (around 33%). Overall, the adaptive interventions were well-received, with participants expressing broad acceptance of the system's approach during debriefings. **DISCUSSION:** The proposed method presents a novel approach to recognize pilot activity based on the real-time assessment of physiological measures, providing a strong basis for closed-loop assistance. Our evaluation demonstrates that this method significantly improves the performance of pilots, particularly during high-priority tasks.

Learning Objectives

1. The audience will learn that adaptive automation agents can increase crew performance in Manned-Unmanned Teaming missions.
2. The audience will learn how physiological measures that are acquired in real-time can be utilized for real-time inference of pilot activity and mental workload in a multitasking environment.
3. The audience will learn how interventions by cockpit automation can be generated that are adaptive to the multitasking of pilots.

[227] ANALYSING PILOTS' PHYSICAL STATE IN SITUATIONS OF HIGH WORKLOAD DURING MILITARY INITIAL FLIGHT TRAINING

Simone Löhlein
University of the Bundeswehr Munich, Neubiberg, Bavaria, Germany

(Original Research)

INTRODUCTION: Situations of excessive demands and high workloads not only lead to personal discomfort and reduced performance but can also lead to errors and accidents in safety-critical environments such as aviation. Identifying the causes and predicting the vulnerability of pilots is therefore an important concern, particularly in military aviation. The identification of individual stress situations can help to design

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targeted training and coping strategies. Therefore, we investigate the relationship between the workload in typical flight training task situations and the individual physical response. The latter is reflected both in subjectively perceived discomfort and workload, but also in objective physiological parameters. **METHODS:** We conducted a human-in-the-loop experiment in a motion simulator with a flight-training-like scenario that was made up of training-typical task blocks with increasing mental demand. Every two minutes subjective perceived workload as well as dizziness and nausea, common measures for physical discomfort were queried. In addition, eye-tracking parameters (attention distribution, saccade rates, gaze patterns and duration of head down phases) and objective flight and side task performances were continuously recorded. The set-up is complemented by the measurement of heart rate, EGG, EDA and body temperature. **RESULTS:** Our results show a positive correlation between the subjective parameters of discomfort and workload (meta-analysis over subjects, $p<0.01$). Further, the objectively measurable value of reaction time increased in correlation with workload. Comparing the objectively estimated workload by experimental design with the subjectively reported workload, we verified the intended increasing mental demands of the training scenario. **DISCUSSION:** The subjective and objective measurements confirm that the modular experimental scenario is well suited to testing different workload situations. In current analyses, we aim to further explore the correlation of workload, performance, and pilots' physical state. To this end, we additionally consider physiological measures as well as eye-tracking data to complete the mental state model.

Learning Objectives

1. Get an idea of the subjective and objective measures that can be used to analyse a pilot's mental state.
2. Understand how physical and mental conditions affect a pilot's condition, well-being and performance.

[228] UTILIZING EEG BRAIN SIGNALS TO EVALUATE PILOT WORKLOAD IN VIRTUAL REALITY FLIGHT SIMULATION TRAINING IN REAL TIME

Evy van Weelden[1], Maryam Alimardani[2], Travis Wiltshire[1], Max Louwerse[1]
[1]*Tilburg University, Tilburg, Noord-Brabant, Netherlands;* [2]*Vrije Universiteit Amsterdam, Amsterdam, Netherlands*

(Original Research)

INTRODUCTION: Conventional ab initio flight training methods require extensive resources and, often post-hoc, subjective evaluations of performance. This research explored integrating Virtual Reality (VR) and other training mediums with (neuro)physiological sensors to assess pilot workload and social coordination (e.g., physiological synchrony) during training and provide real-time feedback. The aims of this work were to better understand the extent to which 1) VR technology and passive brain-computer interfaces are effective tools for flight training, as well as 2) the degree to which mental states can be monitored. **METHODS:** We conducted a literature review and four experiments. First, we performed a systematic review to identify gaps in the literature and explore prospects for EEG-based pilot workload monitoring. Next, we examined how simulator fidelity impacts both subjective (e.g., workload, engagement) and objective (e.g., performance, EEG) measures with novices. Further studies involved modeling EEG data from novice military pilots to predict workload and testing a neuro-adaptive VR training system. Lastly, we assessed interpersonal coordination between student and instructor in simulated and real flights by using cardiac measures to examine dyadic workload. **RESULTS:** Our studies have shown that VR serves as an engaging training medium, supported by subjective and neurophysiological measures of engagement. We found that pilots' EEG signals can successfully be used to monitor pilot workload during VR training, consequently allowing the simulation to adapt and manage pilots' workload in real time. However, pilot performance in the neuro-adaptive simulation did not differ from randomized training. Monitoring interpersonal coordination of learner-instructor dyads using cardiac signals also showed promise for assessing pilot workload during training, but larger samples are needed as we have encountered challenges in navigating the trade-off between exploratory tests and sample size constraints. **DISCUSSION:** Our findings explain and highlight that (neuro)physiological signals of pilots can be used in combination with newly emerging technologies, such as VR, in order to enhance flight training. However, the demonstration of the neuro-adaptive VR flight training system yielded different results between subjects. In fact, multiple studies were affected by inter-subject variability and small sample sizes, highlighting the need for further investigation of inter-subject variability in larger pilot samples.

Learning Objectives

1. The audience learns how wearable sensors such as EEG electrodes can have benefits in flight training, specifically in monitoring trainee's mental state in real-time for evaluation.
2. The audience learns about the added value of Virtual Realty in providing high-fidelity training opportunities and becoming a highly ecologically valid and safe testbed for new training methods or scenarios.

[229] MONITORING ATTENTION IN A SEMI-REALISTIC MUTI-UAV TASK

Anne-Marie Brouwer[1], Ivo Stuldreher[2], Juliette Bruin[2], Patrick Martin[3], Michael Tolston[4], Maykel van Miltenburg[5], Erik Frijters[6]
[1]*TNO/Radboud University Nijmegen, Netherlands;* [2]*TNO, Soesterberg, Netherlands;* [3]*Radboud University Nijmegen, Nijmegen, Netherlands;* [4]*U.S. Air Force Aeromedical Research Lab, Dayton, OH, United States;* [5]*NLR, Amsterdam, Netherlands;* [6]*CML, Soesterberg, Netherlands*

(Original Research)

INTRODUCTION: Modern aerospace systems involve large amounts of information to be processed by human operators. This can be a critical bottleneck, differentiating between success and failure. Continuous measures of human information intake would be useful to evaluate systems or trainees. In real time, they could be used to decide to present information again, or decide that certain tasks can better be postponed or automated. We here focus on late brain EEG responses (event related potentials or ERPs), that are known to reflect top-down attention, as a potential way to monitor information intake in real life environments. **METHODS:** The experiment was conducted at and approved by Radboud University Nijmegen, the Netherlands. A 'pilot' and a 'navigator' were asked to together perform eight 5-min UAV (Unmanned Aerial Vehicle) task blocks in a naturalistic UAV-control setting, including speech. The task entailed flying multiple UAVs safely to target areas and then locating the target. Every other task block, the pilot was asked to change priorities from the general task to attending to certain spoken call signs that were present throughout. EEG was related to the call signs, as well as to other meaningful sounds (e.g. sounds associated with locating a target or with a search time-out). **RESULTS:** Call signs elicited late ERPs, only when they were target call signs, only in the pilots, and only during the blocks in which these sounds were relevant. Consistent with this, call sign performance data also indicated that pilots correctly processed this information. We did not find the hypothesized difference between task block type (yes/no call sign task) in pilots' responses to other task relevant sounds. The results rather show that pilots hardly respond to these sounds at all, while navigators do, which is consistent with the fact that the sounds related more strongly to the navigator's than to the pilot's task. **DISCUSSION:** We showed that even in a noisy, life-like environment, ERPs to sounds occurring in the task (including spoken words as in the call signs) reflect focused attention, as manipulated by (self-perceived) task requirements. Next steps include relating them to performance, apart from task requirements perse.

Learning Objectives

1. The audience will learn about EEG brain markers of attention, specifically the p300.
2. Through the example of monitoring attention in operators performing a UAV control task, the audience will learn about the challenges in the field of passive brain-computer interfaces/neuroergonomics, and the opportunities to enhance well-being and performance in the aerospace domain.

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Wednesday, 06/04/2025 ***10:30 AM***
Centennial Ballroom III

[S-42] SLIDE : AVIATION ACCIDENT INJURY SEVERITY AND PREVENTION

Chair: Douglas Boyd
Co-Chair: Kristin Michelet

[230] DEFICIENCIES IN THE AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST SYSTEM FOR GENERAL AVIATION TRAFFIC DE-CONFLICTION-HUMAN FACTOR CONSIDERATIONS

Douglas Boyd, Mark Scharf
Embry-Riddle Aeronautical University, Daytona Beach, FL, United States

(Original Research)

INTRODUCTION: Under general aviation regulations, aircraft may operate by visual flight rules (VFR) with the pilot responsible for traffic separation via the "see-and-avoid" principle. Unfortunately, this method is known for its poor efficacy due to (ii) age-dependent deterioration of the human's field of vision (ii) fatigue (iii) stress (iv) image location over the blind spot with view from the other eye occluded by a physical obstruction. Recently, the Automatic Dependent Surveillance-Broadcast (ADS-B) system, comprised of a transmitter (ADS-B-Out) and an optional receiver (Traffic-In) has provided an additional means for traffic de-confliction. Although ADS-B-Out became mandatory in 2020 in designated US airspace no study, since then, has determined its efficacy in traffic-de-confliction. **METHODS:** Accidents were per the NTSB database. Responses to an aviator survey on ADS-B usage were collected September-October, 2023. Statistical tests included Poisson distribution and Chi-Square. **RESULTS:** The fraction of midair accidents with a fatal outcome (0.52) was significantly ($p<0.001$) higher (0.16) than accidents unrelated to midair collisions. Although the midair collision rate for ADS-B-Out equipped aircraft (2018-2022) trended downwards ($p=0.355$), such events persisted despite such equipage. Of 3,233 survey respondents, 97% indicated Traffic-In capability -thus, the unremarkable diminution in midair collision rate is unlikely due to low Traffic-In equipage. From a human factors perspective, displayed traffic viewing angle, annunciation type and knowledge of the time delay associated with displaying non-ADS-B-Out aircraft all failed to explain continued midair collisions. However, 86% of respondents were unable to visually acquire ADS-B-In-annunciated merging aircraft explaining, in part, a continued midair mishaps for such equipped aircraft. **DISCUSSION:** Half of mid-air collisions have a fatal outcome and herein we illustrate an imperfect ADS-B system for traffic de-confliction. Regarding practical implications, pilots operating in accordance with VFR should (i) prioritize on maneuvering away from such traffic at the expense of gaining visual contact (ii) avail themselves of air traffic control de-confliction services.

Learning Objectives

1. The limitations of the see-and-avoid method for general aviation traffic de-confliction.
2. The deficiencies of he automatic dependent surveillance broadcast system for traffic de-confliction.

[230A] A NEW SCORING SYSTEM TO PREDICT FATAL ACCIDENTS IN GENERAL AVIATION AND TO FACILITATE EMERGENCY CONTROL CENTER DISPOSITION

Jochen Hinkelbein[1], Manuel Michno[2], Catherina Hippler[3], Felix Liebold[4], Jan Smitz[3], Markus Rothschild[3], Volker Schick[3]
[1]Ruhr-University Bochum, Minden, Germany; [2]Anatomical Institute, Zürich, Switzerland; [3]University Hospital Cologne, Cologne, Germany; [4]University Hospital and Faculty of Medicine Leipzig, Leipzig, Germany

BACKGROUND: Numerous accidents occur with General Aviation aircraft every year. To date, pre-emptive prediction of survival or death is impossible. The current study aims to identify significant factors elementary to predict survival after General Aviation (GA) aircraft accidents. The Implementation of a scoring system, including these factors, may facilitate emergency control centres. **MATERIAL AND METHODS:** Data of flight accidents over a 20-year period (extracted from the German Federal Bureau of Aircraft Accident Investigation [BFU]) was analysed for fixed-wing motorized small aircrafts below 5,700 kg MTOW. Factors of interest were analysed using Chi2- and Mann-Whitney-U-Tests. Logistic regression was used to establish a score to calculate the probability of a fatal outcome after an aircraft accident. **RESULTS:** The BFU lists 1,595 GA aircraft accidents between 2000 and 2019. The factors "third quarter of the year" ($p=0.04$), "last quarter of the year" ($p=0.002$), "fire" ($p<0.0001$), "distance from airport >10 km" ($p<0.0001$), "landing" ($p<0.0001$) and "cruise" ($p<0.0001$), significantly correlated positively or negatively with a fatal outcome. "Take-off", "approach", "month", "day of the week", "persons on board above three", "night-time" and "icing conditions" showed no significant correlation. Using logistic regression "third quarter of the year" and "cruise" were excluded when using the B-STEP method. Including the four significant parameters, the score showed a strong effect with $f2=0.709$. **CONCLUSIONS:** The analysis of GA aircraft accidents in Germany enabled the identification of relevant factors and establishment of a new scoring system for survival prediction after small aircrafts accidents below 5,700 kg MTOW. The implementation of the scoring system in emergency control centres in the context of digital development and artificial intelligence can improve emergency response planning and distribution.

Learning Objectives

1. The audience will learn about General aviation crashes and how to estimate fatality risk.
2. The audience will learn the most important factor for GA accidents.
3. The audience will learn about a new scoring system for prediction.

[231] FATAL SPATIAL DISORIENTATION ACCIDENTS IN GENERAL AVIATION (2003 – 2021)

Hannah Baumgartner, Jason Sigmon
FAA, Oklahoma City, OK, United States

(Original Research)

INTRODUCTION: Spatial disorientation (SD) mishaps are a well-documented threat in general aviation (GA). Previous research by the Civil Aerospace Medical institute (CAMI) and others has examined the prevalence of SD fatal accidents in GA in past decades. However, no current baseline exists nor an evaluation of how current trends, such as a rise in single pilot turboprop and jet aircraft, may influence current rates of SD accidents in GA. **METHODS:** The National Transportation Safety Board's Carol database was queried for final reports that related to GA fixed-wing operations between 2003 and 2021. Reports were filtered to only include those referencing airplanes and included the term "spatial disorientation" in the factual narrative or probable cause. Findings, factual information, and analyses were evaluated for general information (e.g., fatalities, pilot experience, visual conditions) and overall trends across reports. **RESULTS:** A total of 370 final reports that involved fatal GA accidents with some reference to spatial disorientation were analyzed. These included 384 total pilot fatalities, 346 passenger fatalities, and an additional 11 ground fatalities. Accidents were fairly consistent across years, with a peak of 29 fatal SD accidents in 2019. Pilot experience levels varied across these accidents, with an average of 1799 flight hrs (SEM: ±164), and over half of pilots (n=200 of 384), were instrument-rated. Accidents more commonly occurred during day conditions and during the enroute stage of flight. Visual Flight Rules to Instrument Meteorological Conditions (VFR-IMC) occurred in 44% of accidents (n=161). A small but notable increase in SD fatal accidents involving turboprop and small jet aircraft was observed beginning in 2012. **DISCUSSION:** Understanding the current incidence and the

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associated characteristics of SD accidents in GA is integral to addressing training and educational mitigations for SD. An increase in availability of light single-pilot turboprop and jet planes may explain the uptick in fatal SD accidents with these aircraft types. The current data will be contrasted with historical evaluations of SD fatal accidents from CAMI in 1978 and 1996 to better understand the changes in the occurrence of SD in GA.

Learning Objectives

1. Understand the incidence of fatal general aviation accidents related to spatial disorientation.
2. Understand the flight context and pilot demographics associated with fatal spatial disorientation accidents in general aviation.
3. Compare how fatal spatial disorientation accidents in general aviation has changed over time.

[232] INJURY METRICS FOR FUTURE AIRCRAFT ESCAPE AND CRASHWORTHY SYSTEMS

Matthew Lewis
RAF Centre of Aerospace Medicine, Baldock, United Kingdom

(Education - Program / Process Review)

BACKGROUND: Future escape and crashworthy systems need to be designed to minimise the potential for occupant injury during their safe operation. Each phase of the crew escape system can be associated with specific injuries. Even if these injuries occur their occurrence does not necessarily mean the system has malfunctioned as the dynamic nature of the event itself can result in injury. Consequently, during the design process a full understanding of such injuries must be assessed. **OVERVIEW:** There are many international standards which specify the injury metrics with applicable pass/fail criteria. Ideally, each of these criteria should predict the probability of specific injuries utilising injury probability graphs and hazard risk matrices, however, many do not. In their absence the significance of their exceedances is open to user interpretation, potentially resulting in huge costs to military programmes to achieve compliance for theoretical unvalidated injury mechanisms. Critically, the risk of spinal, head, limb flail and parachute landing injuries can be used to assess the safe ride characteristics of the escape system. The escape system standards for, DRI, MDRC, Nij, BRIC, LTA, HIC, etc were reviewed and the pass/fail criterion were assessed to determine if their limits could be validated against real time accident data. **DISCUSSION:** The analysis demonstrated that DRI shows good correlation to real time mishap data but MDRC has little real-world validation. Data from road traffic accidents show that BRIC is a better metric than HIC or LTA for predicting the risk of head injury and should be adopted in the air domain. Validated neck injury criteria have been introduced successfully into recent escape system procurement programmes and must be included in all future programmes particularly where HMD feature. Although windblast limb flail injury is a well understood risk this injury mechanism has no appropriate assessable criterion, other than the surrogate of limb displacement. Likewise parachute landing velocity is used as a surrogate for parachuting injuries where perhaps the tibia or femur injury index, for example, may be a better fit. This work is important for those involved with crew escape safety assessment and procurement, and is critical to minimising injuries to aircrew.

Learning Objectives

1. This presentation demonstrates the importance of using validated injury risk criteria to assess crew safety systems.
2. This presentation demonstrates that new injury metrics for limb flail injuries need to be developed.

[233] ALL GUTS, NO GLORY: THE MEDICAL IMPLICATIONS FOR GLIDER OPERATIONS IN WORLD WAR II

Jim Lucas
Texas A&M University College of Medicine, Bryan, TX, United States

(Education - Tutorial / Review)

INTRODUCTION: The effective use of military gliders by Allied forces during World War 2 is a well-documented but poorly-known aspect of the last great global conflict. And while much of the popular attention for the history of combat aviation and airborne assault in World War 2 is understandably devoted to the pilots of powered aircraft and parachute-borne infantry troops, the glider pilots of that era faced a significantly higher level of risk to life and limb with very little recognition of their bravery or sacrifice.**TOPIC:** The combat glider pilots of World War 2 faced staggering levels of risk on one-way flights into hostile territory - flying powerless aircraft made of metal pipes, wood, and canvas though a hail of flak and machine gun fire to silently reach targets behind enemy lines. With casualty rates as high as 30%, these heroic men were often referred to as "Suicide Jockeys" and the "Brotherhood of the Flying Coffin". Facing alarming levels of risk that would not be remotely tolerated by modern aeromedical standards, these heroes volunteered for missions involving a >90% chance to sustain some level of traumatic brain injury (TBI); flight-control and impact forces that often resulted in dislocations, open fractures, and traumatic amputations blunt and penetrating traumatic injuries; and, not uncommonly, death. And despite these risks, glider pilots were generally marginalized and looked upon as second-class aviators and soldiers for most of the war. The minimization of their impact and significance continues to this day, as most often the topics of gliders and their crews are rarely much more than an afterthought in most historical media. **APPLICATION:** A brief historical overview of the combat glider programs of the Allied forces, some of the major combat operations involving glider-borne troops and equipment, and the mechanisms of morbidity and mortality faced by those involved can provide a fuller understanding of the sacrifices and risks incurred in this early era of combat aviation. This historical perspective can further inform our evolving aerospace medical standards and practices as we look to the future of both combat aviation and deep space exploration. **RESOURCES:** Multiple sources which will be provided with the presentation.

Learning Objectives

1. Participants will learn about the tremendous medical risks and injury patterns faced by combat glider pilots during World War 2.
2. Participants will come away with a much greater understanding of the combat glider programs utilized by both Allied and German forces during World War 2.
3. Participants will gain a much fuller appreciating of the heroism and bravery of this long-overlooked and over-shadowed segment of the early combat aviation community.

[234] CIVILIAN VERSUS MILITARY ROTORCRAFT CRASHWORTHY SEAT STANDARDS FOR CRASH PROTECTION

Danielle Rhodes, B. Joseph McEntire, Joseph Willett, Valeta Carol Chancey
U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: The Army UH-60 and AH-64 helicopter designs incorporated many crashworthy principles described in the Army Aircraft Crash Survival Design Guide. These aircraft are designed to absorb vertical impact energy to mitigate spinal injuries through energy attenuating landing gear, floor structure, and occupant seats. The desired seat performance and occupant restraint requirements were codified in MIL-S-58095 and MIL-S-85510. Both seat specifications were rendered inactive and unavailable for new seat development efforts and only available for reference. In this void, seats certified to civilian standards are being considered for use in military aircraft. A technical review of the military and civilian rotary-wing seat standards was needed to identify their differences and ensure Soldier crash protection would be not compromised. **METHODS:** Static and dynamic test requirements for military and civilian energy attenuating rotary-wing seating systems were reviewed. Documents reviewed included MIL-S-58095A, MIL-S-85510, JSSG-2010-7, SAE AS8049D, and SAE AS8049/1 Rev. B. Elements compared included dynamic test conditions (peak acceleration, velocity change, etc.), static

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strength requirements, and the corresponding pass/fail criteria to include anthropomorphic test device (ATD) response measures. **RESULTS:** While the civilian rotary-wing seat standard more clearly articulates the requirements and incorporates the test surrogate response metrics, its static strength and dynamic test conditions are substantially inferior to military seat specifications and guidance. Some civilian static strength tests are 50% weaker than the military requirement. In dynamic tests, some civilian requirements only apply 37% of the energy of the corresponding military test. **DISCUSSION:** Civilian standards provide an appealing alternative due to less rigorous testing conditions and off-the-shelf, mass-produced materiel for seating systems. However, if civilian certified seats are employed in military rotary-wing aircraft, then occupant crash protection may be severely compromised. The seat may either separate from the fuselage or transmit injurious vertical loads as the seats are not designed to withstand the rigors of military crash environments. It is recommended that obsolete military crashworthy seat specifications be reinstated and updated with dynamic ATD response metrics and current Soldier anthropometry.

Learning Objectives

1. Civilian rotorcraft crew seat performance requirements are less stringent than military rotorcraft crew seat performance requirements.
2. MIL-S-58095A (AV) has been canceled and MIL-S-85510 (AS) rendered inactive leaving program managers without crashworthy performance requirements for testing.

Wednesday, 06/04/2025 ***10:30 AM***
Centennial Ballroom IV

[S-43] SLIDE : UNDER PRESSURE: DCS

Chair: Joseph Dervay
Co-Chair: Andrea Hanson

[235] DEVELOPMENT OF A DIGITAL DECOMPRESSION SICKNESS REMOTE EXAM FOR THE INTERNATIONAL SPACE STATION

Robert Sanders[1], Maybritt Kuypers[2], Sara Mason[3], Jean-Sebastien Zouehi[4], Maurice Marnat[4]
[1]*NASA, Houston, TX, United States;* [2]*MEDES/ESA, Cologne, Germany;* [3]*Aegis Aerospace, Inc, Houston, TX, United States;* [4]*MEDES, Toulouse, France*

(Education - Tutorial / Review)

INTRODUCTION: Decompression sickness is an evolving process, as such, it requires documentation overtime, not just a single moment. As NASA transitions from paper based questionnaires to digital formats, developing software to guide a persons to complete a thorough neurologic exam, allow for historical review and recent reference data, while communicating down to ground base medical resources was a unique challenge as NASA focuses more on exploration, preparing to retire the international space station. **TOPIC:** During spaceflight, there is a risk of crewmembers developing decompression sickness (DCS). This can happen when there is a loss of pressure in the space vehicle or when translating to a lower pressure environment like when performing Extra Vehicular Activities (EVA). NASA Space Medicine developed a contingent paper based DCS exam procedure for crew use in Low Earth Orbit. The EveryWear (EVW) iPad application developed by MEDES/CNES and the European Space Agency (ESA) allows for private medical messaging and data-collection for medial operations and science. It was first deployed on the ISS in support of ESA astronaut Thomas Pesquet's spaceflight in 2016. EVW use expanded to all ESA crewmembers, and in 2022 to all USOS crewmembers. In collaboration with NASA and ESA Medical Operations and MEDES/CNES, a custom DCS module was developed and deployed to the ISS within the EVW application to allow digital capture of the DCS exam conducted by an examining crewmember. The EVW application allows for dynamic questions and seamless photo-documentation. This critical clinical data will be communicated back to mission control in near real-time. The DCS module was augmented to allow crew review of serial DCS exams results which is a critical autonomous capability due to the potential for loss of signal to ground clinical team. **APPLICATION:** This tool is currently available for ISS crew, and will be available on upcoming Artemis missions, where communications will be more limited. The features in this tool have substantial potential for future use in other clinical and research tools for space exploration missions.

Learning Objectives

1. The audience will learn about the digital clinical tool currently available on to the International Space Station for the management of Decompression Sickness.
2. The participant will understand the features developed with this Decompression Sickness Module that would valuable for other clinical and research tools for future spaceflight.

[236] DECOMPRESSION SICKNESS PREVALENCE IN NASA'S EXPLORATION ATMOSPHERE RESEARCH

Kristi Ray[1], Alejandro Garbino[2], Robert Sanders[2]
[1]*UTMB/ NASA JSC, Galveston, TX, United States;* [2]*NASA JSC, Houston, TX, United States*

(Original Research)

INTRODUCTION: The National Aeronautics and Space Administration's (NASA) Exploration Atmospheres studies (EA) are done to assess pre-breathe protocols for denitrogenation and the evaluation of alternate cabin atmospheres and suit pressures for future spacecraft designs for planetary surface exploration (EVA). **METHODS:** EA includes both 3-day and 11-day trials. These trials include a depressurization and saturation to 8.2psia at 34% O2 or a depressurization and saturation to 9.6% at 28.5% O2 with additional repress to 4.3psia or 5.2 psia (simulating spacesuit pressure during EVA). All EVAs were conducted with 85% or 95% O2 with varying prebreathe times of 20 to 150 minutes. The accepted DCS risk is </= 15% risk of type 1 DCS, no type 2 DCS, and </= 20% high grade VGE. There were 6 proposed cases of type 1 DCS cases that were brought to NASA's DSSMB board for evaluation, resulting in a total of 3 cases that were confirmed. There were 2 cases of type 2 DCS that invalidated two prebreathe protocols. In addition, there was three cases of left sided cardiac bubbling that resulted in two of the type 2 DCS cases. **RESULTS:** An in-depth treatment algorithm was used during this study including the use of site level oxygen (SLO) (14.7 psia) and hyperbaric treatments using a chamber-side dual-lock deck decompression chamber with multiplace chamber back up available from NASA's Neutral Buoyancy Lab and local hospitals. The acute type 1 cases were treated with a minimum of 4 hours of SLO and the delayed type 1 case was treated in a hyperbaric treatment with a USN TT5. The acute type 2 cases were treated with a hyperbaric treatment with a USN TT6. All cases had complete resolution of symptoms. **DISCUSSION:** The effect of habitation and suit pressure is an essential part NASA's preparation for the upcoming Lunar Artemis missions to ensure protocols are created that optimize crew safety and health. These studies showed a higher prevalence of type 2 DCS than expected by models.

Learning Objectives

1. The audience will learn about type 1 and type 2 aerospace decompression sickness.
2. The audience will learn about NASA's accepted decompression sickness risk for exploration.

[237] NASA EXPLORATION ATMOSPHERE TESTS 3 & 4: DEVELOPMENT AND VALIDATION OF PLANETARY EVA PREBREATHE PROTOCOLS FOR ALTERNATE ATMOSPHERES AND SUIT PRESSURES

Alejandro Garbino[1], Monica Hew[2], Patrick Estep[2], Brett Siders[2], Karina Marshall-Goebel[3]
[1]*GeoControl/NASA JSC, Houston, TX, United States;* [2]*KBR/NASA, Houston, TX, United States;* [3]*NASA, Houston, TX, United States*

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(Original Research)

INTRODUCTION: Space suits operate at low pressures to optimize astronauts' performance. The drop in pressure from the habitat environment to the suit carries a risk of decompression sickness (DCS), which is mitigated by a 95% O2 prebreathe protocol. Prebreathe protocols for the lunar surface have a significantly higher risk compared to International Space Station microgravity Extravehicular Activities (EVA). In previous studies, we validated a prebreathe protocol from a 56.5 kPa 34% O2 cabin to a 29.6 kPa EVA pressure; however, the enriched oxygen cabin environment poses a flammability risk that requires significant changes to material design and selections. Here, we report outcomes for prebreathe protocols from a sub-30% O2 cabin and associated changes necessary to control DCS risk critical to upcoming lunar missions. **METHODS:** Fourteen volunteers completed 11-day hypobaric chamber studies with an "alternate exploration atmosphere" of 66.2kPa, 28.5% O2. Subjects acclimated for 48 hrs and then participated in five 6-hour simulated EVAs at 29.6 or 35.6kPa, 95% O2. Prior to EVA, subjects underwent a 20, 90, or 150-minute prebreathe. The EVA simulation was designed to be representative of future planetary EVAs, proportionate to the subject's VO2max. Decompression stress was monitored by real-time doppler and echocardiograph alternating every 15 min, as well as clinical monitoring for DCS signs/symptoms. Venous gas emboli (VGE) and DCS outcomes were verified against NASA-STD-3001 acceptance criteria. **RESULTS AND DISCUSSION:** Venous gas emboli (VGE) were identified during all EVAs. A neurological DCS case was identified in the 90-min/29.6kPa prebreathe, terminating further testing of this protocol. No DCS cases were identified in the 150 min/29.6kPa protocol. The 20 min/36.5kPa protocol was rejected due to a Type II DCS case. All DCS symptoms resolved with treatment, with no sequelae post initial treatment of DCS. These various test points highlighted to the significant benefit of elevated suit pressure to shorten prebreathe protocols, but also the difficulty in assessing and managing DCS during sustained EVA operations in remote planetary surfaces.

Learning Objectives

1. Attendees will be able to describe to relationship and tradeoffs between cabin oxygen & pressure, suit pressure and prebreathe duration.
2. Attendees will learn the testing and verification protocols NASA uses to mitigate DCS risk.
3. Attendees will learn how the limitations of suit pressure and materials flammability affect lunar EVA operations.

[238] NON-INFERIORITY PILOT TEST OF AN OXYGEN CLOSED CIRCUIT REBREATHER AT 35,000 FEET.

Maria-Vittoria Carminati[1], Nicolo Favero[1], Lorenzo Garbino-Carminati[2], Alejandro Garbino[1], Jonathan Clark[1]
[1]*C2Space Tech LLC, Houston, TX, United States;* [2]*C2Space Tech LLC, Aurora, CO, United States*

(Original Research)

INTRODUCTION: Human exploration of high-consequence environments comes with challenges, including physiological stresses such as decompression sickness (DCS). DCS occurs when gas bubbles form in nitrogen-supersaturated tissues due to a drop in atmospheric pressure, particularly relevant for space exploration involving extravehicular activities (EVA) and other space missions. Pre-breathe (or pre-oxygenation), involving inhalation of 100% oxygen before decompression, is essential for reducing DCS by decreasing tissue nitrogen levels. However, current prebreathe systems are open-loop, causing substantial oxygen waste and increase in cabin flammability when pre-breathe is conducted in closed environments such as cabins and space stations. In contrast, closed-loop oxygen rebreathers, which scrub CO2, replenish O2, and recirculate gas, significantly reduce gas requirements and flammability risks. **METHODS:** Our study at the Midland Altitude Chamber Complex (MACC) conducted two exposures consisting of a 60-minute pre-breathe and a 30-minute ascent to 35,000 ft. This pre-pilot study involved two participants, with Participant A using an open circuit system on Day 1 and a closed-circuit re-breather on Day 2, and vice versa for Participant B. **RESULTS:** Heart rate remained within normal limits for both systems. SpO2 stayed above 90% for both participants and equipment types over both days. Venous Gas Emboli (VGE) scores similarly did not show marked inferiority of the CCR. **DISCUSSION:** The findings demonstrate that closed-loop oxygen rebreathers provide significant oxygen savings and operational efficiencies compared to open-loop systems, supporting their use in reducing DCS risk while conserving resources in space operations.

Learning Objectives

1. Understand the physiological challenges and limitations of current pre-breathe and high-altitude oxygen delivery mechanisms.
2. Understand the safety and logistical challenges and limitations of current pre-breathe and high-altitude oxygen delivery mechanisms.
3. Understand the opportunities, advantages, and technical requirements of developing closed circuit rebreather oxygen delivery mechanisms for high-altitude pre-breathe technology.

[239] CEREBRAL PERFUSION AND INFLAMMATORY CYTOKINE EXPRESSION FOLLOWING A SINGLE HYPOBARIC HYPOXIC EXPOSURE IN AIRCREW TRAINEES

Meghan Robinson[1], Monroe Turner[1], Bianca Cerqueira[1], Goldie Boone[3], Holly Chapapas[1], Kelly McKay[1], Pedro Ramos[1], John Sladky[3], Paul Sherman[2]
[1]*KBR, Inc., San Antonio, TX, United States;* [2]*USAF 59th Medical Wing, San Antonio, TX, United States;* [3]*Brooke Army Medical Center, San Antonio, TX, United States*

(Original Research)

INTRODUCTION: The effects of hypobaria and hypoxia on the brain, as encountered in high-altitude flight, are not completely characterized. However, studies of chronic exposures, such as those in U-2 pilots, suggest deleterious effects on the structure and function of the brain. **METHODS:** Air Force pilot trainees were exposed to a single hypoxic hypobaric exposure as part of their training. Prior to, 1 day after, and 3 days after their exposure, participants underwent neuroimaging to measure cerebral perfusion via pseudo-continuous arterial spin labeling (pCASL). Data were processed using AFNI and FSL. 162 subjects contributed scans of sufficient quality for analysis. An additional cohort (n=41) participated in a similar experiment, with additional imaging on days 5 and 7, as well as blood samples on the day before, immediately before and after exposure, and 1, 3, 5, and 7 days after exposure. **RESULTS:** Cerebral perfusion increased on both the 1-day and 3-day imaging sessions. The smaller cohort showed increased perfusion in the same regions, on days 1, 3, 5 and 7 ($p<=0.02$). Changes in S100β from before to after exposure were correlated with cerebral perfusion at all time points ($p = 0.014$ to average). Other markers (NFL, UHL) demonstrated correlations with perfusion at both baseline to post-exposure timepoints, and thus are not clearly associated to hypobaric exposure. **CONCLUSIONS:** Our data suggest that a component of the brain's response to a hypobaric hypoxic exposure is to increase cerebral perfusion. This effect, even in response to a short exposure of a few minutes, was detectible even a week later. Further, increase in S100β, a marker of brain injury, was related to baseline perfusion, suggesting that there may be individualized resistance and vulnerability to hypoxic exposures of high-altitude flight. DISCLAIMERS: The views expressed are those of the authors and do not reflect the official views or policy of the Department of Defense or its Components. The voluntary, full informed consent of the subjects used in this research was obtained as required by 32 CFR 219 and DPDO 3216.06.

Learning Objectives

1. Describe changes in cerebral perfusion related to hypobaric hypoxic exposure.
2. Describe correlations of cerebral perfusion following hypobaric exposure to blood biomarkers associated with neural injury.

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[240] AEROMEDICAL CONSIDERATIONS FOLLOWING DIVING-INDUCED OTIC VERTIGO

Gary Toups, Wiaam Elkhatib
Mayo Clinic Hospital, Rochester, MN, United States

(Education - Case Study)

INTRODUCTION: This case report describes a commercial airline pilot and scuba diver who experienced vertigo with nausea during a series of scuba dives. **BACKGROUND:** Scuba diving carries medical risks such as inner ear barotrauma and inner ear decompression sickness, both diving injuries with different manifestations. Resultant vertigo can cause disorientation and incapacitation for pilots. It is imperative to understand the association between diving, vestibular dysfunction, and aeromedical risk. **CASE PRESENTATION:** The subject was a 51-year-old commercial airline pilot and experienced PADI-certified recreational scuba diver. He had an acute episode of vertigo with nausea following a series of scuba dives over a one-week period. On day one, he dove twice to a maximum depth of 80 ft and total time of 40 minutes. On day two, his initial maximum depth was 112 ft, with another dive after a one-hour surface interval to a maximum depth of 100 ft, both with a 40-minute total dive time. All dives included safety stops and were spent mostly in shallow waters per a wrist-mounted dive computer while breathing air. A single right ear clearing issue was resolved via Valsalva. Given his symptoms and suspicion for decompression sickness, the pilot initially underwent recompression chamber therapy (U.S. Navy treatment table 6) without improvement. He subsequently was hospitalized for further workup. Otolaryngology consultants suspected diving-induced right inner ear barotrauma and provided three doses of IV dexamethasone. Symptoms improved. Brain MRI showed nominal internal auditory canals. Outpatient follow up one month later revealed 65% caloric weakness. Three months later, a 42% reduced right vestibular response, slight balance issues, plus mild high-frequency sensorineural hearing loss further suggested vestibular hypofunction following inner ear barotrauma. Comprehensive aeromedical evaluation was required before pursuing pilot medical recertification. **DISCUSSION:** This case highlights the differential diagnosis and aeromedical considerations for vestibular symptoms following scuba diving before resuming flight duties. Specifically, inner ear barotrauma versus inner ear decompression sickness must be distinguished given their vastly different implications towards prognosis and aeromedical recertification. This case highlights the relative dangers of these conditions and their application towards civilian operations.

Learning Objectives

1. Inner ear barotrauma versus inner ear decompression sickness can be distinguished based on clinical presentation and diagnostic evaluation.
2. Scuba diving can be associated with vertigo, a potentially dangerous aeromedical condition.

Wednesday, 06/04/2025 ***10:30 AM***
Regency V

[S-44] PANEL: ASSESSMENT OF PILOTS' SITUATION AWARENESS USING NON-OBTRUSIVE AND REAL-TIME MEASURES

Chair: Torin Clark
Co-Chair: Annemarie Landman

Panel Overview: *Situation awareness (SA) refers to the pilot's understanding of "what is going on", and depends on his or her ability to obtain and integrate relevant information. With the transition to a next-generation air force, SA gains interest, because modern weapon systems are being equipped with advanced sensor technologies and datalink capabilities that are meant to improve the pilots' SA. The assessment of pilot SA can be an important part of the evaluation of new flight deck equipment and procedures. If SA can be measured in real-time, this can even be used for automatic mitigation methods of poor SA. Recent advances in simulator technology offer novel ways of assessing pilots' SA non-obtrusively or in real-time. Using flight data, eye-tracking, and other physiological measures, in combination with known requirements within certain tasks, a pilot's SA can be measured without interrupting the task and without the requirement of secondary tasks or questionnaires. The current panel offers insights into the development of non-obtrusive SA measures, scenarios and tasks. The presenters will share their research protocols, results, considerations on the approach, and lessons learned. These insights will help the community in moving towards the development of validated and effective non-obtrusive and real-time measures of SA. These measures offer opportunities for evaluating SA accurately and in real-time.*

[241] ASSESSING SITUATIONAL AWARENESS IN FIGHTER PILOTS USING BEHAVIORAL MEASURES IN A SIMULATED INGRESS SCENARIO

Annemarie Landman, Lucia Hendrikse, Matthijs Koedijk, Eric Groen
TNO, Soesterberg, Netherlands

(Original Research)

INTRODUCTION: The assessment of pilots' situational awareness (SA) can be an important part of the evaluation of new flight deck equipment or procedures. With the transition to a next-generation air force, SA assessment gains interest, because modern sensor technology and interfaces are meant to improve the pilots' SA. This study was performed to obtain insight into the quantification of fighter pilots' SA using non-obtrusive behavioral measures and conditions that should induce higher and lower SA. **METHODS:** Fourteen F-16 pilots (all male) performed two ingress scenarios in a fixed-base F-16 simulator with a high-fidelity cockpit and visuals projected on a dome. In a "datalink condition" the Link 16 datalink was active, allowing pilots to detect information on air- and ground threats outside of their immediate vicinity. In a "no-datalink condition", the datalink was inactive, and coordinates of air threats were communicated over the radio. A list of events with according pilot responses reflecting adequate SA was developed with the help of two subject-matter experts (SMEs). One SME observed performance and interviewed pilots after each scenario to complete a checklist on pilot responses to each event. From this checklist, SA-detection and SA-comprehension/projection scores were obtained. Pilot responses were also measured using simulator logging and eye-tracking, and pilots judged their own SA using the MARS and SART questionnaires. **RESULTS:** Preliminary results revealed that the observed SA-comprehension/projection responses were significantly higher in the datalink condition, $p = 0.041$, but SA-detection responses were not, $p = 0.510$. Self-reported SA was also significantly higher in the datalink condition on the MARS, $p < 0.001$, but not on the SART, $p = 0.397$. Reliability checks confirmed that test-retest correlations were acceptable for both observed SA-detection, $r = 0.770$, $p = 0.001$ and SA-comprehension/projection, $r = 0.696$, $p = 0.006$. The observed pilot responses and interviews will be used to validate behavioral measures that are based on simulator logging and eye-tracking. **DISCUSSION:** Our datalink and no-datalink conditions appeared to be effective in inducing measurable high and low SA in the pilots, and this affected their comprehension/projection of events more than their detection. Our set of scenario events and observed responses appeared to be a promising basis for the development of automated digital measures that can be obtained through simulator logging and eye-tracking.

Learning Objectives

1. The participant learns about the impact of Link 16 or similar technology on pilot SA and mental workload.
2. The participant learns about validation methods with regards to behavioral measures of SA.
3. The participant learns about suitable tasks and sample groups for applying behavioral measures of SA.

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[242] SITUATION AWARENESS AND WORKLOAD DISSOCIATION IN A SIMULATED SPACEFLIGHT SUPERVISORY CONTROL TASK

Jordan Dixon[1], Mica Endsley[2], Tristan Endsley[3], David Jamrog[3], Laura Smith-Velazquez[4], Avi Pfeffer[4]
[1]*The Charles Stark Draper Laboratory, Inc., Houston, TX, United States;* [2]*SA Technologies, Gold Canyon, AZ, United States;* [3]*The Charles Stark Draper Laboratory, Inc., Cambridge, MA, United States;* [4]*Charles River Analytics, Cambridge, MA, United States*

(Original Research)

INTRODUCTION: Situation awareness (SA) and workload have both received considerable attention over the past several decades. Little research has investigated the relationship between these two constructs however. The present study examines the relationship between workload and SA in a task involving operation of unmanned vehicles performing solar array inspection task on the International Space Station. **METHODS:** Ten participants were required to navigate between 2 and 6 unmanned vehicles to a series of waypoints, scanning ISS solar panels with two different sensors. They were also required to manually orient each vehicle so that it could collect data. Situation Awareness was measured via the Situation Awareness Global Assessment Technique (SAGAT) six times per scenario; 2 freezes during each 10-min block during which either 2, 4 or 6 vehicles were being controlled. Workload was measured using NASA Task Load Index (NASA-TLX) at the end of each SAGAT stop, and by time to respond to alarms. **DISCUSSION:** Considerable differences in the relationship between SA and workload across individuals were found, with 50% of participants showing an inverse correlation between SA and only one workload measure (subjective or secondary task) and 30% showing no correlation between SA and workload on either measure. Reasons for dissociation across different measures of workload and SA are discussed. The implication of these findings for the use of physiological measures of SA will be discussed, including challenges in determining whether common physiological measures, such as EEG, are assessing SA or workload.

Learning Objectives

1. Participants will learn about methodologies to assess situation awareness.
2. Participants will learn about relationships and dissociations between situation awareness and workload.

[243] BEHAVIORAL MEASURES OF SA AND APPLICATION OF AUTOMATIC MITIGATION OF LOSS OF SA IN A SIMULATED SPACEFLIGHT TASK

Torin Clark, Santiago Huertas, Nicole Rote, Erin Richardson, Jacob Kintz, Allison Hayman
University of Colorado-Boulder, Boulder, CO, United States

(Original Research)

INTRODUCTION: Situation awareness (SA) has traditionally been assessed with questionnaires or freeze probe assessments in laboratory environments. However, in some operational environments such as human spaceflight, it would be beneficial to have less disruptive measures of SA. "Embedded" measures derived from operator behaviors, such as actions, inactions, eye movements, or delays in decision making, may be an accurate way to infer SA. Further, if these measures could be used in real-time to continuously monitor operator SA, it may be possible to automatically trigger changes (such as an autonomous system changing its mode of operation) to mitigate the loss of SA. **METHODS:** Across related experiments, we collected written informed consent in a total of 34 subjects (12F/22M), aged 18-43 (mean: 24) under a protocol approved by the University of Colorado-Boulder IRB. Subjects performed a spaceflight-relevant task in which they monitored and maintained an environmental control and life support system, working with a simulated autonomous system. Intermittently, the simulation would "freeze" and subjects would complete the commonly used but disruptive SA Rating Technique (SART) questionnaire. We developed linear regression models to predict SART reports based upon recent operator behavior measures. **RESULTS:** Behavioral measures were able to predict SART reports (of unseen subjects in model building) accurately with mean absolute errors within about 6 points on the SART scale (~10% of the scale). We found model predictive accuracy was best without incorporating operator background information or eye tracking measures, suggesting these measures led to overfitting. Accuracy was similar whether the autonomous mode varied within trials, across trials or remained constant and across different feature-selection approaches used in model building. As a demonstration, we implemented and evaluated a system in which real-time predictions of SA triggered changes in autonomous modes aimed at mitigating losses in SA (while also maintaining ideal levels of other cognitive states, such as mental workload and trust in the autonomous system). **DISCUSSION:** These findings provide guidance to best practices for utilizing behavioral measures to estimate SA non-disruptively, continuously, and in real-time. Future work should aim to validate predictions against objective measures of SA, rather than subjective reports.

Learning Objectives

1. Participants will learn how behavioral measures may be used to estimate SA in non-disruptively.
2. Participants will learn about methodologies for validating predictions of SA against standard SA measurement approaches.

[244] APPLICATION AND VALIDATION OF PHYSIOLOGICAL MEASURES OF SITUATION AWARENESS IN A GENERALIZED PILOTING TASK

Kieran Smith[1], Jasper Shen[2], Tristan Endsley[3], Torin Clark[2]
[1]*University of Colorado Boulder, Draper Scholar, The Charles Stark Draper Laboratory, Inc., Boulder, CO, United States;* [2]*University of Colorado Boulder, Boulder, CO, United States;* [3]*The Charles Stark Draper Laboratory, Inc., Cambridge, MA, United States*

(Original Research)

INTRODUCTION: Situation awareness (SA) comprises a pilot's ability to 1) perceive, 2) comprehend, and 3) project into the future critical information in their environment. Questionnaire and freeze probe assessments of SA have informed advancements in display design and training protocol; however, these methods are difficult to implement in real tasks due to their disruptive nature. Advancements in sensors have enabled insights into a pilot's cognitive state without adding task load. As part of a broader panel on embedded measures of SA, this work evaluates how nondisruptive physiological and behavioral predictions can complement traditional SA assessments. **METHODS:** We collected written informed consent from 30 participants (16F/14M), aged 20-38 (mean: 25.67), recruited from flyers and emails under a protocol approved by the University of Colorado-Boulder IRB. Participants donned physiological sensors and completed a 24-minute simulation of the Multi-Attribute Task Battery II. The task was intermittently paused for twelve 18-question freeze-probe SA assessments, with six binary questions targeting each SA level (perception, comprehension, projection). SA scores (the sum of correct responses out of six) at each level were adjusted for query difficulty. Total scores were also computed. Physiological signals were synchronized, cleaned, and processed into literature- supported features. Relaxed LASSO regression models selected features and predicted SA scores for each level along a continuum. **RESULTS:** Results show mixed performance. Models predicting level 3 and total SA showed improved predictive accuracy (lower mean absolute errors or MAEs) over models trained with shuffled labels (MAEs of 0.81 and 0.87 compared to MAEs of 1.00 and 0.88 for level 3 and total SA, respectively). Models predicting levels 1 and 2 SA showed no such improvement. **DISCUSSION:** These findings underline the challenges of predicting complex cognitive states like SA from physiological and behavioral signals. Additional work may be needed for these signals to be useful in real-time SA evaluations. Future work will incorporate additional embedded measures and investigate non-linear models for predicting SA scores.

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Learning Objectives
1. Participants will learn about challenges in the joint measurement of SA, physiological, and behavioral signals.
2. Participants will learn about successful and unsuccessful approaches in the predictive modeling of SA.

Wednesday, 06/04/2025 ***10:30 AM***
Regency VII

[S-45] SLIDE : MEASURING PHYSIOLOGICAL STRESS IN THE AVIATION ENVIRONMENT

Chair: Joanna Nelms
Co-Chair: Saha Devankush

[245] CARDIOVASCULAR EFFECTS OF HYPERCAPNIA DURING LOWER BODY NEGATIVE PRESSURE AND HEAD-UP TILT

Karolina Twardowska, Mara Bortnowschi, Rocco Skert, Yi-Hsin Lee, Gerrard Rafferty, Ross Pollock
King's College London, London, United Kingdom

(Original Research)

INTRODUCTION: Exposure to head-to-toe acceleration (Gz) may lead to G-induced loss of consciousness (G-LOC) due to reduced head-level blood pressure and flow. Despite various countermeasures, G-LOC remains a safety concern, causing accidents and fatalities. Inhalation of high concentrations of CO2 (5% and above) can improve G-tolerance but leads to breathlessness, headaches, lethargy, and confusion. This study explores the impact of lower concentrations of CO2 (5% and below) on the cardiovascular system and sex effects. **METHODS:** Twenty healthy volunteers (9 women and 11 men) participated in the study. Subjects were exposed to 2 mins of 80-degree head-up tilt and -60 mmHg of lower body negative pressure. This was repeated while breathing five gas mixtures: 0.04% CO2 (room air), 2%, 3%, 4% and 5% CO2 (each containing 21% O2 and balance nitrogen). Continuous recordings of heart rate and beat-to-beat blood pressure were made from which systolic (SBP), diastolic (DBP), and mean arterial blood pressure (MAP) were calculated, and estimates of cardiac output (CO) and stroke volume (SV) were made. After each session, subjects reported symptoms. **RESULTS:** SBP increased with 5% CO2 (+14.8 mmHg; $p<0.001$) compared to room air in all subjects. 4% CO2 increased SBP, but it was significant only in female participants (+11.8 mmHg; $p=0.043$). There was no effect of 2% and 3% CO2 on SBP. DBP and MAP increased with 5% CO2, while pulse pressure increased with both 4% and 5% CO2 with no significant sex differences. There was no CO2 effect on HR, CO or SV. The severity of breathlessness and difficulty breathing significantly increased while inhaling 5% CO2, while lower concentrations had no effect on symptoms. **DISCUSSION:** Inhalation of 5% CO2 significantly increased blood pressure during combined LBNP and head-up tilt, but the response was reduced with lower concentrations of CO2. The blood pressure response was different between female and male participants, suggesting that women may be more sensitive to CO2 or have a stronger cardiovascular response to hypercapnia. While symptom reporting improved with lower concentrations of CO2, the reduced cardiovascular response indicates they are less likely to improve G-tolerance.

Learning Objectives
1. The results suggest a greater impact of hypercapnia during lower body negative pressure and head-up tilt on women compared to men.
2. Inhalation of 4% carbon dioxide or lower results in minimal side effects, however, the cardiovascular response is also blunted.

[246] WITHDRAWN

[247] CHARACTERIZING THE RISK OF ORTHOSTATIC INTOLERANCE AND COUNTERMEASURE PRESCRIPTION FOR EXPLORATION MISSIONS

Jason Lytle[1], Stuart Lee[1], Annelise Miller[2], Stephanie Melvin[3], Sarah Pickering[2], Cambria O'Grady[2], Matthew Poczatek[3], Sondra Perez[1], Steven Laurie[1], Millennia Young[4], James Pattarini[4], Brandon Macias[4]
[1]*KBR, Houston, TX, United States;* [2]*Aegis Aerospace, Houston, TX, United States;* [3]*JES Tech, Houston, TX, United States;* [4]*NASA, Houston, TX, United States*

(Original Research)

INTRODUCTION: Artemis astronauts returning to the Moon will experience head-to-foot (+Gz) accelerations during the descent to and ascent from the lunar surface. Weightlessness induced cardiovascular deconditioning increases the risk of orthostatic intolerance (OI) during +Gz exposures. Given that females are more susceptible to OI when re-exposed to 1-G, the effect of sex on OI and OI countermeasures (CM) must be considered for these missions. The goals of this study were to assess the effect of sex on OI and the efficacy of the Orion orthostatic intolerance garment (OIG) to protect against OI during exposure to +Gz forces anticipated during Artemis missions. **METHODS:** Thirty-seven healthy participants (19 females, 36.4±8.7 years, 172.8±10.8 cm, 72.7±13.4 kg) participated in this IRB-approved study. Hypovolemia induced with 20mg furosemide was used to simulate plasma volume loss typical of spaceflight. Participants were exposed to three 20-minute head-up tilt tests (HUTTs) simulating 0.50-, 0.75- and 1.00-Gz (randomized order), and on a separate day while wearing a custom-built OIG. Plasma volume, tilt tolerance time, blood pressure, and heart rate were measured throughout. **RESULTS:** Furosemide reduced plasma volume by 10.9 ± 3.5 and 11.4 ± 2.8 % in males and females, respectively. While hypovolemic without the OIG, five males and eleven females became presyncopal during 1.00-Gz HUTT, and three males and nine females became presyncopal during 0.75-Gz HUTT. One male and two females became presyncopal during 0.50-Gz HUTT. Females became presyncopal earlier than males during 0.5, 0.75 and 1-Gz tilts. While hypovolemic and wearing the OIG, all males completed all HUTTs without presyncope, while 2 females became presyncopal at 1.00-Gz, 1 female became presyncopal at 0.75-Gz, and all were able to complete the 0.50-Gz. **CONCLUSION:** Based on these data, some hypovolemic males and females exposed to 0.50-, 0.75- or 1.00-Gz during simulated lunar descent or ascent without the OIG can be expected to develop symptoms of presyncope, without activation of a standing and postural muscles during Artemis missions, with females appearing to be at greater risk. The OIG appears effective in mitigating OI across the range of G-levels expected during descent to and ascent from the lunar surface.

Learning Objectives
1. The audience will be able to describe the orthostatic intolerance risks associated with lunar ascent and descent.
2. The audience will be able to understand sex differences in orthostatic intolerance with and without countermeasures.

[248] ADAPTIVE AUTOMATION AND TASK DEMAND TRANSITIONS: ANALYZING THE IMPACT OF TRANSITION DIRECTION ON PHYSIOLOGICAL AND COGNITIVE WORKLOAD RECOVERY

Jonathan Vogl
U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: Advancements in technology have changed the dynamic of work as it is performed in safety-critical tasks. Today, many systems offer operators the option to ease the burden of complex tasks by offloading subtasks to automation technology. The goal of adaptive automation is to eliminate the need for operators to engage/disengage automation, and instead have automated control of subtasks adapt to the

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needs of the operator in real time. However, each change in automation also creates a task demand transition, which have been shown to elicit unexpected effects on cognitive workload metrics. **METHODS:** A subset of results from a larger study examining task demand transitions is examined to identify task demand change effects on continuous physiological data streams. This study aimed to simulate a task demand transition by means of an automated handoff of task controls, yielding a low-high-low task demand sequence using a single-dual-single task presentation method. This design yields two transition directions, i.e., transitioning from a low demand to high demand, or from a high demand to low demand. Two levels of the variable demand schedule were designed to mimic high and low levels of cognitive demand conditions. Cardiac activity (heart rate and heart rate variability metrics) and pupil diameter (left and right pupil) recovery times (i.e., return to baseline after a transition event) were recorded across these dynamic transitions. **RESULTS:** Results indicate a significant transition direction effect within the physiological data ($p = 0.008$), while overall task demand level did not yield significant differences ($p = 0.583$). Thus, the direction which the demand was being driven was more relevant to the recovery time in the physiological metrics relative to the general cognitive workload level itself. **DISCUSSION:** These results may inform future adaptive automation systems to consider the direction of task demand changes to account for influences in physiological data that may occur as a function of cognitive workload history.

Learning Objectives

1. Dynamic task demand transitions are representative of real-world scenarios and should be tested in laboratory settings as unexpected changes may occur as a function of the direction demand is being driven.
2. Physiological metrics may show unexpected changes during task demand transitions that recover to expected levels over time.

[249] WITHDRAWN

[250] COMPARISON OF OPERATIONAL JET FUEL AND NOISE EXPOSURES: AUDIOLOGICAL TEST RESULTS

David Mattie, Tom Jaworek
U.S. Air Force Aeromedical Research Lab, 711th Human Performance Wing, Kettering, OH, United States

(Original Research)

INTRODUCTION: Flight line personnel are constantly exposed to noise and jet fuel while working on flight lines. Studies suggest jet fuel in combination with noise are more associated with hearing loss than with noise exposure alone. However, no previous research used this study design to examine the combined effects of jet fuel and noise exposures on the hearing of flight line personnel. **METHODS:** Samples were collected from 97 flightline exposed and 71 control volunteers stationed at Japan Air Self-Defense Force Air Bases (Hamamatsu, Matsushima, Hyakuri, Yokota and Iruma) and US Air Force Air Bases (Kadena and Misawa) in Japan. Individual noise levels were measured by wearing a personal sound level monitor and volatile organic chemicals (VOCs) by also wearing a chemical sampling pump during a single shift. Blood samples were collected post shift. Urine samples (entire void) were collected prior to shift (morning first void) and post shift. VOCs were measured in air, blood, and urine. An audiologic test battery, consisting of immittance measurements, audiograms, distortion product otoacoustic emissions (DPOAE) and auditory brain response (ABR) was conducted after shift. **RESULTS:** Total VOCs in personal air samples were in the ppb range for each group compared to permissible limits. Tinnitus and temporary hearing loss were reported in audiological histories but were also present in some controls. Average noise levels on the flight line ranged from 90 to 103 dB which exceeded the 85 dB action level for requiring hearing protection and the 90 dB exposure limit, but all exposed subjects reported wearing hearing protection. Although immittance, DPOAE and ABR tests identified 56 out of 336 significant differences at $p<0.05$ between flight line personnel and control subjects, the results were not consistent across tests and aircraft type. **DISCUSSION:** The limited significant results for the battery of hearing tests still indicated the potential for hearing loss and the continued need for hearing protection. (Disclaimer: No DoD endorsement implied.)

Learning Objectives

1. Participants will learn about exposure levels of noise on the flight line.
2. Participants will learn about an audiological test battery for flight line personnel.
3. Participants will learn about the potential for hearing loss from combined exposure to jet fuel and noise.

Wednesday, 06/04/2025 ***10:30 AM***
Hanover F/G

[S-46] PANEL: RAM GRAND ROUNDS - PANEL II

Chair: Serena Auñón-Chancellor
Co-Chairs: Caleb James, Michael Harrison

Panel Overview: *Residency in Aerospace Medicine - Grand Rounds Panel II*

[251] A CASE OF ASTRONAUT RETURN TO DUTY FOLLOWING EMBOLIC CEREBROVASCULAR ACCIDENT MANAGED WITH PATENT FORAMEN OVALE CLOSURE

Matthew Makowski, Vasilis Mavratsas
UTMB, Galveston, TX, United States

(Education - Case Study)

INTRODUCTION: Presented here is a case of an embolic cerebrovascular accident (CVA) in an astronaut and the subsequent management with patent foramen ovale (PFO) closure prior to aeromedical clearance for spaceflight. **BACKGROUND:** Crewmembers with a history of CVA pose a risk to aircraft and spacecraft operations due to the impacts caused by lingering disability, medication side effects, threat of recurrence, and secondary seizures. Treatable etiologies, such as a PFO amenable to closure, create the possibility for waiver and return to flight duties. **CASE PRESENTATION:** A crewmember with prior spaceflight experience and no pertinent past medical history developed a sudden onset peripheral visual field deficit shortly after returning from a high-elevation terrestrial spaceflight analog experience followed by extensive international air travel. Workup was significant for an occipital thrombotic CVA, seen on magnetic resonance imagining, and an echocardiogram revealing a PFO. The crewmember was initially managed with antiplatelet and anticoagulation therapy and subsequently treated with percutaneous PFO closure. The visual field deficit reached near complete resolution. The crewmember subsequently achieved medical clearance for full terrestrial and spaceflight duties. **DISCUSSION:** Civilian and military regulations outline the steps for aeromedical disposition of crewmembers who have suffered a CVA. This case discussion will review CVA waiver requirements from NASA, FAA, and the United States armed services with an emphasis on PFO closure. Learning Objective #1: The audience will learn the aeromedical risks of embolic cerebrovascular accident.

Learning Objectives

1. The audience will learn the aeromedical risks of embolic cerebrovascular accident.
2. The audience will learn the association between high altitude exposure and the development of venous thromboembolism.
3. The audience will learn the association between high altitude exposure and the development of venous thromboembolism.

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[252] ACUTE URINARY RETENTION IN AN ASTRONAUT, ITS TREATMENT AND AEROMEDICAL DISPOSITION - A HYPOTHETICAL CASE

Andrew Lam[1], Michael Stephens[2], Jeffrey Jones[3]
[1]*UTMB, Galveston, TX, United States;* [2]*Mayo Clinic, Rochester, MN, United States;* [3]*Baylor, Houston, TX, United States*

(Education - Case Study)

INTRODUCTION: This case report describes a hypothetical occurrence of acute urinary retention in spaceflight with consideration of treatment, disposition, and prevention. **BACKGROUND:** Acute urinary retention is an operationally relevant condition documented in-flight in astronauts. Micturition may be impaired by biomechanical, pharmacologic, obstructive, psychosocial, and neurogenic factors, many of which are uniquely affected in spaceflight environments. While onset is most common early in a mission, symptoms can recur throughout flight and even upon return to Earth. Besides physical discomfort and pain, acute urinary retention may cause life- and mission-threatening complications such as urinary tract infection, acute kidney injury, and persistent voiding difficulty from damage to the detrusor muscle (i.e., myogenic bladder). **CASE PRESENTATION:** A 55-year-old male astronaut on his second flight to the International Space Station developed suprapubic pressure. During a private medical conference, he shared that he had not voided since orbital insertion. He denied flank pain and fevers. He had no known history of benign prostatic hyperplasia or urinary obstruction. While on station, he had been given an antiemetic to treat space motion sickness symptoms. The flight surgeon advised intermittent self-catheterization and initiated tamsulosin. A first attempt at catheterization failed due to urethral resistance. A second attempt successfully evacuated the bladder. Prophylactic antibiotics were deferred. Tamsulosin was discontinued 14 days later without further issue. **DISCUSSION:** Management of acute urinary retention in spaceflight entails intermittent or indwelling bladder catheterization, with possible concomitant administration of α-adrenergic antagonists and prophylactic antibiotics. Within the Department of Defense (DoD) and NASA, medical standards for urinary retention dictate that crewmembers with pertinent histories or risk factors must undergo evaluation and applicable intervention for a safe return to flight. Measures such as prophylactic medication or surgery, behavior modification, or preemptive catheter placement may prevent urinary retention or reduce its operational impact. Future research may help quantify risks, clarify pathophysiologic mechanisms, and enhance insight into mitigation strategies for acute urinary retention in space.

Learning Objectives

1. List at least 3 risk factors for urinary retention in spaceflight.
2. List 3 potential treatments for urinary retention in spacefarers.
3. Discuss how acute urinary retention may impact operations in human spaceflight.

[253] SPONTANEOUS PNEUMOTHORAX IN A NAVAL AVIATOR: FAILURE TO DISCLOSE SYMPTOMS

William Roy, Caroline McDowell
U.S. Navy NMOTC Naval Aerospace Medical Institute, Pensacola, FL, United States

(Education - Case Study)

INTRODUCTION: This case report describes a Naval Aviator who failed to report acute onset of right chest pain two days prior to flying a training mission at high altitude that resulted in a near total collapse of the right lung. **BACKGROUND:** A safety of flight issue can rapidly develop while operating a naval strike fighter at high altitudes if the low ambient pressure precipitates an acute exacerbation of a pre-existing medical condition, especially one involving the lung where sudden incapacitation of an aviator in control of an aircraft could result. This case report discusses the aeromedical implications associated with spontaneous pneumothorax and further emphasizes the necessity for all aviators and aircrews to disclose symptoms early and seek evaluation from a flight surgeon prior to flying. **CASE PRESENTATION:** A previously healthy, 33-year-old non-smoker U.S. Naval Aviator presented to the medical department complaining of a two-day history of right chest pain that acutely worsened while operating an F/A-18 Hornet at altitudes above 20,000 ft on a training sortie. The aviator dismissed the pain as musculoskeletal in nature, which he first noticed during heavy weight lifting exercise two days earlier. He did not report the chest pain to a flight surgeon and elected to make his assigned flight. The examination was pertinent for absent breath sounds over the right lung and a CXR confirmed near total collapse of the right lung, consistent with a spontaneous pneumothorax. He was admitted to a local hospital, a right thoracostomy tube was placed, and a wedge resection of the apical segment of his right upper lobe and pleurodesis was performed due to recurrence of the pneumothorax. The patient remained stable and was soon discharged. **DISCUSSION:** This case emphasizes the importance of early reporting of new or worsening symptoms by aviators and aircrews to a flight surgeon prior to flying, as safety of flight should be the first, last, and only concern, ensuring not only their health and safety, but also mission completion. Although pneumothorax is a disqualifying condition a waiver may be obtained if conditions are satisfied.

Learning Objectives

1. The audience will be able to discuss the signs and symptoms of pneumothorax.
2. The audience will be able to discuss pre-existing conditions that increase the risk of developing a spontaneous pneumothorax.
3. The audience will gain a better understanding for the importance of aviators and aircrews disclosing medical issues to a flight surgeon prior to flight and the conditions required for waiver approval for pneumothorax.

[254] PITUITARY APOPLEXY: A RARE COMPLICATION

Brian Jimenez Alicea, Erica Murray
U.S. Army, Fort Novosel, AL, United States

(Education - Case Study)

INTRODUCTION: This case report describes an Active-Duty female flight crew member presenting to the emergency room with worsening headache, ophthalmoplegia, and visual disturbances and found to have pituitary apoplexy. **BACKGROUND:** Pituitary apoplexy (PA) is caused by a sudden hemorrhage or infarction of the pituitary gland and is considered a medical emergency. PA is a rare disease with an incidence and prevalence are 0.17 episodes per 100,000 and 6.2 cases per 100,000 respectively. It is generally associated with non-functioning pituitary neuroendocrine tumors. Though PA can present in several ways, the most alarming is sudden onset of debilitating headache, diplopia, and hypopituitarism involving the hypothalamic axis leading to life-threatening hypotension, coma, and death. Diagnosis is confirmed via imaging study, and surgical decompression is preferred in the setting of severe or progressive impairment of vision and neurologic symptoms and clinical deterioration. **CASE PRESENTATION:** A 49-year-old AD female presented to the emergency room with acute onset of worsening right frontal headache, ophthalmoplegia and photophobia. The patient was previously diagnosed with a pituitary macroadenoma and current on her flight physical with an approved waiver. Neurologic examination revealed diplopia with right orbital superolateral deviation and bitemporal hemianopsia. MRI demonstrated expansion of the tumor, and the patient underwent transsphenoidal resection. Postoperatively her neurologic symptoms improved and on discharge resolved with patient eventually achieving full visual recovery. **DISCUSSION:** Pituitary tumors are waiverable and require routine monitoring and subspecialty consult. Although the risk of pituitary apoplexy in macroadenomas is rare, it is a complication that should remain high on the differential.

Learning Objectives

1. The audience will learn to identify the symptoms, signs, and exam findings of pituitary apoplexy.
2. The audience will review the aeromedical implications of pituitary tumors
3. The audience will understand the pathophysiology of pituitary apoplexy.

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[255] NEUROLOGICAL DECOMPRESSION SICKNESS IN A MILITARY DIVER: A CASE REPORT

Coty Winn, Justin Noble
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Case Study)

INTRODUCTION: This case report describes an unprovoked episode of severe neurological decompression sickness (DCS) in a military diver. **BACKGROUND:** Neurological DCS is believed to result from the formation of nitrogen bubbles within cerebral arteries, causing a temporary space-occupying lesion, which blocks blood flow within the brain and may result in stroke-like effects or seizures. **CASE PRESENTATION:** This patient was a healthy special warfare airman in his mid-20s who presented after an episode of severe neurologic compromise, which occurred on ascent during a routine training dive. His symptoms fully resolved after dive chamber treatment with a standard United States Navy Treatment Table Six. He had no prior history of predisposing conditions. No new conditions were identified during an extensive multi-system evaluation. **DISCUSSION:** Neurological DCS is a potentially fatal condition and carries a risk of permanent sequalae. It may occur with significant decrease in atmospheric pressure, whether underwater or at altitude. Affected patients may have predisposing medical or physical conditions, but DCS may still occur in previously healthy individuals. The mainstay of treatment is decompression in a chamber as soon as possible to reduce the mass effect and subsequent ischemia related to bubble formation. Risk of recurrence is difficult to stratify.

Learning Objectives

1. Increase awareness of neurologic DCS in aeromedical and operational providers.
2. Discuss possible contributing factors to DCS.
3. Foster discussion of DCS and return to flight or special statuses.

[256] TYPE 2 DIABETES, ANXIETY, AND METASTATIC PROSTATE CANCER IN AN AIRMAN WITH A CLASS III MEDICAL CERTIFICATE

Michael Stephens, Clayton Cowl
Mayo Clinic, Rochester, MN, United States

(Education - Case Study)

INTRODUCTION: This report outlines a case of an airman with metastatic prostate cancer, type 2 diabetes mellitus, and a history of anxiety requiring the use of pharmacologic treatment who was granted a Special Issuance Authorization with FAA Class III medical certification. **BACKGROUND:** Managing multiple medical conditions poses unique aeromedical challenges for aviation medical examiners. Each condition may impact physical and cognitive function critical to aviation safety. Hypoglycemia risks, medication side effects and cancer-related fatigue or cognitive impairment may compromise in-flight performance. This case underscores the need for tailored assessment in the certification of pilots with complex medical conditions. **CASE PRESENTATION:** A 70-year-old male requested a Class III medical certificate with a history of anxiety disorder treated with pharmacologic therapy, diabetes requiring hypoglycemic medication, and metastatic, biopsy-proven adenocarcinoma of the prostate (Gleason 4 + 4). MRI and PET/CT imaging demonstrated metastases to the liver, rib, regional lymph nodes and right inferior pubic ramus. Radiation therapy and chemotherapy with docetaxil were initiated while luprolide injections, daily abireterone and prednisone were prescribed for maintenance therapy. Although denied a medical twice previously, his clinical status stabilized. PET/CT imaging and labs demonstrated no evidence of tumor recurrence or additional metastatic spread, there was decreased uptake in prior metastatic sites, and his PSA became undetectable. His diabetes was well-controlled utilizing only metformin (hemoglobin A1c 5.9%). A HIMS psychiatrist determined his past anxiety was likely situational and in remission or due to an adjustment disorder following the death of his daughter. He had not required medication for more than 9 years and demonstrated clinical stability. Incidentally, he was found to have a left-eye cataract that did not affect his tested visual acuity. Ultimately, a Special Issuance was granted by the agency. **DISCUSSION:** This case illustrates the challenging certification process for pilots with multiple medical comorbidities. Despite his medical history, aeromedical certification was ultimately successful due to detailed workup, clinical documentation and communication from the AME to the FAA reviewer. This case provides insight into the complexities of managing chronic illness within aviation safety standards emphasizing individual risk assessment.

Learning Objectives

1. Understand aeromedical certification requirements and evaluation process for airmen with complex medical conditions, including metastatic cancer and diabetes requiring hypoglycemic medications and mental health-related issues.
2. Examine the physiological and cognitive impacts of chronic illnesses and their treatments on flight performance, focusing on the risks of hypoglycemia and cancer-related fatigue in aviation safety and its interaction with mental health conditions.
3. Discuss the ethical and regulatory considerations involved in potentially transitioning from FAA Class III Special Issuance to BasicMed for airmen with progressive health conditions, balancing pilot autonomy with aviation safety standards.

Wednesday, 06/04/2025 ***2:00 PM***
Centennial Ballroom III

[S-47] SLIDE : ABOVE THE NECK

Chair: Tyson Brunstetter
Co-Chair: Karina Marshall-Goebel

[257] REVEALING SANS MECHANISMS: NOVEL MRI TECHNIQUES AND THE GLYHPATIC SYSTEM

Luisa Fernanda Jaimes[1], Adriana Zuluaga[2], Diego M Garcia[3]
[1]*Los Cobos Medical Center, Bogotá, Colombia;* [2]*National University of Colombia, Bogotá, Colombia*

(Education - Program / Process Review)

BACKGROUND: Most spaceflight participants experience Spaceflight-Associated Neuro-ocular Syndrome (SANS) to varying extents. SANS, a priority for NASA's human research roadmap, lacks a terrestrial equivalent, complicating long-duration space mission planning. Suspected SANS mechanisms include cephalad fluid shifts, elevated intracranial pressure, and reduced cerebrospinal fluid (CSF) dynamics, exacerbated by factors like CO_2 levels and sleep disruption. Various neuroimaging techniques have attempted to capture SANS-related changes, yet limitations persist in resolving its underlying mechanisms. We propose novel Magnetic Resonance Imaging (MRI) techniques to advance the understanding and assessment of SANS pathophysiology. **OVERVIEW:** Previous efforts proposed mechanical pressure, edema, metabolic and venous stasis as causal factors for SANS. Emerging theories suggest additional roles for cerebral blood volume pulsatility, vascular remodeling, and glymphatic-lymphatic imbalances. Advanced MRI techniques can target these by visualizing changes in the CSF and perivascular space (PVS). Recent studies highlight PVS enlargement in astronauts, likely linked to fluid shifts and CSF flow alterations. MRI could therefore elucidate SANS-related cerebral and ocular changes during prolonged spaceflight in an non-invasive fashion.Innovative MRI approaches, including phase-contrast MR imaging, allow quantification of CSF flow dynamics, and cine sequencing enables real-time visualization of ventricular flow related to cardiac cycles. Structural sequences like T1-weighted and T2-weighted turbo spin-echo imaging can indirectly indicate CSF pressure fluctuations (e.g., via the Evans Index), while pontomesencephalic and callosal angles offer insight into pressure-induced changes. Furthermore, 3D segmentation enables precise volumetric analysis to track PVS dilation over time.

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DISCUSSION: This approach holds significant clinical and operational promise by enhancing knowledge on diagnostics, risk factors and informing countermeasures to mitigate SANS risks. Advanced imaging supports cross-service collaboration, aligning space agencies in bolstering astronaut health for deep-space missions and advancing our understanding of human physiology in extreme environments.

Learning Objectives

1. Understand the proposed pathophysiological mechanisms of Spaceflight-Associated Neuro-ocular Syndrome (SANS), including fluid shifts, intracranial pressure variations, and CSF flow dynamics.
2. Identify advanced MRI techniques applicable for assessing changes in the cerebrospinal fluid (CSF) and perivascular space (PVS) as they relate to SANS.
3. Recognize the potential clinical and operational implications of advanced imaging techniques for diagnosing and mitigating SANS in long-duration space missions.

[258] SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS): 2025 CLINICAL OVERVIEW – EYES & VISION

Tyson Brunstetter[1], Sara Mason[2], Suzi Osborne[3], Millennia Young[1], C. Robert Gibson[3], Mary Van Baalen[1], Ann Tsung[3], William Tarver[1]
[1]*NASA JSC, Houston, TX, United States;* [2]*Aegis Aerospace, Inc., Houston, TX, United States;* [3]*KBR, Houston, TX, United States*

(Original Research)

INTRODUCTION: Spaceflight Associated Neuro-ocular Syndrome (SANS) is unique to long duration spaceflight (LDSF), with unclear pathophysiology. Primary signs include optic disc edema (ODE), chorioretinal folds, globe flattening, and hyperopic refractive shifts. It is not yet known what severity and/or duration might lead to acute or permanent impacts to visual performance. This brief provides the latest SANS clinical analyses from an ocular/visual perspective. **METHODS:** Data were obtained from clinical records to compile a SANS clinical update. Areas of interest include: (1) SANS prevalence, (2) SANS across repeat LDSF missions, and (3) surveillance of retinal nerve fiber (RNFL) thickness. **RESULTS:** (1) SANS prevalence during LDSF: Earliest Indication: 71%; Clinically Concerning: 16%; Pathological with Acute Functional Impact: 5%; and Pathological affecting Long-Term Health: 0%. (2) 16 "Repeat Flyers" have flown LDSF followed by a subsequent long/extended-duration spaceflight (LD/EDSF). Of these, 6 were diagnosed with SANS in their first LDSF, while 10 were not diagnosed with SANS. In subsequent LD/EDSF, all 6 previous SANS cases (100%) were diagnosed with SANS, while 9-of-10 previous non-SANS cases (90%) were not diagnosed with SANS. A SANS/non-SANS diagnosis from prior LDSF was highly predictive of diagnosis in subsequent missions (Fischer's exact test, $p = 0.0009$), with 100% sensitivity, 85.7% specificity. SANS ODE metrics were similar across missions for individuals ($n = 5$; $r = 0.94$, $p = 0.0002$), regardless of SANS status. (3) A small group of SANS cases ($n = 6$) having >7 years of post-flight RNFL data revealed no clinically concerning decreases in RNFL thickness. **DISCUSSION:** (1) Overall SANS prevalence remains stable (~70%), with a subset (<20%) being diagnosed with clinically significant SANS. (2) Previous LDSF SANS cases are highly likely to be diagnosed with SANS in future LDSF at a similar ODE severity. Crewmembers not diagnosed with SANS during a previous LDSF are substantially less likely to be diagnosed with SANS in future LDSF missions. (3) A risk of SANS ODE is permanent loss of RNFL thickness (vs. pre-flight), leading to permanent visual defects. Preliminary results suggest no clinically concerning loss of RNFL tissue over time in a small population of early SANS cases.

Learning Objectives

1. Understand the pattern of Spaceflight Associated Neuro-ocular Syndrome (SANS) across subsequent long-duration spaceflight, in both SANS cases and non-SANS cases.
2. Understand the potential risk of SANS optic disc edema on the retinal nerve fiber layer and an astronaut's visual performance.

[259] CARDIOVASCULAR AND OCULAR GRAVITATIONAL DOSE-RESPONSES DURING GRADED TILT AFTER HYPOVOLEMIA: PRELIMINARY RESULTS

Adrien Robin[1], Syeda Yasmin Zaman[1], Cort Reinarz[1], Kami Lawson[1], Jason McKnight[1], Nastassia Navasiolava[2], Marc-Antoine Custaud[2], Lisa Haddad[1], David Zawieja[1], Ana Diaz-Artiles[1]
[1]*Texas A&M University, College Station, TX, United States;* [2]*University of Angers, MITOVASC, Angers, France*

(Original Research)

INTRODUCTION: Microgravity exposure leads to a chronic upward fluid shift and induces a state of relative hypovolemia. It is suggested that the factors that redistribute fluid play roles in the pathogenesis of spaceflight-associated neuro-ocular syndrome (SANS), stagnant or retrograde blood flow in the internal jugular vein (IJV), and increased risk of venous thrombosis. This research effort proposes to characterize cardiovascular and ocular responses to varying tilt angles in deconditioned participants (16M/16F), either by drug-induced acute hypovolemia or by 48h 6° head-down bed rest in a cross-over design. **METHODS:** In the present work, we discuss the results from 6 participants (5M/1F) from the drug-induced hypovolemia arm of the study (40mg oral furosemide diuretic to induce hypovolemia). Before and 3 hours after ingestion of furosemide, subjects are exposed to a graded tilt protocol (from 45° head-down tilt to 45° head-up tilt, in 15° increments) to generate gravitational dose-response curves. Measurements at each tilt angle include segmental bioimpedance, central hemodynamics, NIRS calf and regional cerebral blood flow, IJV cross-sectional area and pressure, and intraocular pressure (IOP). **RESULTS:** The diuretic protocol led to an acute hypovolemia 3h post treatment (–16±3% in plasma volume, $n=6$, $p = 0.001$). This induced decreases in stroke volume and cardiac output (both $p < 0.001$) and an increase in heart rate ($p < 0.001$). We also observed a non-linear gravitational dependence of the total blood flow in the forehead, IOP, and IJV cross-sectional area, with a global decrease in IOP during hypovolemia ($p = 0.003$). **DISCUSSION:** After 3h post diuretic ingestion, we observe a hypovolemia state, representing spaceflight conditions. Hypovolemia is considered one of the main factors contributing to cardiovascular deconditioning when returning to an Earth-like gravity. At the end of the study, we aim to provide an integrative framework for cardiovascular and ocular responses to acute fluid shift before and after deconditioning, constituting a ground model representing spaceflight induced changes. ACKNOWLEDGEMENTS: This work is supported by the Translational Research Institute for Space Health through Cooperative Agreement NNX16AO69A. This work is also partially supported by the NASA Human Research Program (Grant number 80NSSC20K1521), the College of Medicine at TX A&M University, and the College of Nursing at TX A&M University.

Learning Objectives

1. The audience will learn about the gravitational dose responses curves of cardiovascular and ocular variables related to gravity level.
2. Dehydration causes increases in heart rate, and decreases in stroke volume, cardiac output, and intraocular pressure.

[260] FROM SPACE TO EARTH HEAD-UP TILT SLEEPING LOWERS INTRAOCULAR PRESSURE IN PATIENTS WITH GLAUCOMA

Claudia Stern[1], Alexander Haendel[2], Doris Mittelstaedt[3], Steffen Stupp[3], Alexandra Noppe[3], Freia Paulke[3], Marie-Therese Scmitz[4], Scott Ritter[3], Claus Cursiefen[2], Jens Jordan[3], Philpp Enders[2]
[1]*German Aerospace Center DLR, Cologne, Germany;* [2]*Medical Faculty and University Hospital of Cologne, Cologne, Germany;* [3]*German Aerospace Center, Cologne, Germany;* [4]*Institute of Medical Biometry, Informatics and Epidemiology, University Hospital Bonn, Bonn, Germany*

(Original Research)

INTRODUCTION: Elevated intraocular pressure (IOP) is crucial for the pathogenesis of glaucoma, a leading cause of blindness worldwide.

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IOP responds to gravity, and astronauts often experience an IOP increase during the initial phase of space missions. The microgravity analogue head-down tilt bedrest also increases IOP, particularly in the first days. We tested the hypothesis that head-up tilting of the whole bed by 10° during the night could reduce intraocular pressure in patients with glaucoma. **METHOD:** In a controlled, prospective study, we recruited 16 patients with difficult to control glaucoma from the patient pool at the Department of Ophthalmology of the University Hospital Cologne. Patients were selected based on their confirmed nocturnal IOP peaks while lying down compared to daytime values (an average increase of >5 mmHg in at least one eye). After obtaining informed consent, the study participants were hospitalized for three days and two nights at the DLR :envihab facility. In a "cross-over" fashion, we assigned patients to two groups: Group A remained in a flat, horizontal position throughout the first night, followed by 10° head-up tilt of the whole body throughout the second night; In group B, nocturnal positions were reversed. We measured IOP, the primary endpoint, at midnight, 3:00 a.m., and 6:00 a.m. using rebound tonometry (ICARE pro). **RESULTS:** The patients, aged between 39 to 77 years with an average of 57.7 years had an equal distribution of sexes. The effect of 10° head-up-tilt position on IOP at 6:00 a.m. was statistically significant and estimated as -0.91 mm Hg (95% confidence interval (CI) [-1.39; -0.42]) compared to the flat position. The between patient variation was 3.91 (95% CI [2.64;-5.79]), the between eye variation was 1.55 (95% CI [1.02; 2.35]) and the residual variation was 1.71 (95% CI [1.54; 1.91]). **CONCLUSION:** Our study demonstrates that sleeping in a 10° head-up tilt position attenuates nocturnal IOP in patients with glaucoma and nocturnal IOP peaks. The finding highlights the importance of gravity in IOP regulation and may have practical applications for ocular health maintenance in astronauts and in patients on Earth.

Learning Objectives

1. The audience will learn about the influcence of differen body positions on intraocular pressure.
2. The audience will learn that head-up tilt can reduce intraocular pressure.

[261] SONO-GRAVITY: SONOGRAPHIC NEEDLE GUIDANCE FOR INTRACRANIAL PRESSURE EVALUATION IN MICROGRAVITY

Francisco Santos, Edson Oliveira
Lisbon School of Medicine - University of Lisbon, Lisbon, Portugal

(Original Research)

INTRODUCTION: Spaceflight-Associated Neuro-Ocular Syndrome (SANS) is a significant health risk for astronauts on long-duration spaceflights, potentially caused by elevated intracranial pressure (ICP). Current invasive ICP measurement methods are impractical in space, where safety and ease of performance are paramount, while non-invasive methods still need to be validated and offer less reliability. **METHODS:** We developed and tested a novel invasive lumbar puncture (LP) technique using a Needle Guidance System (NGS) paired with ultrasound and a digital pressure transducer, which is gravity-independent. This study demonstrates that this NGS technique is feasible and easy to perform, even for someone with less medical experience, offering high accuracy rates, and making it a potentially viable method for assessing ICP in microgravity environments. METHODS: Thirty participants (15 males and 15 females), including medical doctors, medical students, and engineering students, were divided into three groups. Participants received minimal training (12 minutes) on both the NGS-assisted and standard LP techniques. Each participant performed five attempts with each technique in a dummy. Metrics such as success rate (successful CSF egress), time to puncture, and subjective evaluations of difficulty and confidence (using the NASA Task Load Index) were recorded. Statistical analysis was conducted using Wilcoxon signed-rank and Mann-Whitney U tests. **RESULTS:** The NGS-assisted technique resulted in significantly higher success rates (80%) compared to the standard LP technique (50%) across all groups ($P < 0.05$). Non-medical participants, including engineering students, performed similarly to medical professionals using the NGS technique (78% vs. 84%, $P = 0.63$), while the standard technique success rate showed a significant difference (28% for engineers vs. 78% for doctors, $P < 0.001$). **DISCUSSION:** The study demonstrates that the NGS technique enhances accuracy and success rates, especially for individuals with no previous LP experience. This suggests the potential for the NGS technique as an ICP measurement method in space environments if we consider that with more training the error rate will certainly decline. Further research is being conducted, applying AI with deep learning algorithms to the technique, and confirming these findings in human subjects and in microgravity conditions.

Learning Objectives

1. Understand how a Needle Guidance System improves the safety and success rate of a lumbar puncture, especially when performed by non-medical personnel.
2. Evaluate the feasibility of invasive intracranial pressure monitoring in space environments using novel medical technologies.
3. Understand the importance of invasive intracranial pressure determination in long-duration spaceflights to the better comprehension of the pathophysiology of Spaceflight-Associated Neuro-Ocular Syndrome.

[262] ASSESSING THE RELATIONSHIP BETWEEN CO2 CONCENTRATIONS AND CONGESTION SYMPTOMS IN MICROGRAVITY

Lorna A. Evans[1], Matthew Makowski[2], Suzi C. Osborne[3], David Alexander[3]
[1]*Mayo Clinic, Jacksonville, FL, United States;* [2]*UTMB, Galveston, TX, United States;* [3]*NASA, Houston, TX, United States*

(Original Research)

INTRODUCTION: The International Space Station (ISS) provides a vital setting for studying the impact of elevated CO2 levels on human health in microgravity. While space adaptation is commonly associated with congestion symptoms, these symptoms can persist in astronauts during long-duration missions, even after the initial redistribution of fluids. Therefore, we aim to investigate the specific relationship between CO2 levels and congestion symptoms. This study seeks to establish that increased CO2 levels aboard the ISS are significantly correlated with the frequency of congestion symptoms experienced by astronauts. **METHODS:** This retrospective analysis included data from various ISS expeditions between 2014 and 2024, involving both male and female crew members. Congestion symptoms and CO2 levels were recorded. CO2 levels from onboard sensors were analyzed as hourly averages and reported as means (SD) for maximum CO2 levels over 7-day periods. A Student's T-test was used to assess CO2 levels between weeks with and without symptoms. The first seven days of spaceflight were excluded to account for space adaptation. **RESULTS:** The analysis of maximum CO2 levels recorded weekly revealed varying effects on congestion symptoms among crew members. In Node 3, with 459 observations, CO2 partial pressure ranged from 1.020 to 5.628 mmHg with a mean of 2.953 mmHg (SD = 0.785). The Lab sensor, which included 349 observations, ranged from 1.196 to 7.174 mmHg with a mean of 2.672 mmHg (SD = 0.784). During weeks in which crew members were symptomatic, the average CO2 level was 2.841 mmHg (SD = 0.639), compared to 2.574 mmHg (SD = 0.842) in asymptomatic members, yielding a significant difference ($p = 0.002$). Columbus 12 showed a highly significant correlation between CO2 levels and congestion symptoms ($p < 0.001$). **DISCUSSION:** This study provides evidence of the relationship between elevated CO2 levels and congestion symptoms in microgravity. Notable variations in the Lab sensor and Columbus 12 data indicate that higher CO2 concentrations may exacerbate these symptoms among astronauts. The consistent findings from these sensors highlight the need for ongoing monitoring

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and management of CO2 levels aboard the ISS. These results are vital for long-duration missions, as CO2 accumulation can cause physiological stress and impair performance. Addressing CO2 management is critical for ensuring astronaut health and mission success.

Learning Objectives

1. Understand the relationship between elevated CO2 levels and congestion symptoms experienced by astronauts in microgravity.
2. Recognize the importance of monitoring CO2 concentrations to improve health management strategies during long-duration space missions.

Wednesday, 06/04/2025 ***2:00 PM***
Centennial Ballroom IV

[S-48] SLIDE : DATA 2 DECISIONS

Chair: Kathleen Samoil
Co-Chair: Stephen VanderArk

[263] STANDARDIZED MULTIDISCIPLINARY RESEARCH OF CREW HEALTH AND PERFORMANCE GENERATES ROBUST EVIDENCE FOR MONITORING AND INFORMED DECISION MAKING

John Hardy, Corey Theriot
NASA HRP Human Health and Performance Contract, Houston, TX, United States

(Education - Program / Process Review)

BACKGROUND: Space medicine professionals face numerous challenges when making critical decisions on how to best manage a crewmember's health and performance often relying on both subject matter expertise and evidence from biomedical research to inform their decisions. However, biomedical research in the space environment is regularly met with several inherent limitations including small sample sizes, disciplinary siloing, and highly variable crew research compliments. To overcome these barriers and address the need for rigorous research data, many space programs have developed multidisciplinary studies with a wider scope of investigation that is reproducible across missions, NASA's Human Research Program's Standard Measures study is an example of such efforts. **OVERVIEW:** The Spaceflight Standard Measures study is an integrated research compliment that monitors spaceflight adaptions across multiple physiological and psychological domains. The study was developed by the Human Research Program in 2017 to monitor high priority human system risks and provide context for concurrent experiments. Each of the six scientific disciplines comprising the study contain a minimal set of previously validated measures that are repeatedly collected throughout all three mission phases. To date, 35 professional astronauts have completed the study, generating a rich dataset of over 100,000 data points. This dataset is accessible to space medicine and research professional for both scientific and clinical inquiries. Results from a linear mixed effect model provides an example of how a longitudinal dataset can be used by researchers and space medicine professionals to inform their decision making. The data of over 30 astronauts was pooled together and an analysis performed on variables of two scientific disciplines: nutritional biochemistry and cellular profile (immunology and virology). The results of the analysis identified differences in how individuals adapt to spaceflight and how crewmember demographics (i.e. age, sex) and mission design (i.e flight duration) affect these responses. **DISCUSSION:** Commentary on the practical application of results from the Spaceflight Standard Measures study for the monitoring of crew health and performance is discussed. Finally, resources on how and where clinicians and research professionals can access standard measures data is provided to further support the space medicine community.

Learning Objectives

1. The participant will be able to identify multiple benefits of a standardized multidisciplinary assessment used to monitor adaptations to spaceflight for space medicine and research professionals.
2. The participant will understand how biomedical research data may be used to improve decisions regarding crew health and performance.
3. The participant understand where and how they can access HRP Standard Measures data to answer their clinical and research questions.

[264] ENHANCING EXPLORATION PLATFORMS AND ANALOG DEFINITION (EXPAND) ESSENTIAL MEASURES PROGRAM FOR COMMERCIAL SPACEFLIGHT

Jimmy Wu[1], Emmanuel Urquieta[2], Eric Bershad[3], Mathias Basner[4], Mark Shelhamer[5], Richard Gibbs[6], Harshavardhan Doddapaneni[6], Aparna Krishnavajhala[6], Adrian Ecker[4], Rihana Bokhari[1], Dorit Donoviel[1]
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(Education - Program / Process Review)

BACKGROUND: With the era of commercial astronaut (CA) missions growing, it is important to collect a standardized suite of medical, research, and environmental data sets across all the various commercial spaceflight missions. This presentation will describe the Enhancing eXploration Platforms and Analog Definition (EXPAND) Essential Measures program and its approach to standardizing the collection of biomedical data and biosamples on these early CA pioneers of commercial spaceflight. **OVERVIEW:** The Translational Research Institute for Space Health (TRISH) has established the EXPAND Essential Measures program to collect a standardized core set of physiological, functional, and environmental data as well as biosamples during the pre-/in-/post-flight phases of a commercial spaceflight mission. TRISH has formed close relationships with the commercial spaceflight providers to enroll their customers in EXPAND Essential Measures. All data and biosamples are managed in a centralized database and repository with an accurate data dictionary and biosample catalog that will be made available to the scientific community for data and biosample requests. TRISH is establishing a Data Privacy and Release Board (DPRB) to review and approve data and biosample requests. **DISCUSSION:** Commercial spaceflight missions create the opportunity to increase the diversity and heterogeneity of humans going into space allowing for a broader understanding of how the human body adapts and adjusts to the hazards of spaceflight. Currently, EXPAND Essential Measures has collected data from three commercial spaceflight missions and nine subjects. Total number of data points collected include 1,450 survey records, 520,022 physiological data points, and 244,882 functional data points. A total of 794 biosamples of various types (e.g. blood, saliva, urine, stool, and body swab) have been collected. EXPAND Essential Measures will enable cross-discipline analysis as well as make the data available to commercial spaceflight stakeholders and scientific community to support the health and safety of human spaceflight.

Learning Objectives

1. The audience will learn about the EXPAND Essential Measures protocol and specific data sets and biosamples that are collected.
2. The audience will learn about the EXPAND Data Privacy and Release Board how the board will serve as the authority in releasing of EXPAND data and biosamples to the scientific community.

[265] THE DEVELOPMENT OF OPERATIONAL MEDICAL STANDARDS AT A COMMERCIAL SPACEFLIGHT COMPANY

Michael Harrison[1], Melinda Hailey[1], Jeffrey McBride[2], Ted Duchesne[1], Todd Huhn[1]
[1]*Axiom Space, Houston, TX, United States;* [2]*UTMB, Galveston, TX, United States*

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(Education - Program / Process Review)

BACKGROUND: Medical standards for commercial spaceflight participants (SFPs) currently are not mandated by any regulatory body. Spaceflight providers may develop proprietary medical certification processes or apply those developed by other agencies such as NASA. We present one company's process to develop and validate a governance structure, medical standards and an associated data archive to inform medical risk assessment and mitigation for short-duration orbital missions. **OVERVIEW:** Medical certification for spaceflight is a multistep process that includes initial medical screening followed by a more comprehensive assessment and evaluation against a set of predefined and objective medical standards to quantify and mitigate risk associated with medical and psychiatric diagnoses. Additional evaluation over the course of mission training provides information related to softer behavioral health considerations such as interpersonal skills, followership and leadership capabilities, and general expeditionary behaviors. The information from the former tools may provide rationale for waivers, follow-up evaluation, or, in extreme cases, disqualification from flight status. Information gathered from the latter is assessed against training milestones and core competencies to influence the training track of the crew as individuals and as a group. One commercial space company has developed and cross-referenced a database of publicly available medical standards from civilian and military resources to create medical standards specifically to support their commercial spaceflight missions and customer base. The database is designed to store medical cases of prospective and flown astronauts while also tracking associated mitigation strategies, in-flight medical events and their associated treatments, and immediate post-flight reconditioning course. **DISCUSSION:** Objective approaches to risk mitigation and medical certification, specific to the population and mission, is required to optimize the safety and success of human spaceflight in the commercial industry. Learning will occur at an exponential rate as the numbers of missions and providers grows in the coming decade. The method adopted by this commercial company allows for frequent and timely modifications to medical standards, influenced by objective data and lessons learned, as customers are evaluated and missions are flown. This iterative approach focuses on safety and provides a method to expand access to spaceflight.

Learning Objectives

1. The audience will learn about the processes in developing and operationalizing a medical standards system specific for the orbital commercial space industry.
2. The participant will gain an understanding of the complexities in risk evaluation and mitigation required to support a population of commercial astronauts flying orbital missions.

[266] EFFECTS OF THE SPACE ENVIRONMENT ON CRITICAL MISSION TASKS: EVALUATING PROCEDURAL PERFORMANCE DURING DEEP SPACE MISSIONS

Dora Babocs[1], Divy Kumar[2], Hyun Yi Woo[3], Rowena Christiansen[4], Krishi Korrapati[5]

[1]*University of Texas Health Science Center at Houston, Houston, TX, United States;* [2]*Northwestern Feinberg School of Medicine, Chicago, IL, United States;* [3]*Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, United States;* [4]*University of Melbourne Medical School, Melbourne, Australia;* [5]*Rosalind Franklin University, Chicago, IL, United States*

(Education - Program / Process Review)

BACKGROUND: Although human factors significantly contribute to mission success, the effects of extended spaceflight on competent procedural performance across long-duration missions has not yet been deeply studied. Exposure to the space environment has a significant impact on all organ systems, especially with longer mission duration. As a result, diverse medical conditions may present, some potentially requiring surgical intervention. This scoping review study will investigate procedural performance in space, with the aim of enhancing surgical and anesthetic safety during long-duration spaceflight. **OVERVIEW:** The NASA Human Research Roadmap (HRR) identifies altered sensorimotor and vestibular functions that can impact critical mission tasks as one of the 23 key spaceflight-associated risks. Particularly for life-saving interventions, performing procedural medicine in space could represent a critical mission task. The study methodology includes using all relevant keywords identified by the team to conduct searches in several major biomedical databases and 'grey' literature, such as NASA databases and Google Scholar, with the results then uploaded to Covidence for processing. **DISCUSSION:** Numerous spaceflight effects on the central nervous system have been noted, including structural and functional alterations, and modifications to adaptive plasticity, particularly in the sensory systems. The sensorimotor, visual, somatosensory, and vestibular networks can all be affected, with altered functional responses to vestibular stimulation after spaceflight. This has implications for transitions between gravitational environments, as do spaceflight-associated cognitive deficits affecting memory, concentration, and task management. Decrements in cognition and reduced tactile feedback and sensation in space may impact on dexterity and fine-motor skills, as well as concentration, decision-making, and effective teamwork during stressful scenarios. Long-term microgravity exposure may affect a surgeon's vision, for instance through development of Spaceflight-Associated Neuro-ocular Syndrome (SANS), and possible radiation-related cataract formation. Alongside the physiological and pathophysiological changes, psychological factors must also be considered. The stress of isolation, a confined environment with limited social interactions, and altered circadian rhythm, with both the duration and quality of sleep being affected, will potentially impact cognitive performance.

Learning Objectives

1. Learners should be able to appreciate the impact of the space environment on various aspects of procedural performance, including physiological, cognitive, and psychological factors. They will gain insights into the challenges proceduralists face during long-duration spaceflight and how these challenges can affect their ability to perform life-saving interventions.
2. The audience will gain insights into how performing anesthetic and surgical procedures could represent a critical mission task, and how this meshes with the key spaceflight-associated risks identified by NASA's Human Research Roadmap.
3. Learners will be able to understand the importance of comprehensive planning to address the unique challenges and considerations for procedural interventions during long-duration spaceflight, including the impact of the space environment on anesthetic and surgical performance, and how teamwork and resource management are key factors in ensuring successful procedural outcomes.

[267] MEDICAL SYSTEM DESIGN FOR A COMMERCIAL SPACE STATION

Carlo Canepa[1], Kenny Chao[2], Molly McCormick[3], Dana Levin[3]

[1]*Baylor College of Medicine, Houston, TX, United States;* [2]*Massachusetts General Hospital, Boston, MA, United States;* [3]*VAST, Long Beach, CA, United States*

(Original Research)

INTRODUCTION: Historically, NASA has used a combination of computational models, subject matter expertise, heuristics, and experience to design spacecraft medical systems. While the goals, population, capabilities, and limitations of commercial space stations differ from previous, government-owned spacecraft, medical care remains a critical part of crew operations. This project adapted NASA's historical approach to the commercial world by using Vast Space's Haven-1 mission as the design reference. **METHODS:** A 40-day reference mission with 2 male and 2 female crew to Vast Space's Haven-1 was used to inform the design. Haven-1 is a single-module station due to launch into low-Earth orbit in 2025. A physician panel with broad expertise and experience first developed a list of likely and/or consequential medical conditions to the mission. The panel then developed a probabilistic risk calculator based on these conditions

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and used clinical and operational experience informed by the results of the risk calculation to identify resource needs and desired quantities, along with mass and volume estimations. The results were compared to custom runs of NASA's PRA tools and published lists of historical spacecraft medical equipment. The final Medical Design Resource List (MDRL) resulted from integrating each of these steps. **RESULTS:** The analysis includes 170 potential medical conditions. Onboard diagnostic and treatment resources were deemed necessary for most of them. 86 unique resources were identified, totaling less than 6 kg of mass and less than 30 L of volume. A comparison of this medical kit to NASA PRA output and published historical spacecraft medical resource data revealed significant overlap. **DISCUSSION:** This process estimated the risk to crew and generated a medical system resource list for a 160-person-day reference mission. The resulting resources were substantially aligned with prior spacecraft medical systems but included a few additional resources commensurate with the medical risks of flying a broader population than historically government-sponsored astronauts. While the effectiveness of this system will need to be validated with in-flight data, this illustrates that previously employed space medical system design methods can be successfully adapted to the commercial environment.

Learning Objectives

1. Historically successful techniques for medical system design can be applied to commercial spaceflight operations.
2. Medical system design must incorporate feedback from engineers, specialist physicians, acute care physicians, preventive medicine physicians, designers, pharmacists, and those with spaceflight experience.

[268] DEVELOPING A CORE COMPETENCY FRAMEWORK FOR INTERNATIONAL AEROSPACE MEDICINE EDUCATION AND TRAINING.

Rowena Christiansen[1], Lisa McNamee[2]
[1]*The University of Melbourne, Melbourne, Australia;* [2]*Trinity College Dublin, Dublin, Ireland*

(Education - Program / Process Review)

BACKGROUND: Current demand for aerospace medicine (AsM) expertise outstrips available trained health professionals internationally, particularly in the capacity to support human spaceflight endeavours. Increasing numbers of commercial spaceflight missions, and a potential paradigm change with future SpaceX 'Starship' high-capacity flights, will only compound this issue. A prior scoping review study by the authors identified thirty-six international AsM education and training (E&T) opportunities currently offered annually, including a small number of board certification-level physician residencies, and some Masters degree programs, as well as short courses. The newly established OSMED organization supports a growing international consensus that AsM E&T can be expanded through collaboration and agreement on core competencies to be attained. **OVERVIEW:** This project aims to identify the core competencies required by existing professional AsM E&T programs and recognised industry standards, such as those published recently by the Potomac Institute, and to leverage these to develop an internationally accessible AsM E&T program that can supplement the current limited 'gold-standard' residency opportunities. Achievement of final competency, and subsequent accreditation to a standard accepted by industry, would potentially create opportunities for international health professionals to participate in supporting human spaceflight missions globally. Such a program could not be successfully developed without international cooperation and collaboration, and the support of existing providers and industry. **DISCUSSION:** Common core competencies from existing programs and published standards include: clinical expertise and skills in emergency, preventative, and occupational medicine; knowledge of the aerospace environment and risks; professional communication and teamwork skills; and operational skills and knowledge. Collating a core competency framework based on existing AsM E&T would facilitate the development of a modular program that could be progressively rolled out and delivered as the underlying infrastructure and support was put in place. However, it is envisaged that a wider consultation of leaders from aerospace and space medicine, and aerospace engineering and design, would provide useful input towards developing an international AsM core competencies framework that will best equip health professionals to meet future needs in a manner that is recognized by industry.

Learning Objectives

1. Participants will learn about existing international aerospace medicine education and training opportunities.
2. Participants will appreciate that recognition of competency to participate in supporting human spaceflight missions is based on a tripartite structure of education, training, and accreditation.
3. The audience will recognise that, while a number of common core competencies can be identified, programs and published standards will differ in some aspects of the components of education and training.

Wednesday, 06/04/2025 ***2:00 PM***
Regency V

[S-49] PANEL: OCCURRENCES OF SPATIAL DISORIENTATION IN MILITARY PILOTS

Chair: Eric Groen
Co-Chair: Tracy Grimshaw

Panel Overview: *Spatial disorientation (SD) is a situation where a pilot's perception of the aircraft motion or orientation is incorrect. SD remains a significant safety risk in flight, hence it is important to understand the conditions that may lead to SD. Likewise, it is important to understand how different manifestations of SD depend on the aircraft type and the operational concept. This knowledge can be used, for example, to update SD training programs so that pilots can learn to cope with SD conditions that are representative of their current operations. In this panel, researchers from the UK will share results from SD surveys held among their military pilots. One presentation will review the latest survey results; another presentation will provide insight in trend analysis based on the SD database; and a third presentation will explain pilot experiences with dissociative types of SD, such as the Giant hand phenomenon.*
One typical result of the SD survey was that fighter pilots regularly experience a sensation of the Leans during air-to-air refueling in low-visibility conditions. Apparently, the contour of the tanker aircraft can be perceived as a false horizon. This observation inspired an exploratory study on the possibility to induce the Leans during air-to-air refueling in a fixed-base simulator. The results of this study will be addressed in the fourth presentation. A fifth and final presentation will discuss episodes of overwhelming SD where the pilot is unable to make a properly coordinated response.

[269] UNDERSTANDING THE FACTORS CONTRIBUTING TO SPATIAL DISORIENTATION IN UK MILITARY AVIATION: ANALYSIS OF INCIDENTS 2021- 2024

Tracy Grimshaw[1], Jonathan Boyd[1], Alaistair Bushby[2]
[1]*QinetiQ LTD, Farnborough, Hampshire, United Kingdom;* [2]*RAF CAM, Henlow, United Kingdom*

(Original Research)

INTRODUCTION: The UK Disorientation Incident Survey (DIS) has collected anonymous military aircrew reports of spatial disorientation since 2004, to understand the factors that are associated with disorientation. The aim of the latest survey was to collect incidents occurring from January 2021 to March 2024. **METHODS:** The DIS asks aircrew to describe occasions in flight when they either became confused about their aircraft position, motion or attitude or they suddenly realised that the position, motion or attitude of their aircraft

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had changed. Aircrew also rated the risk to flight safety of each incident. Independently, spatial disorientation (SD) experts analysed the incident descriptions to establish the factors that contributed to the incident and to determine whether the SD was recognised (the aircraft had not significantly departed from its intended attitude or position) or unrecognised (the aircraft had significantly departed from its intended attitude or position). **RESULTS:** There were 656 responses to the survey, of which 81 involved SD incidents; 47 rotary-wing, 25 fast-jet, and 9 multi-engine. For fast-jet, the majority of SD incidents took place during the day (88%), with many featuring associated with clouds (60%), formation flying or air-to-air refuelling (72%). Fifty-six percent experienced the leans. For rotary-wing, incidents occurred during both day (49%) and night (47%) and mainly involved environmental factors e.g. featureless terrain, clouds. For fast-jet and multi-engine aircraft, unrecognised SD was mainly associated with daytime flying and in-cockpit distraction. Unrecognised rotary-wing SD mainly involved environmental factors (e.g. brown-out, low ambient light). Only 4 out of the 81 SD incidents reported through the survey had been reported through official reporting channels. **DISCUSSION:** Results highlight that SD continues to pose a risk to flight safety, yet reporting of SD through official mechanisms is low and therefore does not provide a full understanding of the risks of SD to military aircraft. The incidents collected in the latest survey will be used in training and education for aircrew.

Learning Objectives

1. To understand the number of SD incidents in UK military aircraft 2021-24.
2. To understand the factors contributing to SD between 2021-2024.

[270] TRENDS IN UK MILITARY ROTARY WING SPATIAL DISORIENTATION INCIDENTS SINCE 2004

Jonathon Boyd, Tracy Grimshaw
QinetiQ Ltd, Farnborough, Hampshire, United Kingdom

(Original Research)

INTRODUCTION: Spatial disorientation (SD) continues to present a risk to flight safety for military aircrew. The UK military has surveyed aircrew regarding experience of disorientation seven times between 2004 and 2024. These data have been used to establish common themes and trends associated with the development of disorientation. The database currently holds 709 UK military SD incidents across all UK military air platforms, including the latest survey data from early 2024. The current presentation describes the analysis of 399 RW incidents collected between 2004 and 2024. **METHODS:** The data were analysed to determine 1) factors contributing to SD (e.g. manoeuvring, environmental, pilot, aircraft factors), 2) how these related to the risk to flight safety (minor, significant or severe) as judged by aircrew and, 3) whether the SD was recognised (the aircraft had not significantly departed from its intended attitude or position) or unrecognised (the aircraft had significantly departed from its intended attitude or position), as judged by SD subject matter experts. Logistic regression analysis was conducted to infer which incident factors were associated with risk to flight safety and SD recognition. **RESULTS:** The number of RW incidents reported has remained constant since 2012, with some variations in platform types. The most prevalent factors involved with incidents were flying at night (57%) and use of night vision devices (NVD) (38%). Generally, unrecognised incidents involved brown-out/whiteout and pilot factors including in-cockpit distraction. Drifting, low ambient light wearing NVD, brownout/whiteout and landing were involved with a high proportion of significant/severe incidents. The majority of unrecognised SD incidents were associated with a significant risk to flight safety. **DISCUSSION:** The database represents a unique record of UK military SD incidents over a 20 year period, with results reflecting changes in operational focus and aircraft. Results have been used to inform SD education and training and these latest results will be used to understand key factors involved in SD risks to flight safety.

Learning Objectives

1. To understand trends in rotary wing spatial disorientation over a 20 year period.
2. To understand the factors featured in unrecognised disorientation in rotary wing aircraft.

[271] A SURVEY OF AVIATION DISSOCIATIVE PHENOMENA AMONGST UK MILITARY AIRCREW

Vanesa Garnelo-Rey[1], Tracy Grimshaw[2], Jonathan Boyd[2]
[1]*RAF CAM, Bedfordshire, United Kingdom;* [2]*QinetiQ LTD, Farnborough, United Kingdom*

(Original Research)

INTRODUCTION: For many years, aviation dissociative phenomena known as "break-off", "giant-hand" and "knife edge", were thought to be largely experienced by fast jet pilots flying high altitude transits. However, anecdotal evidence suggested these phenomena are experienced by a wider variety of aircrew and not just at high altitude. A survey of the prevalence of these phenomena was undertaken to understand the incidence across UK aircrew. **METHODS:** The UK Disorientation Incident Survey has been undertaken by the MOD since 2004. The latest survey included additional questions in order to capture across-career aircrew experiences of aviation dissociative phenomena. Aircrew were provided with a description ("usually known as "break-off", a "giant hand" controlling the aircraft or a feeling that the aircraft is finely balanced as if on a "knife edge" from which it might fall asked to describe any incident") and asked to describe in their own words any incidents that fitted that description. The survey was sent to serving military aircrew between January and April 2024. **RESULTS:** Six hundred and seventy-six survey responses were received in total. Of these, 26 reported experiences that matched the definition of aviation dissociative phenomena. Twenty-two occurrences were reported by pilots and four by other aircrew. Sixteen occurred in fast jet, seven in rotary wing, two in multi-engine aircraft, and one in a light training aircraft. Eighteen reports were identified as "break-off" episodes, seven as "knife-edge" and one as "giant-hand". No links were found to sortie profile or environmental condition (e.g. day, night. Episodes were reported over a wide range of altitudes. Eighteen reports described sensory constancy (the sensation of "nothing happening"). Fatigue was cited in only seven of the episodes. In nine reports, aircrew considered flight safety as severely compromised, for the remainder, the episodes were considered minor. Only one episode was reported through an official reporting channel. **DISCUSSION:** These results challenge previous assumptions that these phenomena are exclusive of fast jet aircrew flying high altitude transits and in low arousal states; survey results found that although predominant in pilots, other aircrew are also susceptible, and almost a third of the episodes were not in a low arousal state. Flight safety can be severely compromised but the lack of formal reporting poses an important challenge.

Learning Objectives

1. These survey results aid in understanding the nature of aviation dissociative phenomena moving away from specific platforms, altitudes, conditions, and aircrew roles.
2. Raising awareness and education can help promote formal reporting.

[272] ATTEMPT TO INDUCE THE LEANS DURING AIR-TO-AIR REFUELING IN A FIXED-BASE FLIGHT SIMULATOR

Eric Groen
TNO, Soesterberg, Netherlands

(Original Research)

INTRODUCTION: A fighter pilot of the Royal Netherlands Air Force experienced a serious incidence of the Leans when flying close to a tanker aircraft in poor visibility. According to a recent survey on spatial disorientation (this panel), military pilots in the UK also reported to have sensed the Leans during air-to-air refueling (AAR), often because the tanker aircraft is perceived as a 'false horizon'. In this case study

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we explore the possibility to induce the Leans during AAR in a fixed-base flight simulator. **METHODS:** A military test pilot performed AAR formation flights in a fixed-base mock-up inside a Dome projection system. Each flight started and ended with straight and level flight, and contained a turn of either 10 or 30 deg angle of bank (left or right). Roll rate was varied between 5.7 deg/s (0.1 rad/s), 2.9 deg/s (0.05 rad/s), 0.57 deg/s (0.01 rad/s), and 0.2 deg/s (0.003 rad/s). The pilot was asked to comment on any maneuvering, disorientation or Leans sensations. The flight took place 'in the weather' and without the head-up-display (but with cockpit instruments). Two formation positions were tested: 'on the wing', which is about 30m from the tanker fuselage, and about 3m outside and behind the wing tip; and 'pre-contact' position, which is approximately 5m after, and slightly below, the tanker aircraft. **RESULTS:** At the highest roll rate (5.7 deg/s) the turn was easily detected, at 2.9 deg/s and 0.57 deg/s it was not always, or seldomly noticed, respectively; and at 0.2 deg/s the turn was never noticed. Turns were more difficult to detect in the 'pre-contact' position compared to 'on-the-wing'. Furthermore, turns of 30 deg angle of bank were more disorienting for the pilot, although he never experienced a 'bodily' sensation of the Leans. **DISCUSSION:** This study shows that it was possible to disorient the test pilot during an AAR scenario in a fixed-base flight simulator, although it did not induce true 'bodily' Leans. The most effective scenario was in pre-contact position, with turns of 30 deg angle of bank and roll rates below 0.57 deg/s. The results suggest that it can be useful to include an AAR scenario in a ground-based spatial awareness course, and further research on this topic will be conducted.

Learning Objectives

1. Participants will learn that fighter pilots may experience the Leans during air-to-air refueling.
2. Participants learn that it is difficult to induce a true sensation of the Leans in a fixed-base flight simulator.

[273] TYPE III SPATIAL DISORIENTATION: OVERWHELMING OR INCAPACITATING?

Angus Rupert
U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: Spatial disorientation (SD) has sometimes been categorized into three types: Type I disorientation in which the pilot does not recognize they are disoriented until impact with the ground; Type II disorientation in which the pilot recognizes he/she is disoriented and is attempting to recover and lastly Type III in which the pilot is unable to recover either because they are totally incapacitated or the disorientation is so overwhelming they are unable to respond correctly. Within Type III the mechanisms of overwhelming disorientation differ from those of incapacitating disorientation and need to be differentiated since the approach to solving the two different Type III mechanisms must be tailored to the causal factors. **METHODS:** Several examples of Type III disorientation were culled from pilot testimonials to select two examples of Type III disorientation that fit into the category of overwhelming disorientation and two examples of the category of incapacitating disorientation in which the pilot is physically unable to make a properly coordinated response. **DISCUSSION:** When examined from the perspective of sensory inputs and motor responses these examples suggest solutions to prevention of both categories of Type III SD. During incapacitating SD in which vestibular reflex responses prevent the pilot from making correct inputs automation is the best solution. With overwhelming disorientation in which the pilot can still manipulate the controls but is unable to provide the correct response despite the availability of correct information due to the strength or salience of the perception, then prevention via multisensory cueing is likely the best approach. Although some may argue Type III disorientation is simply a sub category of Type II the differing mechanisms of the subtypes of Type III SD warrant a separate categorization.

Learning Objectives

1. Demonstrate an understanding that Type III Spatial Disorientation has more than one sensory etiology with differing solutions to address different causation factors.
2. Describe both sensory and mechanical solutions to Type III SD.

Wednesday, 06/04/2025 ***2:00 PM***
Regency VII

[S-50] PANEL: SYNERGY OF MULTIDISCIPLINARY COLLABORATION: PRINCIPLES & PRACTICES OF MARY F FOLEY

Chair: Marian B. Sides
Co-Chairs: J. Karen Klingenberger, Nora Johnson

Panel Overview: *This panel is the fourth educational event of the Mary F Foley Endowment. The collaborative panel will portray the principles and practices of Mary Foley, and will demonstrate how diverse skill sets from various disciplines can synergistically strengthen service outcomes and team performance. In 1955, Mary "Bunny" Foley R.N. became interested in the air transport of invalids. She traveled the world, meeting with airline medical directors, and surveying the handling of patients. She published "Air Travel for Patients," that established early standards for air travel. In 1958 she joined the United States Air Force and became a flight nurse. In 1960 she joined the research team at OH State University's Aviation Medicine Research Laboratory. During her career she conducted groundbreaking research on the effects of weightlessness and long-term acceleration on the human body. As a scientist and test subject, she flew in zero-gravity parabolas and operated the human centrifuge to understand G-force limits for pilots and the effects of weightlessness on pulmonary function and lung capacity. She studied the stress reduction benefits of head cooling helmets for F-16 fighter pilots and made advances in occupational medicine. As a past president and pioneer member of the Aerospace Physiology Society, Mary Foley was among the first class of physiologists to be granted Board certification in Aerospace Physiology, in 1977. Foley was a Fellow of the Aerospace Medical Association, AsMA, a pilot and a member of the International Association of Women Pilots. In the spirit of Mary Foley's legacy, the panel consisting of advance practice experts from five disciplines, will present and describe their supportive roles. Disciplines that form the team include Aerospace Physiology, Physical Therapy, Pharmaceutical Services, Occupational Health Nursing and Human Factors. Representatives will describe synergistic benefits that evolve from collaborative efforts related to effective communication, best practices, safety, innovation, skill expansion, adaptability, cooperation, mutual respect, team spirit, and more. Discussion will embellish awareness of the synergistic benefits. This event will offer illuminating insights, inspiration, mentoring, and leadership development for AsMA members.*

[274] MARY FOLEY - CUTTING EDGE APPLIED RESEARCH IN AEROSPACE PHYSIOLOGY

Lloyd Tripp
LDT-Consulting, Mount Holly, NC, United States

(Education - Program / Process Review)

BACKGROUND: The Aerospace air and ground environments are not without hazards to aircrew and groundcrew alike. Mary Foley recognized these issues early on and focused on lung function in fighter pilots and the mitigation of thermal loads in aircrew and groundcrews during pre-flight and flightline operations. **OVERVIEW:** Working with the 906 TFG Wright-Patterson AFB., Mary performed pre- and postflight pulmonary function tests on F-4 pilots. Her study examined the effects of high-G on pilot lung function. Although the pulmonary function study was unpublished the approach of having aircrew participate in a research study was a giant step forward for operational aerospace

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physiology research. Mary's research interests also focused on the mitigation of thermal load related to environmental exposures. Working with industry, she introduced the re-freezable cooling headpiece (CHP) which provided head cooling during physical workload in hot environments. **DISCUSSION:** An assessment of the CHP looked at end-user comfort during physical work, in actual and simulated environments. Testing was conducted at Wright-Patterson and Brooks AFB. Her unpublished results showed CHP provided significant relief from thermal burden. Researchers at the U.S. Army Research Institute of Environmental Medicine (USARIEM) were interested in the CHP to mitigate heat load on soldiers. A collaborative study was conducted at USARIEM's climatic chamber exposing participants to 104-degree F. while exercising on a bicycle ergometer. Results indicated the CHP decreases physiological strain during thermal exposures. Mary saw the thermal burden created by the military's chemical protection suit or MOPP gear and partnered with Wright-State University's Aerospace Medicine Residency Program, to evaluate the efficacy of the CHP with subjects wearing MOPP gear. Participants were exposed to 100.4, 84.2 and 75.2o F. in an environmental chamber and rode a bicycle ergometer. Results revealed a reduction in CHP physiological strain while subjects maintained physical performance. This presentation will discuss how the application of principles in aerospace physiology can mitigate environmental stress on the human body. Mary Foley's collaborations between industry, academia, and military organizations is a model for successful aerospace physiology research programs across the DoD today.

Learning Objectives

1. The audience will gain an understanding of collaborative research across industry, academia and military can drive the development of a product to mitigate the adverse physiological effects of thermal loading.
2. The audience will learn about pertinent research that supports the underlying issues associated with thermal exposure.
3. The audience will be able to identify opportunities to improve upon the technologies described and the possibilities for future products.

[275] MARY F. FOLEY- FOUNDATIONAL MEDICAL CONSIDERATIONS AND PRINCIPLES OF PHYSICAL THERAPY FOR FLIGHT

Clint Copeland
U.S. Air Force, Yorktown, VA, United States

(Education - Program / Process Review)

BACKGROUND: As early as the 1970s, approximately 500 million passengers participated in air travel annually. Mary Foley was responsible for publishing the first formalized medical recommendations for air travel in 1973, setting baseline expectations for conditions spanning several major body systems. For many years afterwards, her work served as the sole resource describing medical considerations for commercial flight as a passenger. **OVERVIEW:** Mary's dedication to medical safety set the stage for deeper research on the physiological stresses of flight and enabled several efforts to better define and address risk factors for the execution of physical therapy solutions to provide the best care possible. Her work conveys a clear desire to minimize patient risk and to provide the best care possible. In line with this effort, she was an avid supporter of interdisciplinary care and strongly believed that the most effective way to address medical issues was for care teams to work collaboratively toward patient goals. **DISCUSSION:** The recommendations made by Foley in the 1970's have evolved to numerous flight guidelines spanning passenger, patient, and aircrew roles. A more robust form of these recommendations known as aviator medical standards now exist within the Federal Aviation Administration(FAA) and Department of Defense (DoD). These modern standards establish physiological minimums for initial flight qualification and return to flight duties following a physically limiting injury or pathology. In line with Mary's hopes, medical standard guidelines have fostered a greater sense of collaboration within interdisciplinary teams, by uniting practitioners across multiple disciplines toward a well defined goal. This presentation will discuss the benefits of Mary F Foley's work by highlighting how her initial recommendations laid the framework for modern day resources. Furthermore it will explain the role of physical therapy principles in aerospace medicine and will describe how the practice of physical therapy embodies Mary F Foley's legacy of interdisciplinary collaboration in the evolution of best practices in standards of care for quality outcomes.

Learning Objectives

1. The audience will gain an understanding of recommendations outlined in Mary Foley's 1973 publication Air Travel for Patients.
2. The audience will learn about modern day medical aviation standards made possible by Mary Foley's work.
3. The audience will understand the role of physical therapy in interdisciplinary care as it relates to maximizing outcomes relevant to the aerospace realm.

[276] OCCUPATIONAL NURSING PRACTICE IN AEROSPACE NURSING WITH APPLICATIONS FROM MARY F FOLEY

Cathy Dibiase
InoMedic Health Applications, Kennedy Space Center, Titusville, FL, United States

(Education - Program / Process Review)

BACKGROUND: Keeping the worker safe whether on the ground, in the air or in space, can be a difficult task. To inform our practice and to provide the best care to our patients we can look to the foundations laid by Mary Foley as she was a nursing trailblazer. **OVERVIEW:** Current practice guidelines in place today were built upon Mary's research work. As a nurse she became insightful to the challenges pilots and aircrew as well as passengers were facing after traveling for several months and seeing the issues firsthand. Her work with pulmonary function testing research was multidisciplinary and the research subjects multiracial. **DISCUSSION:** Worker and patient safety along with prevention through surveillance were some of the occupational nursing principals that Mary employed in her research. She understood that occupational exposures may not only allow the worker to not make it home whole each night, but that long term conditions and disease progression could be halted or lessened. Mary laid the foundation for lay person air travel in her original work and publication that outlined who should fly and contraindications for certain conditions. In this work, Mary outlines common flying effects and conditions that would be affected. Mary understood the importance of patient engagement and education to inspire change. Her work with the Heart Association helped show the correlation of uncontrolled hypertension as well as the long-term smoking effects on pulmonary and cardiovascular systems. My discussion of these principals will benefit the session attendee by increasing their knowledge of how all members of a team can contribute and work toward a common goal.

Learning Objectives

1. Attendees will be able to list at least three conditions from Mary's air travel paper that were contraindicated.
2. Audience will be able to cite relevant principals of occupational nursing employed by Mary.
3. Learners will identify the impact of education on patient engagement.

[277] PHARMACEUTICALS IN AEROSPACE MEDICINE: A PIECE OF THE WHOLISTIC APPROACH

Emma Ives
UNC Eshelman School of Pharmacy, Durham, NC, United States

(Education - Program / Process Review)

BACKGROUND: Pharmaceuticals have been a part of aviation since the earliest days of human flight. Their impacts on safety and performance have been extensively covered in the literature. This presentation will explain the historical role of pharmacy in aerospace medicine and describe how the practice embodies Mary F Foley's legacy of interdisciplinary collaboration in the advancement of the field. **OVERVIEW:** Pharmacy has been

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involved with human pursuit of flight since its inception. During World War II, various players in aviation were concerned regarding pilot fatigue, necessitating the need for research into stimulants and their impact on performance. The FAA recognized the hazards related to pharmaceuticals in commercial pilots and published their first guide in 1962 to assist medical examiners in evaluation of pilot duties. Similarly, Mary F Foley had the foresight and vision to be engaged in a variety of topics that laid the groundwork on what is now known regarding aerospace physiology. While she did not directly study pharmaceuticals, she utilized an interdisciplinary approach to research evident in her paper "Air Travel For Patients" includes various aspects of patient care during flight, including the importance of medication access. Pharmacy, as a profession, is the most accessible form of patient care. The pharmacist serves as the drug specialist, health insurance expert, and patient care advocate, making them a vital part of the care team. **DISCUSSION:** Due to the pharmacist's extensive training, they can assist the care team in navigating the ever changing pharmacy landscape, making health care access easier for patients. Similar to Mary F Foley's legacy, pharmacy touches a variety of aerospace topics and is equipped to support aerospace medicine from a safety and performance perspective to advance the field. The multidisciplinary approach to integrating pharmaceuticals adds a team synergy, exponentially enhancing patient care.

Learning Objectives

1. The audience will gain insight into the historical role of pharmacy in aerospace medicine.
2. The Audience will learn about the role of pharmacy in a health care team.
3. The Audience will be able to identify opportunities for pharmacy to improve accessibility of patient care.

[278] INTERDISCIPLINARY HUMAN FACTORS CHALLENGES IN AIR TRANSPORT OF PATIENTS

Annette Sobel
Texas Tech University, Lubbock, TX, United States

(Education - Program / Process Review)

BACKGROUND: Mary Foley was a sentinel for interdisciplinary issues concerning aeromedical transport of patients. Her careful research identified several essential principles requiring human factors exploration and scientific analysis. **OVERVIEW:** This presentation will highlight the aerospace human factors educational and research advances identified through Mary Foley's work. As a pioneer in interdisciplinary advances, Mary needed to produce measurable human factors effects tied to improved patient outcome. A full taxonomy of research at Air Force Research Lab and other national labs has emerged. **DISCUSSION:** This presentation will discuss human factors issues and demonstrated countermeasures intended for early identification of physiologic stress such as hypoxia, vibration, gravitational forces, noise, hypothermia, circadian desynchrony, to name a few. In addition, specific examples of the human-computer and human-system interfaces needed and evaluated in the process of developing holistic patient care models. Notably, new approaches to sensing and early detection of medical problems and syndromic surveillance within the patient-aeromedical environment will be expounded upon. The emerging role of human-system centered Artificial Intelligence within this complex patient care environment will also be discussed. The audience will gain an understanding of the complex models fostered by Mary Foley. As a result of her ground-breaking work, critical synchronization of applied and basic interdisciplinary human-system research is now determined as necessary to optimize patient outcomes.

Learning Objectives

1. The audience will gain an understanding of the essential nature of interdisciplinary human factors work in improving outcomes of air transport of patients.
2. The audience will gain an understanding of the essential nature of interdisciplinary human factors work in improving outcomes of air transport of patients.
3. The audience will be able to identify opportunities for future human factors research synchronization.

Wednesday, 06/04/2025 ***2:00 PM***
Hanover F/G

[S-56] PANEL: RAM GRAND ROUNDS – PANEL III

Chair: Sonya Heidt
Co-Chairs: David Navel, Sadie Henry

Panel Overview: *Residency in Aerospace Medicine – Grand Rounds Panel III*

[421] CONSTANT ADJUSTMENT – DIAGNOSES ARE IMPORTANT: A CASE REPORT

Victor Parker, David Trindle
USAFSAM, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: This case study evaluates the aeromedical fitness of a senior pilot with a history of recurrent adjustment disorder with mixed anxiety and depression over the course of 5 years. **BACKGROUND:** A pilot with nearly 20 years of military service and close to 3000 flying hours self-removed from flight duties due to mental health challenges triggered by significant life stressors between 2019 and 2024. They received therapy and treatment, leading to symptom resolution, though administrative actions complicated their career. **CASE PRESENTATION:** The pilot underwent intensive therapy, with approximately 150 sessions of various therapeutic modalities. They also engaged in healthy lifestyle changes, contributing to full resolution of anxiety and depression symptoms by early-2024. Despite their mental health progress, they faced administrative actions, including an upcoming discharge board for vaccine refusal on sincerely held religious beliefs. Their psychotropic medications were discontinued in September 2023 and therapy was concluded in spring of 2024. During their nearly 5-year treatment, they experienced multiple life stressors that would present just as another stressor was controlled. They reported improved emotional resilience, enhanced family relationships, and the ability to apply therapeutic skills to assist others. Psychological testing revealed no psychiatric symptoms or fear of flying, and they remained motivated to return to operational duties. **DISCUSSION:** The USAF Aeromedical Consultation Service (ACS) recommended pilot disqualification from Flying Class II duties due to a history of adjustment disorder and recommended a waiver, valid for two years, contingent upon continued mitigation actions. Using the USAFSAM Aeromedical Risk Matrix, their risk was classified as "Serious" (score of 6), with mitigation strategies including resilience-building, follow-up care, and observation for symptom recurrence. This case highlights the complexity of managing aviators with mental health histories and the importance of diagnoses in disposition. The successful recovery and demonstrated coping strategies of the patient support a Flying Class II waiver, although administrative actions continue to pose professional challenges. Further data is needed to refine policies balancing mental health recovery and career viability in military aviators.

Learning Objectives

1. Identify the aeromedical risks and mitigation strategies for pilots diagnosed with Adjustment Disorder.
2. Evaluate the impact of Mental Health diagnoses on flight readiness and waiver eligibility.

[422] BINGE DRINKING BLUES: A FOLATE STORY

Kyle Richardson
Naval Aerospace Medical Institute, Pensacola, FL, United States

(Original Research)

INTRODUCTION: This case report describes the diagnosis and management of a Naval Aircrew Candidate (NAC) applicant who was found to have Alcohol Use Disorder secondary to being diagnosed with Folate Deficiency Macrocytic Anemia. **BACKGROUND:** Alcohol use disorder, which accounts for the majority of macrocytic anemia, poses a

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significant threat to the safety of flight. Few individuals honestly report alcohol use on routine screening forms or questionnaires to Aeromedical Examiners AMEs) or Flight Surgeons (FS). Recognition of lab abnormalities within the screening complete blood count (CBC) should prompt AMEs and FS to investigate for underlying causes that may be disqualifying. **CASE PRESENTATION**: A 24-year-old male NAC applicant presented for special duty screening at the Recruit Training Command (RTC). During the initial screening complete blood count (CBC), he was found to have a hematocrit (Hct) at 39.6% and a mean corpuscular volume (MCV) of 113.1 fL. An anemia workup was completed, ruling out drug and thyroid-related causes, noting marginally low folate and iron, for which he was started on folate and iron supplementation. At his four-week follow-up, Hct and MCV were 39.1% and 104.8fL, requiring a general and aviation special duty waiver. Before transferring to Naval Air Station Pensacola, the general duty waiver was granted, and the aviation waiver was submitted to AERO for approval. Upon arrival to Pensacola, local FS evaluation noted a previous history of emergency room visits before enlistment, as well as a recent local emergency room visit, in which alcohol intoxication was noted at each visit, and one noted a breathalyzer of 0.283 g/L. After further questioning, the member endorsed excessive alcohol consumption and was referred to the substance abuse rehabilitation program (SARP) for further evaluation. The evaluation showed a moderate to severe alcohol use disorder, accounting for the folate-deficient anemia. **DISCUSSION:** This case will discuss the importance of routine screening for anemia and the workup for macrocytic anemia. It will also discuss the current aeromedical waiver considerations from civil and military governing authorities for alcohol use disorder. Additionally, this case will highlight the importance of a thorough review of patient records or the need to request additional labs or records before waiver submission or AME certification.

Learning Objectives

1. Reaffirming the necessity of screening labs for active-duty special duty applicants.
2. Educational insight on trends in complete blood count values that support further inquiry about alcohol use.

[423] THE JOINT CONSIDERATION: A HYPOTHETICAL CASE OF SPACEFLIGHT CERTIFICATION AFTER HIP ARTHROPLASTY

Samantha King, Christine Schwartz
UTMB, Galveston, TX, United States

(Original Research)

INTRODUCTION: This case reports on a HYPOTHETICAL career astronaut with prior short duration flight experience seeking re-certification for spaceflight after a total hip arthroplasty. **BACKGROUND:** Musculoskeletal symptoms are one of the most frequently noted medical complaints experienced by crewmembers during spaceflight. Additionally, the rigors of training and inflight activities, such as extra-vehicular activity (EVA), put additional musculoskeletal stress on crewmembers. The effect of spaceflight environment on cartilage is a current area of research. In addition to these stresses, crewmembers experience terrestrial degenerative changes of the joints. Advanced osteoarthritis can be treated with joint replacement. History of joint arthroplasty has unique considerations for certification for spaceflight. **CASE PRESENTATION:** A 50-year-old crewmember with prior short duration flight experience and EVA experience underwent a minimally invasive total right hip arthroplasty 24 months prior to recertification, for osteoarthritis which had failed conservative management. The crewmember completed post-operative physical therapy and has been cleared by the orthopedic surgeon for return to duty with continued routine yearly follow-up. The crewmember has no current restrictions on range of motion or limitations in training activities as evidenced by performance in dynamic functional testing. **DISCUSSION:** Current military wavier guidance exists for certification of pilots after joint arthroplasty, but such standards do not exist for spaceflight. The potential need to qualify individuals with a history of hip arthroplasty could increase with the expanding population of astronauts and spaceflight participants. Individuals considering surgical intervention should discuss the impact of surgical approach on dislocation risks, particularly in the context of re-entry and landing forces. After surgery, it is critical to assess any impact on function and performance. The decision for certification will need to consider bone remodeling surrounding the implant, risk of implant associated fracture, joint infection, and radiation impacts. Given the limited spaceflight data in individuals with joint arthroplasty, careful assessment will be needed when certifying crewmembers.

Learning Objectives

1. The audience will learn the differences between NASA, FAA, and DOD requirements for certification of crewmembers with hip arthroplasty.
2. The audience will understand the need for further research in joint arthroplasty in long-duration and exploration missions to fill knowledge gaps and inform future policy.

[424] WITHDRAWN

Wednesday, 06/04/2025 ***2:00 PM***
Grand Hall East Corridor - Posters Only

[S-52] POSTER : NO, YOU CAN'T FLY! YES, YOU CAN!

Chair: Amos Meyers
Co-Chair: Maybritt Kuypers

[285] DEVELOPMENT OF PREDICTIVE MODELS FOR EARLY DETECTION OF REASONS OF UNSUITABILITY FOR MILITARY AIRCREW MEMBERS BY MEANS OF MACHINE LEARNING

Claus Otto[1], Marcus Stiemer[2], Stefan Sammito[1]
[1]*German Air Force Centre of Aerospace Medicine, Cologne, Germany;*
[2]*Helmut Schmidt University / University of the Federal Armed Forces Hamburg, Hamburg, Germany*

(Original Research)

INTRODUCTION: Military aviation requires high health and fitness standards for all aircrew members because of the significant risks associated with minor health issues. To predict potential health risks among military aircrew, advanced machine learning models were created. The study used detailed data collected at the German Air Force Centre of Aerospace Medicine over 17 years, focusing on clinical, demographic, and biochemical parameters crucial for assessing cardiovascular risks. **METHODS:** Three machine learning methods – Random Forest, Long Short-Term Memory (LSTM), and Convolutional Neural Networks (CNN) – were employed to predict health risks based on clinical, demographic, and biochemical data. Corresponding models were trained using preprocessed data. Preprocessing addressed missing data and class imbalances using SMOTE and custom loss functions. Performance evaluation included accuracy, precision (specificity), recall (sensitivity), and F1-score. **RESULTS:** The Random Forest model demonstrated strong predictive capabilities for significant health outcomes, although it struggled with predicting membership to minority classes even after resampling. It achieved a precision of 0.80 and a recall of 0.97 for the majority class while fell back to a precision of 0.08 and a recall of 0.40 for the minority class. The LSTM and CNN models displayed moderate success but faced challenges with overfitting and instability during training. The best model achieved an overall accuracy of 0.62, with a precision of 0.21 and a recall of 0.58 for the minority class. **DISCUSSION:** The results highlight the importance of high data quality and completeness as well as balance over the considered classes to improve model accuracy and reduce bias. While all models showed promising values for the majority class, only the LSTM showed recall values beyond mere guessing for the minority class. The LSTM and CNN models require further refinement to enhance robustness and generalization across diverse datasets. Despite limitations, all models showed potential to enhance early health risk detection for military aircrew. The results of this study provide concrete hints how data acquisition processes can be enhanced in order to obtain robust models with higher predictive capability.

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Learning Objectives
1. Demonstrate the application of machine learning in forecasting health risks within military aviation.
2. Assess the effectiveness of Random Forest, LSTM, and CNN models in predicting early health risks using real-world medical data.

[286] CLEARED FOR TAKEOFF: A 30-YEAR ANALYSIS OF CENTRAL SEROUS RETINOPATHY IN USAF AVIATORS

Lyndsey Vu, Jon Ellis, Mike Parsons
USAFSAM, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Central serous chorioretinopathy (CSR) is an ocular disease that causes visual impairment, often temporary, and usually in one eye. CSR is characterized by the development of fluid within the inner layers of the retina, which results in a hyperopic refractive shift and visual distortion. Many cases of CSR resolve spontaneously, although reoccurrence has been reported in up to 50% of cases. The Air Force Aeromedical Consultation Service CSR management group database currently reports 218 aircrew members with CSR. The goal of this study is to obtain a better understanding of how CSR impacts the flying mission. **METHODS:** This is a retrospective study using subjects enrolled in the CSR management group. Parameters include gender, age, crew position, medications, affected eye, visual outcomes, flying status, treatment (if any), and reoccurrence episodes. No contact between investigators and subject occurred. **RESULTS:** Two hundred eighteen subjects were enrolled. Sixteen subjects were excluded due to insufficient documentation or outdated medical history. An additional 50 subjects were excluded due to incomplete data or were lost to follow-up. The study population consisted of individuals aged 36-40, with most participants being pilots. At the peak of the CSR event, 43% of the subjects had a best corrected visual acuity (BCVA) of 20/20, 19% had a BCVA of 20/30, and 18% had a BCVA of 20/25. After recovery, 92% of the subjects had a BCVA of 20/20, 5% had a BCVA of 20/30, and 2% had a BCVA of 20/25. Most cases (76.6%) resolved spontaneously without treatment, and 60% of the subjects did not experience a recurrence. The mean time from the initial event to waiver approval was 12.9 mo, with a median of 7 mo. **DISCUSSION:** This study provides valuable insights into the management and outcomes of CSR in a cohort of U.S. Air Force aviation personnel. Furthermore, the study demonstrates that a significant proportion of subjects were able to obtain a waiver. Overall, this study contributes to the growing body of knowledge on the management and outcomes of CSR in aviation personnel and highlights the need for further research in this area.

Learning Objectives
1. Understand the prevalence, visual outcomes, and recovery time of central serous chorioretinopathy (CSR) in U.S. Air Force aviation personnel.
2. Identify risk factors and the rate of recurrence of CSR in this specific population.
3. Evaluate the impact of CSR on the flying mission and the ability of affected individuals to obtain a waiver.

[287] WITHDRAWN

[288] IN-FLIGHT AND IN-SIMULATOR SPEECH INTELLIGIBILITY EVALUATION FOR HELICOPTER PILOT AND AIRCRAFT CAPTAIN WITH HEARING LOSS DUE TO OTOSLEROSIS

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(Education - Case Study)

INTRODUCTION: Those cases report describe a military helicopter pilot and aircraft captain whose have presented hearing loss due to otosclerosis, both of them off standards and they have been evaluated in-flight and in simulator. **BACKGROUND:** Correct hearing function is required to fitness in military pilot and aircraft crew members. Hearing loss in aircrew members is potential safety risk, and the detrimental effects of hearing loss on individual and unit performance can be significant. However, many pilots may be affected by hearing loss, as general population. Otosclerosis is a common cause of hearing loss. Aircrew member with otosclerosis, his flight fitness may be questionable. **CASE PRESENTATION:** The case one: a 46-yr old military helicopter pilot (Puma and Super Puma). He was an experienced pilot, with 3000 total flying hours. He has presented during his periodic visit a hearing-loss at the right ear in tonal audiometry which exceeds standards. The scanner of petrous bones objectified bilateral otosclerosis stage II. Vocal audiometry in noise (intelligibility threshold at 60 db) was also outside satandards. His file was presented for waiver, view his experience, an in-flight intelligiblity evaluation was conducted in helicopter and encompassed a variety of flight conditions. Recorded and live voice speech materials were presented to the pilote through the internal communication system. In flight test has shown a good understanding by the pilot of the words and phrases repeated during the in-flight test speech. A fitness with waiver was accorded to pilot with restriction. Case two: a 57-yr old aircraft captain at Royal Air Morocco. He is an experienced pilot also, with 18651 total flying hours. He has presented a bilateral hearing-loss in tonal audiometry during periodic visit exceeds standards of civil aviation authority of Morocco. Vocal audiometry has shown deafness in both silence and noise. The diagnosis of otosclerosis has beesn made. An in-simulator intelligibility test was conducted showed good understanding and good coordination with the crew members. Fitness with waiver was accorded. **DISCUSSION:** Those cases highlight the place of intellibility test in flight or in simulator for pilots with hearing loss, especially in pilot with otosclerosis and have high experience in duty. However the pilots with hearing-loss with good experience may get waiver to keep there places if they pass the test in flight with success.

Learning Objectives
1. To report our experience with two cases of hearing loss in aircrew pilots whom have otosclerosis.
2. To show the utility to do intelligibility evaluation in flight or in simulator for experienced pilots whose presented a hearing loss out side the standards.

[289] FUNCTIONAL AND MORPHOLOGICAL EFFECTS OF OCCUPATIONAL HYPOBARIA ON THE BRAIN – OUTCOME OF EUROPEAN MULTINATIONAL NATO-PARTNERS

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[3]*German Federal Armed Forces Hospital Koblenz, Koblenz, Germany*

(Original Research)

INTRODUCTION: Repetitive non-hypoxic hypobaria is a common occurrence in the aerospace environment and has been proven to be linked to subcortical white matter hyperintensities (WMH) on fluid-attenuated inversion recovery (FLAIR) magnetic resonance imaging (MRI) in the brain. This prompts the question of whether such exposures could have a deleterious impact on brain structure and function. **METHODS:** In a single-center study, 19 altitude chamber personnel (ACP) from four European countries in NATO with repetitive non-hypoxic hypobaric exposure were compared to a control group of 28 healthy individuals. MRI was performed to assess the occurrence, volume, and distribution of white matter hyperintensities (WMH), as well as white matter parcellation, cortical volume, and thickness. Furthermore, diffusion-weighted imaging (DWI) acquisitions were subjected to analysis. Additionally, neurophysiological tests, including

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visual and auditory evoked potential (VEP/AEP), and ocular coherence tomography (OCT), and psychometric tests (Vienna test system, WinSCAT), were administered. **RESULTS:** Both groups demonstrated the presence of white matter hyperintensities (WMH), albeit to a lesser extent than has been reported in the general population. The number and volume of WMH increased with age and were positively but insignificant influenced by the cumulative chamber exposure time of the ACP. No differences in WMH characteristics (number, volume, and distribution) or in mean diffusivity and fractional anisotropy in DWI were observed between groups. However, there were notable reductions in lateral orbitofrontal cortical volume and thickness, as well as a decrease in volume of the pars opercularis of both hemispheres in the study group. Neurophysiological and -psychological findings revealed no differences between the two groups. **CONCLUSION:** Our study found no striking evidence to suggest that occupational non-hypoxic hypobaric exposure in ACP, as currently employed by participating NATO Air Forces, can lead to brain damage.

Learning Objectives

1. It is essential to comprehend the cerebral responses that indicate a neurotrophic (repair) response after hypobaria, which suggests recuperation from glial (white matter) injury. This is a consequence of the NATO HFM RTG-274.
2. It is imperative to comprehend the necessity for further investigation into the neuropathophysiology of brain injury resulting from repeated hypobaric exposure.

[290] FATAL PULMONARY BAROTRAUMA FROM A COMMERCIAL FLIGHT

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(Education - Case Study)

INTRODUCTION: This case report describes a case of fatal pulmonary barotrauma in a commercial airline passenger. **BACKGROUND:** There is a paucity of cases of infectious causes of pulmonary barotrauma in the literature unless the patient is mechanically ventilated. Here we report a presumed pulmonary barotrauma caused by gas expanding as barometric pressure reduced during a commercial flight, with tragic consequences. Further information gleaned months later from the next of kin sheds more light on the cause. **CASE REPORT:** A 71-year-old female lost consciousness on a commercial flight from Melbourne, Australia to Hobart,Tasmania, Australia. Subsequent hospital investigations reveal a large cavitating lesion in the left lung and free gas in the brain, suggestive of pulmonary barotrauma and cerebral arterial gas embolism (CAGE). Progression of the hypoxic brain injury caused death. Subsequent details emerged months later of a pre-existing large pulmonary cyst. **DISCUSSION:** The likely cause of death was a combination of infection in a pre-existing pulmonary cyst which was then ruptured by either equalisation, cough suppression, change in barometric pressure or a combination of all three, causing cerebral arterial gas emboli (CAGE). This case highlights the vulnerability of individuals with either unknown or undisclosed medical conditions which may be affected by the flight environment resulting in significant morbidity or more over, mortality.

Learning Objectives

1. The audience will understand the risk and origin of pulmonary barotrauma in commercial air travel.
2. The audience will learn about the challenges of differentiating a diagnosis and managing passengers who collapse during commercial air travel.

[291] PLACE OF CARDIOVASCULAR MAGNETIC RESONANCE (CMR) IN CARDIOVASCULAR PATHOLOGY AND ITS INTEREST IN AERONAUTICAL EXPERTISE.

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(Education - Tutorial / Review)

INTRODUCTION: In cardiovascular pathology, cardiovascular magnetic resonance has emerged over time as a test with single potential, it finds all its interest in aeronautical medicine because cardiology expertise plays an important role in aeronautical fitness visits, the priority of the aviation medicine expert is to maintain the highest level of air safety, by limiting the risk of sudden or subtle incapacitation in flight due to cardiac pathologies. **TOPIC:** This non-invasive, non-irradiating, with few contraindications, and economically reasoned examination, allows a static and dynamic analysis of the cardiovascular system, providing complementary data to cardiac ultrasonography. Thanks to a good spatial and temporal resolution, a three-dimensional approach, and an excellent contrast between circulating blood and the myocardium, cardiovascular magnetic resonance is a reference method for imaging congenital heart disease, heart tumors, large vessels and pericardium, its major advantage is to be able to associate the study of the myocardial viability, to the analysis of the myocardial perfusion, and to a functional approach of the cardiac muscle by the study of the right and left ventricular functions. **APPLICATION:** Cardiovascular magnetic resonance finds all its interest in aeronautical expertise of flight crew, in addition to first-line examinations, including electrocardiogram and echocardiography, which do not always allow to decide on the absence of underlying cardiac disease, which would have a consequent impact on the decision of aptitude either in admission or revisional visit,the first interest of Cardiovascular magnetic resonance in aeronautics, resides in case of suspicion of Arhytmogenic Right Ventricular Dysplasia, and this in front of a bundle of clinical arguments or some electrophysiological arguments in particular: complex ventricular extrasystoles from the right ventricle, presence of epsilon wave. This examination may be used in aircrew, for diagnostic purposes, if there is suspicion of coronary insufficiency, with a contentious, sub maximal or not feasible stress test, and may be used also for the evaluation of a coronary known flight crew, for example remote from a revascularization procedure as part of its professional rehabilitation.cFor flight crew members suffering from sarcoidosis, regular Cardiovascular Magnetic Resonance monitoring is essential, because cardiac involvement in sarcoidosis is symptomatic in only 5% of cases.

Learning Objectives

1. The participant will be able to undersatnd that Cardiovascular magnetic resonance have a significant impact on the aeronautics aptitude decisions whether in admission visit or periodic, in addition, it presents a real added value in doubtful cases, compared to echocardiography, with a favorable cost / profitability ratio.
2. The first interest of Cardiovascular magnetic resonance in aeronautics, resides in case of suspicion of Arhytmogenic Right Ventricular Dysplasia ,namely, in front of family history of sudden death or one of the following electrophysiological arguments in particular: complex ventricular extrasystoles from the right ventricle, presence of epsilon wave.
3. The audience will learn about the great help of Cardiovascular magnetic resonance, in the context of the cardiomyopathie screening especially hypertrophic, in case of significant repolarization disorders and limits left ventricular hypertrophy without further explanation.

[292] MANAGING MUSCULOSKELETAL PAIN IN HIGH-PERFORMANCE PILOTS: REHABILITATION AND EXERCISE INTERVENTIONS

Di Huang[1], Kai Sheng Khor[1], Justin Nast[2]
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(Education - Program / Process Review)

BACKGROUND: Musculoskeletal pain, particularly in the neck and lower back, is highly prevalent among fighter jet and helicopter pilots due to prolonged sitting, vibration exposure, and high G-forces. These issues negatively impact pilot performance, safety, and operational readiness, making them critical concerns for Aviation Medicine. The increased

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frequency of musculoskeletal disorders in pilots has led to grounding and underscores the need for effective, evidence-based rehabilitation interventions. Addressing these issues is critical, as demands on pilots continue to grow, and gaps in standardized rehabilitation protocols remain unfilled. **OVERVIEW:** This scoping review synthesizes current literatures and recent studies on rehabilitation interventions designed to mitigate musculoskeletal pain in pilots. Key studies focus on exercise regimens, stretching protocols, and physical therapy programs that target pain reduction and improve muscular endurance in pilots suffering from neck and back pain. By reviewing a broad array of evidence, including studies on military helicopter and fighter-jet pilots, this review identifies both current practices and gaps in addressing pilot musculoskeletal health. This work seeks to inform future efforts to standardize rehabilitation protocols tailored to the specific occupational needs of aircrew. **DISCUSSION:** The operational significance of this research lies in its potential to enhance pilot performance, reduce flight-related injuries, and improve operational readiness. Musculoskeletal pain is a widespread issue across all services and international aircrews, and this scoping review provides insights into how targeted rehabilitation can extend a pilot's career and improve mission effectiveness. From a clinical perspective, it emphasizes the need for cross-service collaboration to implement standardized rehabilitation programs that could be applied in military and civilian aviation spheres. This work advances aeromedicine by proposing evidence-based solutions to enhance human performance, ultimately reducing medical downtimes and preventing pilot attrition due to musculoskeletal injuries.

Learning Objectives

1. The audience will be able to understand the effectiveness of rehabilitation interventions in reducing musculoskeletal pain among high-performance pilots.
2. The audience will be able to identify gaps in current rehabilitation protocols and understand the need for cross-service collaboration in addressing pilot musculoskeletal health.

[293] CONSIDERING PRESCRIPTION STIMULANT MEDICATION TO MITIGATE FATIGUE IN NASA PILOTS

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(Original Research)

INTRODUCTION: Stimulants have been used to combat fatigue in military pilots since World War II. They continue to be in use by United States military pilots today. Previously, this was also a practice employed by NASA flight surgeons for NASA pilots. However, following a friendly fire USAF incident in 2003, the practice of prescribing stimulants for NASA pilots to combat fatigue was halted due to uncertainty about the safety of stimulant usage in pilots. Since then, despite following all other fatigue mitigation policies, NASA pilots flying to and from Kazakhstan for astronaut retrieval have raised concerns about the impact of persistent fatigue on flight operations and safety. Our study aimed to determine what, if any, was the safest and most effective prescription treatment for pilot fatigue. **METHODS:** A thorough literature review was conducted to determine the efficacy, benefits, and deficits of various stimulant medications for use in pilots. In addition, a review of recent flight mission schedules was conducted to determine the cause of persistent fatigue in pilots. **RESULTS:** Current literature suggests that modafinil appears to have a low incidence of adverse reactions, does not appear to have a significant potential for addiction or abuse, has a long-duration half-life, and does not seem to affect recovery sleep. Some studies have even suggested cognitive benefits, including decreased impulsivity and improved fluid reasoning. **DISCUSSION:** Fatigue remains a severe concern in aviation, suspected to be the cause of 21-24% of major civil and military aviation accidents in the last twenty years. Fatigue is greatest during the window of circadian low (WOCL) and is worsened when flying at night. Due to the nature of space capsule landings, mission operations routinely must schedule flights at times that include night-time flights, and flights that occur during NASA pilots' WOCL, even with circadian rhythm shifting methods. The US Air Force and Navy routinely prescribe stimulant medications to aid their pilots in combating fatigue while flying. We propose that in addition to non-medication fatigue mitigation procedures, NASA pilots be prescribed Modafinil during long-haul, nighttime flights, to ensure flight safety. Due to the long onset of action, we propose a single, scheduled dose of Modafinil be built into the flight schedule at least two hours prior to the pilots' WOCL, to ensure maximum blood levels of Modafinil when the risk of fatigue is greatest.

Learning Objectives

1. The audience will learn the main contributing factors to persistent fatigue in NASA pilots.
2. The audience will learn the currently used stimulant medications in US Air Force policy for pilots.
3. The audience will learn the benefits and concerns around prescription of stimulants in pilots.

[294] MICRODOSING: ALTERNATIVE DOSING SCHEDULES FOR MODAFINIL IN AIRCREW

Patrick Edwards
RCAF - USAFSAM RAM, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: This literature review investigates the existence of past research into alternative dosing schedules for modafinil in aircrew. Modafinil, a eugeroic drug that mimics amphetamines with respect to wakefulness, has been studied extensively since its creation in the late 1980s. As a non-amphetamine stimulant, modafinil represents an acceptable alternative to caffeine however, only standard dosing schedules (typically 50, 100, or 200 mg, twice or three times per day) are followed. Unfortunately, these dosing paradigms often disrupt subsequent intentional sleep cycles. **METHODS:** The literature search on alternative dosing of modafinil was completed in late April 2024. Databases searched were PubMed, ProQuest, Academic Search Complete, Web of Science, CINAHL Complete, Cochrane Central Register of Controlled Trials/Cochrane Clinical Answers/Cochrane Database of Systematic Reviews/Cochrane Methodology Register PsychInfo, and the Defense Technical Information Center R&E Gateway. No publication date limit was applied. Results were derived from one search string per database and all results were included. (Search terms included modafinil, aviation, aerospace medicine, pilots, aircraft pilots, aviators, military personnel, medicine, military, dosage, low dose, off-label, "fatigue countermeasure," countermeasure, dose-response relationship.) There were 717 total results across all databases and 493 when deduplicated. All articles were reviewed. **RESULTS:** This literature review included 493 articles from 1988 to 2024. Only one article considered doses less than 50 mg (16.7 mg/8 h for 24 h). Notably, others demonstrated that 50 mg once was not sufficient. To date, no research has considered a loading dose followed by smaller maintenance doses. **DISCUSSION:** The importance of wakefulness in aviation cannot be overstated, particularly in combat operations. Moreover, in the context of near-peer adversaries, the notion of fighting a war built around an aviator's ideal sleep schedule is unrealistic. Thus, more research is urgently needed to determine the best dosing schedule for wakefulness aids, including modafinil, to maximize both mission success and subsequent rest while avoiding abuse. This objective might be met with an initial loading dose followed by smaller hourly doses, titrating to mission length. As a result, shortened or aborted missions would not commit the aircrew to lengthy periods of wakefulness.

Learning Objectives

1. Understand the current state of research into modafinil dosing schedules in aircrew.
2. Realize the importance of wakefulness in aviation, particularly in combat operations.
3. Appreciate the need for further research into alternative dosing schedules.

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[295] ASSESSMENT OF THE G TOLERANCE PREDICTIVE MODEL BASED ON THE CARDIAC FORCE INDEX

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(Original Research)

INTRODUCTION: Initially, the cardiac force index (CFI) was developed to monitor the running performance and prevent adverse events among military academic students. The CFI serves as an effective measure for collecting the cardiovascular changes during dynamic physical activities. In previous research, we consistently identified a relationship between the G tolerance and relaxed walking CFI (WCFI). The purpose of this study was to evaluate the effectiveness of the developed model for predicting the G tolerance prior to the centrifuge training. **METHODS:** The predictive model for the relaxed G tolerance (RGT) was published in 2023 and is defined by the following equation: 0.066 × age + 0.043 × (WCFI × 100) – 0.037 × height + 0.015 × systolic blood pressure – 0.010 × HR + 7.724. To validate this model, an additional 53 flight cadets (test group) were enrolled in this study. Before the high G training, the test group wore the Zephyr Biomodule devices (Medtronic, Minneapolis, MN, USA) to collect two minutes of resting and walking data used to generate the CFI values. Blood pressure and heart rate (HR) measurements were also taken prior to the high G training. The RGT was assessed under a gradual onset profile. The SPSS 24.0 software was utilized to evaluate the consistency between the estimated and observed RGT values. **RESULTS:** A total of 213 subjects (model group) were recruited for the establishment of the RGT predictive model. The mean age of both the model and test groups was approximately 25 years, and there were no significant differences in demographic and physiological data between the two groups. The average RGT in the model group was 4.9 ± 0.9 G, with 44.6% of subjects exceeding 5 G. Similarly, the test group had an average RGT of 4.9 ± 0.9 G, with 45.3% exceeding this threshold. The estimated value of the RGT was 4.8 ± 0.3 G, which closely matched the observed value. **DISCUSSION:** In this small study, we began by evaluating the CFI-related model for estimating the G tolerance. The actual and predictive averages of the RGT demonstrated a strong consistency between the two groups. In the next work, improving the accuracy of interval estimation and establishing the cut-off values for determining the high or low G tolerance will enhance the practical application of this model in the high G training.

Learning Objectives

1. Introduce another innovative cardiovascular parameter to predict the G tolerance.
2. Understand the considerations and mechanisms of the novel cardiac data in relation to G tolerance.

Wednesday, 06/04/2025 ***3:30 PM***
Lennox

[S-71] PANEL: AEROSPACE MEDICINE ADVANCES IN IBEROAMERICA

Chair: Rocio Del Pilar Garzon Ayala
Co-Chair: Beatriz Puente Espada

Panel Overview: *This panel brings together prominent researchers from several Latin American countries, continuing the tradition of presenting advances in the field in their native language. The session covers topics in human performance and applied aerospace medicine, highlighting the importance of regional collaboration to address common problems and improve practices in this discipline. The active participation reflects the growing interest and commitment towards the development of aerospace medicine in the region. This panel is consolidated as a fundamental space for the advancement and dissemination of knowledge in the aerospace field.*

[390] COGNITIVE IMPAIRMENTS DISCRIBED IN NORMOBARIC HIGH ALTITUDE CHAMBER IN LATINOAMERICAN CIVIL AVIATIONA AND THE FIRST IN ANTIOQUIA (COLOMBIA)

David Puerta-Malca[1], Diana Gutierrez[2], Orlando Gracias[3], Juan Camacho[2], Tatiana De la Hoz[2], Adriana Zuluaga[2]
[1]*MAISO, Bogotá, Colombia;* [2]*MAISO, Medellin, Colombia;* [3]*GRANCOLOMBIANA, Bogotá, Colombia*

(Original Research)

INTRODUCTION: Hypoxia, defined as an oxygen deficiency in the blood, tissues, and cells, compromises physiological functions and is particularly concerning in aviation. Factors contributing to hypoxia include issues with oxygen transport, usage, or binding, often exacerbated at higher altitudes where atmospheric pressure decreases. Aeronautical personnel are at risk, especially as hypoxia can cause cognitive impairments and sudden incapacitation. This report aims to explore cognitive changes after exposure to hypoxia, assessed in the first normobaric hypoxia chamber in Antioquia, Colombia. **METHODS:** In October 2021, during a hypoxia training session in Medellín, Colombia, a female cabin crew member volunteered to undergo neuropsychological testing before and after exposure to hypoxia. The test, was administered two hours prior and immediately following the session, which simulated an oxygen pressure equivalent to an altitude of 8,000 ft, with exposure up to 33,000 ft. **RESULTS:** The participant reached a maximum altitude of 33,000 ft with a minimum oxygen saturation of 83%. Despite no self-reported symptoms, cyanosis was observed by the training team. Post-exposure neuropsychological tests showed a significant decrease in estimation scores, indicating reduced capacities for abstract reasoning, trajectory anticipation, and energy management of the aircraft. **DISCUSSION:** This case highlights the potential cognitive impacts of hypoxia on flight crew members, even in the absence of reported symptoms. The observed cognitive decline post-exposure underscores the importance of hypoxia awareness and training to prepare aeronautical personnel for high-altitude conditions.

Learning Objectives

1. Identify the physiological and cognitive effects of hypoxia.
2. Evaluate the impact of hypoxia on cognitive functions in aviation personnel.
3. Develop strategies for hypoxia awareness and training in aviation.

[391] CARDIOVASCULAR RISK FACTORS EVALUATION IN AGRICULTURAL PILOTS OF COLOMBIA WITH CURRENT MEDICAL CERTIFICATION, 2024

Maria Angelita Salamanca[1], Luis Arteaga[2]
[1]*Civil Aviation Authority of Colombia, Bogotá, Colombia;* [2]*Aeronautica Civil de Colombia, Bogotá, Colombia*

(Original Research)

INTRODUCTION: Cardiovascular diseases, mainly coronary disease, are a leading cause of medical disqualification and sudden incapacitation in pilots, linked to cardiovascular risk factors (1, 2). The prevalence of these factors among agricultural aviation pilots, who have a high accident rate in Colombia, has not been characterized (3). Previously, 10% of first-class pilots were found to be at medium/high risk according to the Framingham

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scale, with variables such as smoking, age over 45 years, blood pressure, body mass index, and cholesterol levels (4). **METHODS:** This cross-sectional descriptive study used data from medical records completed during the aeromedical certification process. Of 139 records of agricultural aviation pilots with current certification in October 2024, 2 were excluded for incomplete information. Data on sociodemographic, anthropometric, and cardiovascular risk factors were analyzed using the Epi Info statistical package. **RESULTS:** All pilots were male, with a median age of 37 years (IQR 31-54). According to the AHA-ASCVD score, 12.4% had borderline cardiovascular risk, 7.3% intermediate risk, and 0.7% high risk. 80% had low cardiovascular risk. Prevalences of risk factors included: 58% older than 40 years, 5% smokers, 6% with a history of high blood pressure, 73% with high blood pressure as a risk factor, 32% with total cholesterol ≥200 mg/dl, 22% with HDL cholesterol <40 mg/dl, 31% with triglycerides ≥150 mg/dl, and 2% with diabetes mellitus. Additionally, 16% were obese. Pilots with higher cardiovascular risk had significantly higher median age, systolic pressure, total cholesterol, triglycerides, and blood sugar compared to those with low risk. **DISCUSSION:** 80% of agricultural aviation pilots have low cardiovascular risk. Given their acrobatic, solo flight operations and accident rates, managing operational risk and addressing modifiable cardiovascular risk factors in the remaining 20% is crucial. Optimizing the implementation of protocols by the Colombian civil aviation authority for managing cardiovascular risk factors in medical certificate holders is recommended.

Learning Objectives

1. evaluate the cardiovascular risk factors in agricultural aviation pilots of Colombia using de AHA/ASCVD.
2. evaluate cardiovascular risk factors in the group of agricultural pilots with high cardiovascular risk.

[392] HOMOZYGOUS FAMILY HYPERCHOLESTEROLEMIA AS AN ORPHAN DISEASE IN COMMERCIAL PILOTS IN LATIN AMERICA

Jean Carlos Duenes[1], Jorge Serrano[2], Priscila Pratto[2], Carlos Arciniegas[3], Guillermo Lara[3]

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(Original Research)

INTRODUCTION: Orphan diseases are also called rare diseases that affect a small number of people compared to the general population. Rare diseases are life-threatening, or long-term debilitating, diseases of low prevalence and high level of complexity. Most of them are genetic diseases; others are rare cancers, autoimmune, or toxic and infectious diseases. These diseases experience difficulty in obtaining precise diagnoses, as well as obtaining an exact diagnosis since information is generally scarce. At the cardiovascular level, Homozygous Familial Hypercholesterolemia is a rare and potentially fatal disease that is characterized by plasma levels of total cholesterol > 500 mg/dl, extensive xanthomas and cardiovascular disease. **OBJECTIVES:** • Know the number of commercial pilots without LDL and HDL • Register number Pilots who receive Statins and PCSK9 Inhibitors • Know how many pilots failed treatment with PCSK9 inhibitors • Confirm diagnosis of Homozygous Familial Hypercholesterolemia through Genetic Testing **METHODS:** It is a retrospective descriptive study, carried out between June 2020 and June 2023 with the Aeronautical population only Commercial Pilots: Chile, Colombia, United States, Mexico, Peru and Venezuela, through analyzing the results of Total Cholesterol, LDL, HDL. In those pilots without goals, Molecular studies were carried out for LDLR, APOB, PCSK9, APOE LDLRAP1 genes. **CONCLUSION:** Our research confirmed the high CLDL level in the absence and presence of coronary heart disease, even with low risk factors, 70% of the pilots began treatment with high-intensity statins, 34% of the population received reinforced treatment with PCSK9 Inhibitors for three months with favorable results in 97% of pilots. The favorable results were 97% of the sample of 34% of the pilots who received booster treatment. However, 0.33% of the population has Homozygous Familial Hypercholesterolemia demonstrated by these Genetic tests, this would be the first publication related to Commercial Pilots in the world. Due to its high level of complexity and prognosis of developing serious coronary disease, it would be a dilemma to certify our pilots or approve them with certain restrictions.

Learning Objectives

1. Understand the implications of Homozygous Familial Hypercholesterolemia as a rare disease in commercial pilots, including its diagnosis, treatment options, and prevalence in the aeronautical population of Latin America.
2. Analyze the effectiveness of high-intensity statins and PCSK9 inhibitors in managing cholesterol levels in commercial pilots, and evaluate the impact of genetic testing on confirming diagnoses and informing treatment decisions.

[393] COMPREHENSIVE CARE PROGRAM FOR AERONAUTICAL PERSONNEL

Johana Giraldo-Alzate, Mateo González-Agudelo, Diego M. García

National University of Colombia., Bogotá, Colombia

(Education - Program / Process Review)

BACKGROUND: Mental health conditions are critical in the aviation industry, as they can impair cognitive performance, potentially leading to incidents or accidents. Studies show that the longest medical leaves are often linked to psychiatric conditions. Reports from the Colombian CAA indicate that mental health cases are the second leading cause of medical sick leave and the primary cause for denial of aeromedical certification (AMC), accounting for 18% of all cases. Research further suggests that pilots frequently avoid disclosing mental health concerns due to stigma and fear of AMC loss, highlighting a critical need for trusted, supportive programs. **OVERVIEW:** Recognizing the gap in mental health support from authorities and airlines, pilot associations established a support network to provide comprehensive care for all crew members. This network creates a safe space where individuals can address mental health issues in an environment built on confidentiality, transparency, trust, and mutual respect. Although funded by the airline to support all personnel, the program operates with full independence and confidentiality. It focuses on substance use, and sleep disorders, while also providing support for mental health emergencies. Remote guidance is available through an aerospace medicine specialist, offering access to psychiatry, psychology, couples therapy, and other services to ensure comprehensive care as needed. In the first 8 months of the program, follow-up rates included 63% for mental health, 13% for substance use, 10% for sleep disorders, and 13% for other issues. Of these, 57% are actively engaged in flight operations, and 13% have completed their follow-up. Additionally, emergency mental health support has been offered in two cases. A Peer Pilot Support Program is also part of this initiative. **DISCUSSION:** This innovative program provides a valuable alternative to traditional wellness initiatives by authorities and airlines, offering a new model for mental health support networks in Latin America. It fosters a culture of biopsychosocial well-being, positively influencing crew members and their social and family lives. The program has a cost-effective impact by reducing medical leaves, AMC suspensions, and preventing mental health disorders. This model enhances crew members' trust, promotes careseeking behaviors, and contributes to both human performance and operational safety.

Learning Objectives

1. Understand the structure and objectives of a comprehensive care program designed to support the mental health and well-being of aeronautical personnel in Colombia and Latin America.
2. Identify the benefits of implementing an independent mental health support program for aviation personnel in reducing medical leaves and promoting operational safety.

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[394] SYNCOPE AND AEROMEDICAL FITNESS: OUTCOMES FROM A 23-CASES IN COLOMBIAN AVIATION PERSONNEL

Alexandra Mejia Delgado
Civil Aviation Authority of Colombia, Bogotá, Colombia

(Original Research)

INTRODUCTION: Syncope is a common condition in the general population, with an occurrence rate of over 3% in the general population, affects both the general and working-age populations, where the relapse risk in patients with vasovagal syncope is about 4% per year. yet it is a disqualifying condition for most aerospace personnel due to the risk of incapacitation in inflight. Recent changes in aeromedical policy have opened pathways for certification in cases of single, well-documented, and controlled syncope episodes. Restricted certification may be allowed after 3-6 months, with full certification only after five years without recurrence. Most favorable aeromedical dispositions occur in cases with non-recurrent mechanisms. **METHODS:** occurrence of syncope reported to the Civil Aviation Authority was 23 medical records were reviewed. The aeromedical decision process for certificate holders with syncopal episodes is described. **RESULTS:** The Colombian Civil Aviation Authority (ColCAA) evaluated 23 syncope cases in aviation personnel reported since 2018-2024 (n=23), using both medical evidence on syncope and international certification protocols. The median age of affected personnel was 32, including 7 cabin crew, 7 captains, 5 first officers, and 4 flight school students. Definitive disqualification occurred in five cases due to cardiogenic syncope (1 case) and recurrence or student status (4 cases). The remaining 18 cases (78%) were cleared for resuming flight activities. Vasovagal syncope, with identifiable and avoidable triggers, was diagnosed in 19 cases. The average wait time for clearance was 5.18 months. **DISCUSSION:** The syncope recurrence risk varies by case, with individual factors like episode frequency and underlying conditions affecting outcomes. ColCAA conducted case assessments following ICAO standards, deeming most personnel fit to resume duties under periodic follow-up. This case series emphasizes the need for individualized assessments in aviation medicine, showing that personnel with benign, well-managed syncope may safely return to duty, enhancing policy refinement for syncope certification.

Learning Objectives

1. To understand the importance of individualized assessment in cases syncope.
2. To understand the approach to risk stratification in the aeromedical decision process.

[395] COLOMBIAN COGNITIVE SCALES: A NEW HORIZON IN OPERATIONAL SAFETY

Gloria Quiñones
Civil Aviation Authority of Colombia, Bogotá, Colombia

(Original Research)

INTRODUCTION: The Civil Aeronautics of Colombia has launched an innovative human factors intervention program through its Aeronautical Medicine program. This initiative assesses personality, stress perception, and higher cognitive processes in air traffic controllers (ATCs) to enhance operational safety and well-being (1, 2, 3,4). The program is tailored to Colombian cultural factors, resulting in specific scales to improve occupational competencies. (5) **METHODS:** The neuropsychological battery was piloted in Colombia to assess critical aviation skills such as attention, visual tracking, memory, and logical reasoning. (2) The Civil Aeronautical Authority of Colombia selected and acquired the rights to use a computerized neuropsychological assessment. The cross-sectional study based on a convenience sample with sequential selection initially involved 157 air traffic controllers (ATCs), but only data from 142 participants were usable. This included 42 women and 100 men, aged 19 to 66 (mean 41.51 +/- 9.17), over a period of three years. The evaluation was tailored to meet job demands and organizational challenges, with a focus on competencies and teamwork. Additionally, personality tests (TEA-TPT) and the Work Stress Questionnaire (JSS) were administered. **RESULTS:** The computerized neuropsychological assessment effectively assessed the cognitive abilities of ATCs, providing key data for decision-making and development plans. The data highlighted areas for improvement and strengths in occupational competencies, reducing operational risk due to human factors. The creation of Colombian-specific scales allowed for more accurate evaluations of aeromedically certified personnel. **DISCUSSION:** Implementing the computerized neuropsychological assessment in Colombia advances human factors evaluation in aviation. The tool's ability to detect subtle cognitive changes is crucial for operational safety. (2, 3) Colombian-specific scales enable more accurate evaluations, enhancing aviation safety, promoting ATC well-being, and supporting decision-making. This program strengthens occupational competencies and minimizes operational risk due to human factors, establishing a database for psychophysical fitness decisions.

Learning Objectives

1. Evaluate the performance of aeromedically certified personnel in comparison with the results of exploration tests to establish intervention programs that strengthen the weaknesses found.
2. To develop and use specific scales for Colombia in the exploration of the cognitive domains of aeromedically certified personnel.
3. Create a baseline for the neuropsychological evaluation of personnel, allowing continuous monitoring of their operational performance as appropriate.

Wednesday, 06/04/2025 ***4:00 PM***
Centennial Ballroom I & II

[S-53] PANEL: THE 15TH ANNUAL RAM BOWL

Chair: Allen Parmet
Co-Chair: Rebecca Blue

Panel Overview: *The 15th Annual RAM Bowl features participants from the Air Force, Navy, Army, Mayo Clinic, UTMB and international representatives competing for the Louis H. Bauer Trophy. Aerospace Medicine Residents are required to demonstrate multiple competencies to satisfy the requirements of ACGME and ABPM and serve as specialists in the field. Multiple tools are available for developing appropriate didactic knowledge in aerospace medicine, public health, epidemiology, biostatistics and health care management. Residents participate in a college bowl format that test aerospace medicine competencies including the flight environment (atmosphere, radiation, vibration, acceleration, and microgravity), clinical aerospace medicine, aircraft and space vehicle systems/operations, accident investigation, historical events, aerospace physiology, human factors, ergonomics, medical standards, Federal Aviation Administration regulations, passenger transport, restraint and escape, cockpit resource management and aeromedical transportation. Questions are divided into toss-up and bonus questions. Multiple rounds of competition will lead to the selection of an individual victor and awarding of the Louis H. Bauer Trophy to the top team, sponsored by the American Society of Aerospace Medicine Specialists.*

[296] THE 15TH ANNUAL RAM BOWL

Allen Parmet[1], Rebecca Blue[2], Rahul Suresh[3], Alex Garbino[4], Walter Dalitsch III[5], Mary Cimrmancic[6], Joanna Helms[7], Roy Hoffman[8], Jan Stepanek[9]
[1]*University of Southern CA, Kansas City, MO, United States;* [2]*University of Texas Medical Branch, Scottsdale, AZ, United States;* [3]*NASA JSC, Houston, TX, United States;* [4]*Geocontrol, Houston, TX, United States;* [5]*Dalitsch Aviation, Moose Factory and Sled Racing Corporation, Moosepoo, AK, United States;* [6]*Marquette University, Milwaukee, WI, United States;* [7]*Texas Air National Guard, Houston, TX, United States;* [8]*U.S. Navy, Pensacola, FL, United States;* [9]*Mayo Clinic, Scottsdale, AZ, United States*

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(Education - Tutorial / Review)

The 15th Annual RAM Bowl features participants from the Air Force, Navy, Army, Mayo Clinic, UTMB and international representatives competing for the Louis H. Bauer Trophy. Aerospace Medicine Residents are required to demonstrate multiple competencies to satisfy the requirements of ACGME and ABPM and serve as specialists in the field. Multiple tools are available for developing appropriate didactic knowledge in aerospace medicine, public health, epidemiology, biostatistics and health care management. Residents participate in a college bowl format that test aerospace medicine competencies including the flight environment (atmosphere, radiation, vibration, acceleration, and microgravity), clinical aerospace medicine, aircraft and space vehicle systems/operations, accident investigation, historical events, aerospace physiology, human factors, ergonomics, medical standards, Federal Aviation Administration regulations, passenger transport, restraint and escape, cockpit resource management and aeromedical transportation. Questions are divided into toss-up and bonus questions. Multiple rounds of competition will lead to the selection of an individual victor and awarding of the Louis H. Bauer Trophy to the top team, sponsored by the American Society of Aerospace Medicine Specialists.

Learning Objectives

1. The contest will enable participants to prepare for ABPM examinations in Aerospace Medicine.
2. Attendees will receive an intense review of Aerospace and Preventive Medicine.

THURSDAY, JUNE 05, 2025

Thursday, 06/05/2025 ***10:00 AM***
Centennial Ballroom I

[S-54] PANEL: THE FAST AND THE CURIOUS: CHARTING NEW FRONTIERS IN AVIATION MEDICINE

Chair: Sandra Salzman
Co-Chair: Zachary Masters

Panel Overview: *The Fast and the Curious: Charting New Frontiers in Aviation Medicine: Join the International Association of Military Flight Surgeon Pilots discussing forward leaning research on optimizing human performance in aviation as well as case studies of their application. As mechanical airframes push the boundaries of speed, endurance, and agility, it's crucial to understand how the human body and mind can keep pace with the evolving mission set. With an eye on both ops and medicine, IAMFSP will explore cutting-edge strategies in aviation medicine, from enhancing cognitive function to improving physical resilience, ensuring that the operators of tomorrow's aircraft can handle the intense demands of high-speed missions. Don't miss this chance to hear from those uniquely qualified to merge flight expertise with medical innovation!*

[297] MILITARY AVIATOR PEER SUPPORT PROGRAM: FOSTERING A CULTURE OF MUTUAL SUPPORT – WINGMEN, ALWAYS

Sandra Salzman[1], Darrell Zaugg[1], Aedrian Bekker[2], Gerhard Fahnenbruck[3], Keith Frank[4], William Hoffman[5]
[1]*U.S. Air Force, Ramstein AB, Germany;* [2]*Centre for Aviation Psychology, London, United Kingdom;* [3]*Stiftung Mayday, Frankfurt am Main, Germany;* [4]*U.S. Air Force Aeromedical Research Lab, Red Feather Lakes, CA, United States;* [5]*U.S. Air Force, Fort Sam Houston, TX, United States*

(Education - Program / Process Review)

BACKGROUND: Military aviator culture has historically endorsed a persona of an always ready, unwavering, and healthy. Pilots suffering from stress or mental health conditions may worry about seeking medical care due to potential professional or social repercussions, including losing their medical certificate and facing expensive evaluations. A 2019 study reported that 78.6% of pilots felt worried about seeking medical care, and 60.2% delayed care due to concerns about their pilot status. 2023 Stiftung Mayday data finds that 92.5% of stressful events can be completely resolved through a timely discussion with an empathetic and understanding peer. The Andersen Behavioral Model of Health Services Use suggests that pilots' attitudes, social norms, and perceived control may contribute to their reluctance to seek care. Most often, military aviators discuss problems with trusted peers, rather than trained professionals, to prevent any impact of an issue on their ability to fly. **OVERVIEW:** This presentation discusses establishment and utilization of a Military Aviator Peer Support Programs within the USAF, based on those that exist in the United States and European Union civilian aviation. This will include a discussion of the volunteer selection, training, and utilization within the 86th Operations Group at Ramstein Air Base. It will highlight some of the metrics monitored to identify success and challenges and trends in perception, trust, resource utilization and impact on the mission. Finally, we will look at potential short- and long-term considerations if MAPS programs were implemented across the military flying force and how that may build a stronger wingman culture within the USAF. **DISCUSSION:** The operational significance of aircrew culture on mission readiness and aviation safety is one of perception. By training wingmen who are already the social center of their aviation peers to be empathetic listeners armed with knowledge of the many resources available to handle problems of daily life, we may begin to see increased peer connectedness, resilience, and decreased stress index. Applying lessons learned from civilian culture and sharing knowledge with the aviators who already advise their peers, may provide a way for aviators to help each other, and triage those who need professional assistance.

Learning Objectives

1. The participant should be able to describe cultural challenges aviators meet when requesting assistance for non-flying issues.
2. Audience members should understand the key differences between peer support programs and other types of mental health medical care.
3. Participants should be able to discuss the specific reduction in risk of long-term mental health problems gained through early contact with peer support.

[298] UPDATE: INTEGRATED PERFORMANCE AND CARE TEAMS IN A SPECIAL OPERATIONS AIRCREW TRAINING SETTING

Zachary Masters
U. S. Air Force, Navarre, FL, United States

(Education - Program / Process Review)

BACKGROUND: Aeromedical Providers are key in aligning medical support aligns with the mission of the unit they support and furthering aviation safety throughout their organization . In the case of aircrew formal training units, the mission is to produce trained aircrew for operational units throughout the world. The efficiency and effectiveness of the training pipeline at that one unit affects every other unit in the community. The opportunity to establish healthy lifestyle and habits and an understanding of proper protocol relating to changes in health status, initiation of medications and aeromedical disposition early in these flyers careers can have a lasting effect on aviation safety. The reorganization of the military medical system and the U.S. Air Force operational structure necessitates leaders at all levels to re-examine the components of their organization and the value added by each. **OVERVIEW:** This presentation will provide updates on the status of the embedded healthcare and performance optimization team at the largest Aircrew Formal Training Unit in U.S. Air Force Special Operations Command. This will include a discussion of the makeup of the team and why that has evolved along with the process of

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acquisition and selection of resources and equipment. It will highlight some of the emerging, high-yield or promising equipment and techniques utilized by the team. We will then turn to current challenges and trends in student and instructor health and explore data regarding training delays and performance on aircrew evaluations. Finally, we will look towards the future of this team and similar teams and how they can continue to stay relevant and prepare Aircrew for the next conflict. **DISCUSSION:** The operational significance is in aircrew training and aviation safety. These small teams and embedded medical units are the trend within the U.S. military and recent policy changes will further necessitate their existence. Applying lessons learned and sharing knowledge to guide their development and improvement is essential to the future of military aerospace medicine. The panel applies to cross-service, international or civilian aeromedical providers who may seek to establish programs for aircrew student performance optimization and aviation safety.

Learning Objectives

1. The participant should be able to describe current trends and challenges for healthcare professionals in aircrew training and apply this knowledge to guide development of similar programs seeking to follow such a construct.
2. Audience members should understand the emerging demands for healthcare and human performance teams associated with Aircrew Training.

[299] HIGH CONSEQUENCE INFECTIOUS DISEASE PATIENT MOVEMENT: NEW FRONTIERS IN A PERSISTENT CHALLENGE

Christopher Backus
TRANSCOM, Scott AFB, IL, United States

(Education - Program / Process Review)

BACKGROUND: Paraphrased from Department of Defense (DoD) Joint Publication 4-02, a high-consequence infectious disease (HCID) includes any infection that either: leads to hazardous waste as categorized by the Department of Transportation, or can cause a high mortality rate among otherwise healthy people and at least some types of direct clinical specimens pose risks to laboratory personnel or poses a known risk of secondary airborne spread within health care settings or unknown mode of transmission, or no effective countermeasure exists. Not all facilities are qualified to treat HCIDs, therefore patients must be moved. Air movement benefits from speed, however, incurs risks to the patient, to the healthcare team, to the aircrew, and to populations at the destination and any enroute stops. As the internationally recognized authority in aerospace medicine, members of the Aerospace Medical Association should stay abreast of new developments in HCID patient movement (PM). While capabilities have existed for decades, a succession of different diseases have shown technology, and processes must continually evolve to reduce the risk of this necessary intervention. **OVERVIEW:** Commander, U. S. Transportation Command is the DoD single manager for PM providing DoD global PM through Defense Transportation System in coordination with other Combatant Commands, and as directed, appropriate U.S. Government agencies. Analyzing existing capabilities for HCID PM, the Command Surgeon (TCSG) initiated a program review and planning process to reduce risk and expand existing capabilities to a wider range of pathogens. Corona Virus 2019 pandemic response confirmed utility and safety of PM using the Negative Pressure CONEX. However, respiratory viruses pose different challenges from other pathogens, such as viral hemorrhagic fevers. Aware of Marburg Virus Disease (MVD) cases in Rwanda, TCSG co-hosted a working group to improve existing capability to safely move HCID patients. **DISCUSSION:** High quality HCID PM improves patient outcomes while reducing risks to population at origin, population at destination, healthcare workers, and aircraft crew members. The ability to operate in any environment regardless of infection risk while maintaining an HCID PM capability enhances operational options for the DoD.

Learning Objectives

1. The participant will be able to define High Consequence Infectious Diseases.
2. The audience will learn about U.S. Transportation Command's role in patient movement.
3. The learner will better understand risks associated with High Consequence Infectious Disease Patient Movement.

[300] AERIAL DELIVERY OF FRESH AND STORED BLOOD PRODUCTS

Emma Robertson[1], Roselyn Fuentes Clemente[2], Grigory Charny[3], Jesse Chasteen[2]
[1]*U.S. Air Force, Eglin AFB, FL, United States;* [2]*U.S. Air Force, Destin, FL, United States;* [3]*U.S. Army, Destin, FL, United States*

(Education - Program / Process Review)

BACKGROUND: This presentation discusses standard operating procedures for airdrop as a potentially viable method to deliver blood products to medics treating hemorrhaging patients in austere environments when timely transport to higher levels of care or regular resupply are not feasible. Comprehensive mortality studies of the Afghanistan and Iraq conflicts suggest that 91% of survivable deaths are related to hemorrhage. Mortality increases by 5% with every minute delay. Whole blood (WB) is the preferred resuscitation product for prehospital treatment of patients in hemorrhagic shock. There is an increasing effort to have medics administer WB to massively hemorrhaging patients as soon as possible to the point of injury. However, not all ground medics will have WB on hand. Additionally, the collection of WB from unit-prescreened type O blood types is time-consuming and resource-intensive. Lastly, prescreened type O blood may be difficult to obtain in sufficient amounts to treat massively hemorrhaging patients, to treat multiple patients in a mass casualty, or in a prolonged field-care setting. **OVERVIEW:** Aerial resupply provides a potential platform to deliver WB to medics when CASEVAC is not possible. Air superiority is not guaranteed in future near peer conflicts, further limiting timely evacuation requiring a shift toward prolonged field care. As military operations shift to more austere and denied areas of operation potentially spanning wide geographic arenas, FDA-approved blood products will not always be readily available. Additionally, Large Scale Combat Operations will result in large numbers of casualties, the inability to evacuate patients, or to medically resupply by the conventional means developed during the War on Terror. Prolonged Critical Care is nearly a certainty. **DISCUSSION:** A review of the literature utilizing various aircraft and unmanned aerial systems as well as different types of blood products overall demonstrated feasibility of airdrop delivery/airdrop. All airdropped and control blood units met criteria for blood transfusion per transfusion guidelines as outlined by the Joint Trauma System Whole Blood Transfusion Clinical Practice Guideline and the Association for the Advancement of Blood and Biotherapies Circular of Information for the Use of Human Blood and Blood Components. Acceptable levels of hemolysis for stored PRBC units is <1%.

Learning Objectives

1. The participant should be able to describe the reasoning behind the need for guidance for airdrop delivery of blood products.
2. Audience members should be able to discuss various delivery systems and data outcomes from published studies supporting the feasibility of blood airdrop.

[301] SUBJECTIVE VS OBJECTIVE MEASURES OF WORKLOAD IN AN EXPERIMENTAL FUTURE VERTICAL LIFT PARADIGM

Ian Curry[1], Matthew D'Alessandro[1], Tom Berger[2]
[1]*U.S. Army, Fort Novosel, AL, United States;* [2]*NASA Ames Research Center, Palo Alto, CA, United States*

(Original Research)

INTRODUCTION: Managing cognitive demand is critical for aviation safety, yet accurately assessing pilot workload during complex flight maneuvers remains challenging. This study evaluated an integrated

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methodology combining real-time cognitive engagement indicators to provide a comprehensive assessment and assess the reliability of physiological and subjective measures for monitoring operator state. **METHODS:** Six experienced U.S. Army rotary-wing pilots completed simulated high-workload flight scenarios consisting of low-altitude, reconnaissance, and air threat avoidance maneuvers. Continuous wireless electroencephalography (EEG), heart rate data, and subjective workload ratings were recorded during the flights. These were then analyzed to assess the coherence of subjective and objective measures of workload. **RESULTS:** EEG engagement indices and heart rate variability metrics demonstrated reliable within-subject consistency across trials for individual pilots, with mean intraclass correlation coefficient values ranging from 0.59–0.69. Both measures exhibited synchronized fluctuations across pilots at key events, increasing during high workload segments and decreasing in lower demand periods. Subjective ratings also showed good within-subject reliability, with mean intraclass correlation coefficient values ranging from 0.74–0.85. **DISCUSSION:** The findings of this study provide strong support for the feasibility of using a multi-measure approach that integrates EEG, heart rate variability, and subjective ratings. This approach can continuously monitor real-time cognitive workload fluctuations during simulated rotary-wing operations. While objective measures showed within-subject consistency, substantial between-subject variability highlights the importance of individualized neurocognitive profiling. The integration of neurophysiological, autonomic, subjective, and environmental data holds great promise for the future of pilot workload assessment despite the challenges posed by individual differences.

Learning Objectives

1. Demonstrate an understanding of real-time physiological monitoring techniques in complex simulated flight environments.
2. Describe the aeromedical and human factors challenges associated with Future Vertical Lift (FVL) capabilities, with emphasis on cognitive state monitoring.
3. Discuss individual responses to flight stressors and apply self-referencing methods for assessing workload and performance.

[302] PREVELENCE OF MENTAL HEALTH SYMPTOMS AMONG US ARMY AVIATORS: THE IMPACT OF MISSION TYPE

Aric Raus[1], Fred Volk[2], Sarah Spiridigliozzi[2]
[1]*Army University, Fort Leavenworth, KS, United States;* [2]*Liberty University, Lynchburg, VA, United States*

(Original Research)

INTRODUCTION: Aviation flight operations require constant vigilance where pilots must perform under significant physical and psychological stress. Prolonged or intense stress events can lead to mental health issues, even among those with formal resilience training. While the impact of stress within the aviation community has undergone increased scrutiny, little is known about the effects of specific aviation mission sets on mental wellness. **METHODS:** Quantitative survey responses were collected from a larger study of current and former U.S. Army Aviation personnel recruited via social media and snowball sampling between October 2023 and February 2024. This study utilized the four-question Public Health Questionnaire (PHQ-4) and the four-question Posttraumatic Stress Checklist for DSM 5 (PCL4-5) to determine pilots meeting the screening criteria for Generalized Anxiety Disorder (GAD), Major Depressive Disorder (MDD), and Posttraumatic Stress (PTSD) by the aircraft mission types of Unmanned Aerial Systems (UAS; N=60), Cargo (CH; N=33), Utility/MEDEVAC (UH; N=142), and Attack/Reconnaissance (AH; N=59). **RESULTS:** A total of 294 valid responses were received to determine the selected mental health screening criteria. Among pilots, UAS operators had the highest propensity for meeting screening criteria for all three conditions (61.7% ≥ one condition), followed by Cargo (42.4%), Attack/Reconnaissance (40.7%), and Utility/MEDEVAC (33.1%) aviators. When compared by individual conditions, UAS operators' responses were statistically more likely to meet the anxiety (55.0%) and PTSD (31.7%) screening criteria than all other mission types. **DISCUSSION:** The results indicate a high percentage of current and former US Army flight crews experience discernable levels of anxiety, depression, and PTSD. UAS operators' symptom levels were statistically higher than other pilots for anxiety, PTSD, meeting any condition, and meeting all three screening criteria. UAS operators undergo unique stressors from other mission sets. Some missions require operators to follow targets' patterns of life for days before conducting kinetic operations, allowing pilots to see them as individuals. Additionally, operators are not at personal risk, which may increase moral injury. Finally, distinctive barriers to care may impact mental health seeking among this career field. Future research should focus on specific causes for these increased mental health symptom rates and methods for reducing them.

Learning Objectives

1. Participants will gain additional insight into the prevalence of GAD, MDD, and PTSD symptoms among U.S. Army Aviation Pilots.
2. Attendees will be familiar with the higher prevalence of mental health symptom levels among UAS operators when compared to other US Army aviators.
3. Participants will better understand the gaps in knowledge that need to be researched regarding mental wellness among military aviators.

[303] FACTORS ASSOCIATED WITH PRESCRITPION STIMULANT USE FOR FATIGUE MITIGATION IN MILIARY AVIATION

Jacob Berry
U.S. Air Force, Idaho Falls, ID, United States

(Original Research)

INTRODUCTION: Fatigue management is critical for aviation safety, but there are knowledge gaps regarding the operational use of prescription stimulants by military pilots. This cross-sectional study aims to characterize stimulant use patterns and associated factors in a deployed fighter aviation unit over 5 months. **METHODS:** The study will analyze data from 37 single-seat fighter pilots who flew 1,098 sorties during a deployment. Using de-identified pharmaceutical records, flight schedules, and unit rosters, the research will examine relationships between stimulant use and factors such as mission duration, circadian disruption, deployment length, rank, age, and secondary duties.Key hypotheses include: 1. Pilots flying sorties >4 hours are more likely to use stimulants 2. Greater takeoff time variation increases stimulant use likelihood 3. Stimulant use is not affected by deployment duration 4. Lower-ranking pilots use stimulants more frequently 5. Younger pilots use stimulants more frequently 6.Secondary duties impact stimulant use 7. Pilots become physiologically addicted to stimulants during deployments 8. Pilots become physiologically addicted to stimulants during deployments. **RESULTS:** Statistical analysis will assess associations between the binary outcome of stimulant use and various predictor variables. This will illuminate factors influencing pilots' decisions to use prescribed stimulants. **DISCUSSION:** The findings will provide valuable insights into real-world stimulant utilization patterns in an operational military aviation setting. Results can inform evidence-based policies on fatigue countermeasures, guide commander decision-making on pharmaceutical interventions, and identify opportunities to mitigate pre-existing fatigue factors. Ultimately, this research aims to enhance aviation safety while optimizing pilot performance in demanding operational environments.

Learning Objectives

1. Identified the conditions and regulations regulating pharmaceutical fatigue medication in the US Air Force.
2. Described which factors are associated with pharmaceutical utilization during flights.
3. Identified which concepts regarding pharmaceutical fatigue medication are supported by this research.

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Thursday, 06/05/2025 ***10:00 AM***
Centennial Ballroom II

[S-55] SLIDE : BRAIN, BACK, AND BEYOND

Chair: Mary Van Baalen
Co-Chair: Basil Spyropoulos

[304] NOVEL METHOD FOR EVALUATION OF THE EFFECTS OF ROTARY WING TRANSPORT ON A LARGE ANIMAL POLYTRAUMA MODEL

Rachel Kinsler[1], Andrew Mayer[2], Amy Lloyd[1], Laura Kroening[1], Ryan Mackie[1], Ciara Grunig[2], Jessica McQuaid[2], Hans van der Horn[2], Mandy Pacheco[3], Nicholas Michaliszyn[3], Jeffrey Molles[1]
[1]*U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States;* [2]*Mind Research Network, Albuquerque, NM, United States;* [3]*Lovelace Biomedical, Albuquerque, NM, United States*

(Original Research)

INTRODUCTION: Injuries resulting in hemorrhagic shock (HS) and traumatic brain injury (TBI) are leading causes of mortality and morbidity for combat trauma. Treatments consist of hemorrhage control, rapid fluid infusion, and evacuation to a medical treatment facility. Recent scientific publications suggest aeromedical evacuation (AE) may compound brain and organ damage in TBI/HS patients by increasing hemorrhage, decreasing cerebral blood flow, and further reducing the amount of oxygen reaching vital organs. The objective of this study was to evaluate the effects of flight profiles on survival, neurological function, and vital organ function. **METHODS:** The study was completed at the Lovelace Biomedical Research Institute (LBRI) using a validated swine polytrauma model (TBI/HS). It was a 24-hour survival study with 24 swine randomized to one of three experimental conditions: standard evacuation flight (SEF), tactical evacuation flight (TEF), or mock AE flight. Animals were exposed to a rapid acceleration/deceleration TBI. After TBI, animals underwent a controlled blood loss of 40% blood volume. AE was initiated 90 minutes post-blood loss with standard interventions (blood reinfusion, ventilation, and warming). After a 60-minute flight aboard a U.S. Army HH-60M medical helicopter, the animals were monitored for 24 hours. Sensors that measure acceleration, altitude, temperature, and noise were placed in the aircraft and on the animal. Invasive intracranial pressure (ICP), invasive blood pressure, and standard vital signs (VS) were also recorded during flight. **RESULTS:** Full datasets for were obtained for 20 animals (TEF [N=7], SEF [N=7], and mock [N=6]). Most animals showed improved VS upon receipt of standard interventions during AE. Notable events observed during AE include dislodged catheters, increased sedation, VS motion artifact, and tachycardia during maneuvers. Rotational velocity values were significantly different between the TEF and SEF profiles. Post-processing of the VS measures indicated they can be linked to environmental parameters during transport. ICP readings revealed distinct patterns specific to vehicle vibration, in particular vibration transmitted through the head. The clinical outcomes combined with these transport parameters are examined for patient transport algorithm development. **DISCUSSION:** A novel method for quantitative characterization of the effects of rotary-wing flight on a polytrauma model was employed.

Learning Objectives

1. The audience will be able to discuss the unique stresses of the rotary-wing flight environment on patients.
2. The participant will be able to understand the data analysis process for flight data collected and understand how it can be used to improve patient transport.

[305] DETERMINING CLINICALLY RELEVANT FINDINGS FOR MAGNETIC-RESONANCE IMAGING OF THE SPINE IN ASTRONAUTS: A FOCUSED LITERATURE REVIEW

Dacia Boyce[1], Danielle Anderson[2], Richard Scheuring[2]
[1]*U.S. Army, Fort Carson, CO, United States;* [2]*NASA - JSC, Houston, TX, United States*

(Original Research)

INTRODUCTION: Astronauts are routinely exposed to spaceflight hazards during occupational duties. The spine is greatly affected, with losses in strength, bone density, and risk for herniated nucleus pulposus (HNP) postflight. Astronaut spine health is monitored by magnetic resonance imaging (MRI). Historically, control groups consist of age and sex matched cohorts or the crewmembers' preflight MRI, with decision making guided by military waiver standards. With few comorbidities and high standards for physical performance, aviators and elite athletes are suitable populations for comparison. To refine interpretation of astronaut spine imaging, a focused literature review was conducted to determine the clinical relevance of MRI findings in astronauts and these analog groups. **METHODS:** A search of English language peer-reviewed literature published from 1985 to 2024 in PubMed and EMBASE was conducted to elicit studies related to MRI findings and spine pathology in astronauts, analog study participants, elite athletes, and aviators. Waiver practices in military aviation and NASA technical reports were also considered. **RESULTS:** In aviators, accelerated degenerative changes in the spine are frequently noted on imaging, regardless of pain. With age, control populations do not differ significantly from their aviator peers. Back pain is common, but not disabling. Military standards focus on ruling out underlying pathology or risk of sudden incapacity. In those with HNP, after surgical intervention many professional athletes and aviators successfully return to duty, even in collision sports or high-acceleration airframes. In athletes, disabling back pain often requires surgical management to enable return-to-play. Degenerative changes vary with age, sport, and play frequency. Astronauts develop spinal musculature atrophy in microgravity, findings which correlate terrestrially with athletic injury and back pain. Changes in disc height and water content are more pronounced in analog studies than are evident postflight. **DISCUSSION:** Astronauts, athletes, and aviators with a variety of spine conditions continue service or successfully return to duty after rehabilitation. Obtaining pre- and postflight MRIs enable characterization of changes to the spine in microgravity, and provides valuable considerations for mission training. Athlete and aviator data can inform aeromedical decision making for astronauts, especially as their mission tasks expand under the Artemis program.

Learning Objectives

1. Identify MRI findings which are likely of minimal clinical significance in the aviation, athletic, and astronaut populations.
2. Understand medical similarities and key differences between astronauts and selected comparison groups.
3. Understand considerations for return to duty clearance in these special populations.

[306] LOW BACK PAIN IN AVIATION: A LITERATURE REVIEW ON PAIN DEVELOPMENT.

Nina Frings[1], Jan Schmitz[2], Denis Bron[3]
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(Original Research)

INTRODUCTION: Lower Back Pain (LBP) represents a significant health burden in aerospace medicine, particularly affecting flight personnel and astronauts exposed to high G-forces and microgravity environments. This study examines molecular pain mechanisms in LBP and evaluates therapeutic approaches specific to aviation conditions. **METHODS:** A systematic PubMed review analyzed publications from 2019-2024 regarding molecular pain mechanisms, established medications, and innovative therapies in LBP. The analysis focused on early pain stages and intervertebral changes, incorporating data from long-term space missions and fighter pilot cohorts to assess aerospace-specific risk factors. **RESULTS:** LBP involves complex molecular cascades featuring inflammatory mediator-activated nociceptors. Key pathways include TNF-α binding to TNFR1/2 receptors activating NF-κB, IL-1β triggering IL-1R signaling, and IL-6/gp130 complex activating JAK-STAT pathways. Microgravity environments

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demonstrate altered cytokine profiles and accelerated disc degeneration. While conventional treatments (NSAIDs, opiates) work through established mechanisms, emerging approaches using monoclonal antibodies targeting specific cytokines and stem cell therapies show promise for treating acceleration-induced spinal damage. **DISCUSSION:** Understanding molecular pain mechanisms in aerospace-specific LBP reveals new therapeutic possibilities. While traditional medications provide symptomatic relief, targeted therapies such as cytokine receptor antagonists and stem cell approaches offer potential causal treatments with fewer side effects—crucial for maintaining flight fitness. Future research should focus on evaluating these approaches under aerospace conditions and developing personalized treatment strategies addressing aviation and space medicine demands.

Learning Objectives

1. Microgravity environments significantly alter inflammatory cytokine profiles, accelerating intervertebral disc degeneration through activation of molecular pathways.
2. Traditional pain management approaches may be insufficient for aerospace-specific LBP due to operational constraints and altered physiological responses.
3. Personalized medicine approaches, particularly those targeting specific cytokine pathways, show greater promise for maintaining flight readiness than conventional treatments.

[307] POST-CRASH RECOVERY: BACK TO CROP-DUSTING AFTER SEVERE TRAUMATIC BRAIN INJURY

Alexandra Mejia[1], Diego M. Garcia[2], David Puerta[1], Gloria Quinonez[1]

[1]*The Colombia Civil Aviation Authority, Bogotá, Colombia;* [2]*Universidad Nacional de Colombia, Ormond Beach, FL, United States*

(Education - Case Study)

INTRODUCTION: This case study examines the aeromedical fitness evaluation of a crop-dusting pilot who sustained a severe traumatic brain injury (TBI) following an aircraft crash. After a period of treatment, recovery, and assessments for residual neurocognitive impairment, the pilot was granted a special issuance to return to flight duties. **BACKGROUND:** Crop-dusting pilots face high neurocognitive and physiological demands, including g-forces, thermal stress, precise see-and-avoid requirements, and low-altitude maneuvering. The lack of specific evidence for this unique field necessitates a performance-based, individualized approach to aeromedical certification, supported by close monitoring. Standard neuropsychological assessment tools are valuable for initial screening but often require supplementation by in-depth neurocognitive evaluations tailored to operational needs. This case underscores the need for specialized assessments to manage the risk of neurocognitive impairment in TBI-affected pilots, particularly in high-demand operations like agricultural aviation. **CASE PRESENTATION:** The case involves a 49-year-old male agricultural pilot with no significant personal or family medical history, who suffered a TBI with cerebral edema and microhemorrhages after an aircraft accident during a fumigation flight in 2022. Decompressive surgery was not required. After a two-year period of restricted flying duties, he was re-evaluated by a neurologist, an orthopedist, and the Colombian Civil Aviation Authority (ColCAA) aerospace medical team. Flight proficiency tests were also administered with satisfactory results, and follow-ups consistently indicated preserved cognitive function. Additionally, various psychometric scales were used to rule out PTSD. **DISCUSSION:** The ColCAA aeromedical team, following ICAO regulations, deemed the pilot fit to resume agricultural aviation duties with continued surveillance, including biannual neurocognitive assessments. This case illustrates the critical importance of establishing performance-based baselines and conducting individualized aeromedical evaluations across diverse pilot populations and operational settings. Such tailored assessments help ensure that aeromedical evaluations are fair, consistent, and suitable for the demands of specialized aviation roles, thereby promoting both flight and public safety.

Learning Objectives

1. The audience will learn about the aeromedical decision process after a traumatic head injury.
2. To understand the comprehensive assessment process according to ICAO regulation and another international dispositions in difficult aeromedical certification cases.
3. The audience will learn about the complexity and physiological demands on high-performance aviation, like crop dusting pilots.

[308] THE RELATIONSHIP BETWEEN COGNITIVE ABILITY AND RESILIENCE OF FLIGHT STUDENTS

Yujiao Zhu, Kaiyong Xu

Civil Aviation Medicine Center of CAAC, Beijing, China

(Original Research)

INTRODUCTION: To investigate the possibility of auxiliary evaluation of flight students' resilience by making use of cognitive ability tasks, and to provide competence evaluation reference for flight students' selection and training. **METHODS:** 709 flight students were tested by computer-based cognitive ability tests with tablets, including visual matrix comparison task and corresponding variant task, the Resilience Scale for Chinese Adolescent and several basic cognitive tasks. We compared differences in various indicators of tasks among flight students and analyzed whether students' performance in stress scenarios has something to do with their resilience. **RESULTS:** There were significant differences in various indicators between visual matrix comparison task (daily context) and corresponding variant task (stress context) ($t = 27.97 \sim 117.77$, $P < 0.01$). Stress resistance scores of flight students was positively correlated with positive cognition scores (one dimension of resilience) ($P < 0.05$). **DISCUSSION:** The stress situation triggered by cognitive tasks can help to evaluate flight students' resilience to a certain extent so that it could provide scientific evidence and feedback for screening, selecting and training flight students.

Learning Objectives

1. The audience will learn about new ideas and methods that can be tried in the process of screening flight trainees.
2. The audience will learn that, in addition to questionnaires, cognitive tasks can be used to assess trainees' psychological resilience.

[309] MISHAP MENTAL HEALTH RECOMMENDATIONS FOLLOWING MILITARY PILOT SURVIVAL

Kevin Heacock

USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Case Study)

INTRODUCTION: This case report describes a military pilot with multiple mental health disorders who was involved in a mishap resulting in loss of aircraft, with the pilot surviving. **BACKGROUND:** Military pilots with mental health disorders pose a unique challenge in the aviation community. Obtaining a waiver for these conditions requires careful consideration of the individual's ability to safely perform their flight duties. The literature has shown that mental health disorders can negatively impact a pilot's performance and increase the aeromedical risk. Additionally, obtaining a waiver for multiple mental health disorders can be particularly risky, as the interaction between these conditions can be complex and unpredictable. **CASE PRESENTATION:** The subject pilot had a history of multiple mental health disorders. They had a one-year waiver for their mental health conditions as was recommended by the Aeromedical Consultation Service (ACS) at the United States Air Force School of Aerospace Medicine (USAFSAM). The waiver was extended by the waiver authority for 6 months. The pilot was involved in a mishap a few months after the waiver extension, resulting in loss of aircraft. The mishap report recommended this case be used to educate aeromedical professionals across all services about the dangers inherent in obtaining a waiver for multiple mental health disorders and evaluating each case

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studiously to ensure that aircrew are truly safe to fly. **DISCUSSION:** This case underscores the critical importance of cautious evaluation and decision-making in determining the fitness of military pilots with mental health disorders. The literature has shown that mental health disorders can negatively impact a pilot's performance and increase the aeromedical risk. Obtaining a waiver for multiple mental health disorders can be particularly risky, as the interaction between these conditions can be complex and unpredictable. This case can serve as a valuable case study for the training of aeromedical professionals, emphasizing the need for rigorous evaluation and careful consideration of each individual's unique circumstances and the potential risks involved in granting a waiver for multiple mental health disorders. Distro A: Cleared for Public Release, AFRL/PA, AFRL-2024-5999, 25 Oct 2024

Learning Objectives

1. Understand the unique challenges and risks posed by military pilots with multiple mental health disorders.
2. Recognize the importance of careful evaluation, decision-making, and waiver considerations for military pilots with mental health disorders, as highlighted in the case of a military pilot with multiple mental health disorders involved in a mishap.

Thursday, 06/05/2025 ***10:00 AM***
Centennial Ballroom III

[S-78] PANEL: THE VSS UNITY SUBORBITAL FLIGHT EXPERIENCE: MEDICAL OUTCOMES AND LESSONS LEARNED

Chair: Duncan Hughes

Panel Overview: BACKGROUND: *This panel presents medical results of the suborbital flight experience with the now-retired spaceship VSS Unity from 2021-2024, during which time it flew 9 fully crewed suborbital spaceflights involving a total of 36 SFPs and 18 pilots.* ***DESCRIPTION:*** *The first presentation provides an overview of specific medical conditions, risk mitigation efforts, and spaceflight outcomes for suborbital spaceflight participants (SFPs) that were evaluated via the Virgin Galactic standard medical screening process. The second presentation describes observed biopsychosocial effects of the suborbital spaceflight experience. This includes a discussion of anxiety, the effects of prior high-adventure activities, and the "overview effect." Each has implications for screening, training, monitoring, and post-flight follow-up. The third presentation examines radiation monitoring in a high-operations-tempo commercial suborbital spaceflight environment including requirements, equipment selection considerations, the regulatory environment, and implementation challenges. The final presentation provides a first-hand account from a flown researcher regarding the challenges of designing, integrating, and executing human-tended research payloads on a suborbital vehicle platform.* ***DISCUSSION:*** *Discussion will include results, future research plans, and implications for the field of space science. The VSS Unity flight experience illustrates that the learning period continues to be extremely important to iterative integration of lessons learned to improve medical screening, training, and follow up for commercial SFPs.*

[310] MEDICAL CONDITIONS, RISK MITIGATION, AND OUTCOMES FOR COMMERCIAL SUBORBITAL SPACEFLIGHT PARTICIPANTS

Karen Ong, Duncan Hughes, Johnene Vardiman-Ditmanson
Virgin Galactic, Las Cruces, NM, United States

(Education - Program / Process Review)

BACKGROUND: At present, no regulatory standards exist for medical screening of commercial spaceflight participants (SFPs). Additionally, little evidence exists for best practices in screening and medical care for commercial suborbital SFPs, who come from a wider demographic background, may have multiple medical conditions, and receive limited training compared to professional/governmental astronauts. Understanding the outcomes of a broad population of layperson SFPs after spaceflight will inform decisions about risk assessment, safety, and regulation. **OVERVIEW:** Participants of 9 suborbital spaceflights were medically screened, trained, flown, and assessed after return from space as part of routine operations (the Virgin Galactic "Medical Journey"). We summarize observed medical conditions, risk mitigation, and outcomes of commercial suborbital SFPs from the VSS Unity flights (aged 18-80y) flying suborbital profiles on a winged vehicle with maximum acceleration of +4.5 Gz/+2.5 Gx. We discuss notable medical conditions, medical mitigation efforts, medications flown, and outcomes including rates of illness, injury, motion sickness, and accommodations. **DISCUSSION:** No major injuries were reported. The sole minor injury (back strain) resolved with conservative measures. Few SFPs reported motion sickness with all cases being either self-limited or resolved after rescue medication with zero cases of emesis. Of greater concern were unplanned SFP actions, unreported medications (particularly sedative hypnotics), and participant anxiety. No adverse outcomes were observed for SFPs or reported by pilots flying multiple spaceflights (including consecutive monthly missions). In summary, layperson SFPs with a variety of common medical conditions tolerated suborbital spaceflight with no major injuries, cases of emesis, or adverse medical outcomes related to pre-existing conditions.

Learning Objectives

1. The participant will be able to describe rate of injury observed in commercial suborbital spaceflight participants.
2. The participant will be able to describe rates of motion sickness and emesis observed in commercial spaceflight participants.
3. The audience will be able to understand considerations for medical screening and postflight care in scaled operations.

[311] BIOPSYCHOSOCIAL CONSIDERATIONS IN COMMERCIAL SUBORBITAL SPACEFLIGHT

Johnene Vardiman-Ditmanson, Duncan Hughes, Karen Ong
Virgin Galactic, Las Cruces, NM, United States

(Education - Program / Process Review)

BACKGROUND: Considerable interest exists in layperson and scientific communities regarding the biopsychosocial implications of spaceflight. To date, much attention has been paid to potential positive outcomes of spaceflight such as the "overview effect," with less attention paid to the possible adverse sequelae. Previous spaceflight analog (centrifuge) studies have shown anxiety to be one of the most significant medical risks. **OVERVIEW:** We provide an overview of selected biopsychosocial observations from 9 suborbital spaceflight missions involving pilots, mission and research specialists, government, and/or private spaceflight participants (SFPs). We discuss the Virgin Galactic approach to mental health screening for biopsychosocial factors that impact training, safety, and enjoyment of flight. Important considerations include anxiety, crew composition & dynamics, unplanned/undisclosed actions, media and social media pressures, organizational expectations, guest/friends/family concerns, and the influence of previous adverse events. We discuss physiologic arousal, emotional interpretations, the "overview effect", and potential long-term considerations. Finally, we discuss countermeasures and the need for additional observations in this area. **DISCUSSION:** Knowledge regarding the biopsychosocial effects of suborbital spaceflight on layperson SFPs is still in its infancy. The medical screening process and integration of medical personnel into spaceflight training (which can be a novel, stress-inducing environment) allows development of trusting relationships, identification of potential problem areas, implementation of preventive measures, observation of SFP affect and behavior, and early intervention and mitigation if needed. We discuss clinical practices found to be effective, lessons learned, and the importance of providing clinical input on psychosocial and crew dynamics as part of the overall risk assessment.

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Learning Objectives
1. The participant will be able to describe the importance of screening for previous adverse effects and possible mitigation measures.
2. The participant will be able to describe factors that may cause anxiety in commercial suborbital spaceflight participants and potential countermeasures.
3. The participant will be able to describe existing biopsychosocial measures for spaceflight and potential limitations.

[312] RADIATION MONITORING FOR SUBORBITAL PROFILES: IMPLICATIONS AND LESSONS LEARNED

Kristen Taraszewski, Duncan Hughes, Karen Ong
Virgin Galactic, Las Cruces, NM, United States

(Education - Program / Process Review)

BACKGROUND: Suborbital spaceflight profiles bring spaceflight participants (SFPs) to altitudes exceeding 50 miles. Historically, suborbital flight profiles have been considered low dose radiation exposures due to both altitude and duration of exposure. However, the anticipated frequency of suborbital spaceflights at planned operational scale, will yield a flight rate involving multiple flights per day. While no current regulatory guidance exists for radiation monitoring, expert consensus is to treat pilots as radiation workers. Additionally, there is heightened public perception and concern regarding the potential effects on SFPs. **OVERVIEW:** Radiation monitoring of all vehicle occupants involved in suborbital spaceflight missions is being performed at Virgin Galactic. We provide an overview of the development of a human radiation monitoring program in a commercial setting, including equipment selection, evolution of processes, technology & software advancement, data retrieval & interpretation, individual radiation monitoring, and cumulative exposure assessments. Space weather forecasting will also be discussed as it relates to operational preparation and exposure avoidance. We discuss considerations in the implementation of radiation monitoring at scale, including automation of various aspects of data processing, linkage with pilot/SFP electronic medical records for occupational health monitoring, and long-term implications. Finally, we discuss how industry collaboration has catalyzed innovation and government support for developing the next generation of radiation tools and software. **DISCUSSION:** The decision to monitor any human health parameter requires careful consideration of the benefits expected, especially given the mass constraints of missions, the necessity of cost efficiency, and tradeoffs with other critical systems. Despite these constraints, radiation monitoring is a standard practice on Virgin Galactic flights. Data from VSS Unity flights have shown that radiation exposure from a single suborbital spaceflight is similar to that of a commercial airline flight from Denver to Los Angeles. Space weather forecasting efforts ensured 2 planned missions were deconflicted with solar events that may have increased radiation exposure up to six-fold. Thus, continued forecasting, prediction, and monitoring of human radiation exposure for suborbital missions is essential.

Learning Objectives
1. Participants will be able to describe the expected amount of radiation exposure for a single suborbital spaceflight.
2. Participants will be able to understand the challenges in implementing a commercial spaceflight radiation monitoring system.
3. Participants will be able to describe the benefits of long-term monitoring of cumulative radiation exposure for pilots involved in frequent suborbital spaceflight missions.

[313] SUBORBITAL RESEARCH AND HUMAN-TENDED PAYLOADS: LESSONS LEARNED

Kellie Girardi[1], Duncan Hughes[2], Karen Ong[2], Johnene Vardiman-Ditmanson[2]
[1]*International Institute for Astronautical Sciences, Boulder, CO, United States;* [2]*Virgin Galactic, Las Cruces, NM, United States*

(Education - Program / Process Review)

BACKGROUND: Opportunities to conduct space research have traditionally been quite restricted in terms of access, cost, and flexibility. Parabolic flight provides only a limited microgravity duration, whereas orbital flight is cost prohibitive, has years-long planning and manifesting cycles, and generally relies on persons outside of the research team (e.g., government astronauts) for payload manipulation or troubleshooting. **OVERVIEW:** We present a summary of successfully completed suborbital research from the perspective of a flown research specialist. The experiments included the first suborbital, human-tended, free-floating payload, the first continuous glucose monitor worn during dynamic phases of flight, and a wearable sensor system collecting biometric data throughout the spaceflight. Some important considerations for suborbital flight experimentation include the flight profile (acceleration force ranges of -1.5/+4.5 Gz and -0.5/+2 Gx), cabin ergonomics, payload safety reviews, and the coordination, choreography and deconfliction of biologic sampling and the pre-/post-flight access to payloads & astronauts. Special attention will be paid to the process of integrating research with flight operations and maximizing opportunities for science (e.g., aerobatic training flights, dress rehearsal opportunities, etc.). **DISCUSSION:** Suborbital research is often envisioned as part of the experimental progression from parabolic flight to experiments on orbit. However, suborbital research has distinct advantages and challenges which requires its own paradigm for experiment planning and execution. Advantages include rapid access to payloads before/after missions, interaction during the mission, flexibility leading up to the spaceflight, and the possibility of multiple, iterative missions allowing scientist interaction with payloads. Challenges include ergonomics, integration with the flight suit, knowledge of timelines in which interaction is limited or impossible, power sources, and qualification for flight. Wider understanding of these factors can help improve suborbital experimental design and improve efficiency for flight integration.

Learning Objectives
1. The audience will learn about considerations for physiologic evaluation over the course of a suborbital spaceflight.
2. The audience will learn about the unique opportunities and challenges of a suborbital spaceflight platform for experimentation.
3. The audience will learn about emerging best practices for designing and integrating experiments for a suborbital spaceflight profile.

Thursday, 06/05/2025 ***10:00 AM***
Centennial Ballroom IV

[S-57] PANEL: SURGERY IN SPACE: REALITIES AND CHALLENGES OF PROCEDURAL MEDICINE AND CRITICAL CARE FOR EXPLORATION-CLASS SPACE MISSIONS

Chair: Danielle Carroll
Co-Chair: Matthew Melin

Panel Overview: *Delivery of procedural and critical care is resource intensive and requires skilled medical staff, infrastructure, and equipment. Long-duration missions involving deep space transit and planetary surface operations may bring with them unplanned medical events in which respiratory and cardiovascular compromise mandate critical care support. With the evolution of space travel to incorporate a broader swathe of civilian spacefarers, this reality is truer than ever: the space medical community must plan for the provision of medical care and support for individuals with more chronic medical conditions than the average professional astronaut. Even seemingly simple terrestrial medical tasks, such as continuous vital sign monitoring, supportive ventilation, and point-of-care imaging, pose much greater challenges in the exploration-class mission environment. Similarly, establishing prompt access to medication and blood products is often difficult, and availability of skilled staff will likely be limited. Furthermore, physiologic*

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alterations in response to microgravity can predispose astronauts to sepsis and other systemic physiologic conditions, as a result of spaceflight-induced changes in endovascular physiology. This panel, delivered on behalf of the Space Surgery Association, will discuss the current and potential future states of technology and concerns related to procedural support and surgical critical care in the spaceflight environment. Dr. Pantalos will discuss his team's work with dehydrated red blood cells, a promising, developing technology for transfusion therapy both on Earth and during exploration space flight. Ms. Rothrock will discuss the impact of variations in gravitational forces on arterial resistance and blood pressure, highlighting the role of tissue compressive forces in microgravity and hypergravity conditions. Dr. Formanek will discuss the statistical models that his team created to evaluate the effect of level of anesthesiology training on basic perioperative care needs, with relevant applications to space medicine. Finally, Dr. Mathyk will describe her recent work with gynecologic ultrasound in parabolic flight, in support of women's health for upcoming space missions.

[314] UPDATE ON PRESERVED RED BLOOD CELLS FOR TRANSFUSION THERAPY IN REDUCED GRAVITY

George Pantalos[1], Brett Janis[2], Jonathan Kopechek[1], Charles Elder[1], Sienna Shacklette[1], Thomas Roussel[1], Michael Menze[1]
[1]*University of Louisville, Louisville, KY, United States;* [2]*DesiCorp, Inc., Louisville, KY, United States*

(Original Research)

INTRODUCTION: We have previously reported on the need for a method to deliver a transfusion of red blood cells for crewmembers experiencing spaceflight-induced anemia or traumatic blood loss. A new technology that preserves red blood cells by optimized dehydration (dRBC) for up to four years at ambient cabin conditions provides an emerging option. Updates on the status of the dRBC approach is reviewed. **METHODS:** Using compounds upregulated in desiccation-tolerant organisms (anhydrobiotes) and automation of biomedical processes, dehydration techniques for RBCs combined with flow-through ultra-sound induced loading of lyoprotectants (e.g. trehalose) have resulted in the successful preservation of dRBCs for more than four years. Flight performance of dRBCs was evaluated during 0-g periods of parabolic flight to assess rehydration and cell recovery as well as blood gases. Current efforts are optimizing the dehydration process to maximize the oxyhemoglobin/methemoglobin ratio and dRBC recovery. Manual and automated rehydration and performance assessment is being prepared for suborbital and orbital flight evaluations. Preliminary tests are checking the appropriateness of methods used to prepare dRBC from animal blood for human blood. **RESULTS:** Successful rehydration and recovery of dRBCs (>70%) comparable to 1-g values was demonstrated in parabolic flight with in-flight pO2 ≥ 150 mm Hg. Effective simulation of dRBC infusion was demonstrated in parabolic flight. The oxyhemoglobin/methemoglobin ratio is very close to clinical acceptance (90%) with the level of hemolysis declining. Creating dRBC from human blood will be similar to the process with animal blood with minimal modification. **DISCUSSION:** Steady progress is being made to create clinically acceptable dRBC for terrestrial and spaceflight transfusion therapy. The dRBC-based transfusible units are thermally stable, easily stored, have significantly extended shelf-life compared to current blood preservation protocols, rehydrate rapidly in reduced gravity, are lightweight, and use a conventional blood infusion set. Crews will launch from Earth with dual-chamber bags containing compatible dRBCs and rehydration solution, and COTS transfusion sets packed in medical supply kits for immediate use. Further evaluation of dRBC rehydration will occur in a suborbital flight in 2026 and in orbital flights in 2025 and 2026. [NASA-80NSSC18K1664, DOD W81XWH-20-1-0866, NSF PFI-1827521, NASA 80NSSC23K0855]

Learning Objectives

1. Understand the concept of red blood cell preservation by optimized dehydration processes.
2. Understand the options for rehydration of dehydrated red blood cells.
3. Appreciate the logistical advantages of using dehydrated red blood cells over current blood preservation methods.

[315] BODY MASS AND GRAVITATIONAL FORCES: A MODELING APPROACH TO UNDERSTANDING BLOOD PRESSURE REGULATION

Sara Rothrock[1], Mimi Lan[2], Jay Buckey[3]
[1]*Brown University, Providence, RI, United States;* [2]*Dartmouth College, Hanover, NH, United States;* [3]*Dartmouth College, Lebanon, NH, United States*

(Original Research)

INTRODUCTION: Understanding blood pressure dynamics in microgravity is crucial for managing critical care patients during spaceflight. Continuous blood pressure measurements in space show reductions compared to preflight values, but the mechanisms driving these changes remain unclear. Though previous research has emphasized blood volume reduction due to fluid shifts, this alone cannot explain both the immediate and sustained drops in blood pressure observed in astronauts. The elimination of tissue compressive forces on the vascular system in weightlessness represents another critical factor beyond fluid dynamics. These absent forces may decrease arterial resistance, potentially contributing to lower blood pressure. To better understand these mechanisms of blood pressure regulation, this study examines the relationship between body mass and blood pressure across varying gravitational forces. **METHODS:** Using a lumped-parameter cardiovascular model developed in MATLAB® Simscape Fluids™, blood flow dynamics were simulated to examine how varying gravitational forces and body mass alter blood pressure through changes in transmural pressure. Body mass variations were simulated by adjusting anthropometric measurements in 10% increments. Measurements were taken at the aortic arch, a region shown to be an optimal location for predicting cardiovascular events. **RESULTS:** Simulations demonstrated a reduction in blood pressure under microgravity (0G) conditions, with the extent of this reduction varying by body mass. Individuals with greater simulated body mass experienced more pronounced decreases in both systolic and diastolic pressures in microgravity. Conversely, in hypergravity (2G) conditions, blood pressure increased due to elevated tissue compressive forces, which raised vascular resistance and, consequently, blood pressure. **DISCUSSION:** These findings suggest that body mass and gravitational forces play a role in regulating blood pressure by modulating transmural pressures. Although long-term spaceflight involves reductions in blood volume, the immediate decrease in blood pressure observed in microgravity may stem from the absence of tissue weight effects on vessels, particularly in individuals with higher body mass. This mechanism is further supported by the hypergravity findings, where increased tissue weight elevates vascular resistance and blood pressure—an effect that also scales with body mass.

Learning Objectives

1. Understand how the absence of tissue compression in microgravity can lead to reduced arterial resistance and lower blood pressure.
2. Learn about how cardiovascular lumped parameter modeling can assist in predicting blood pressure responses to gravitational changes.

[316] EFFECTS OF INEXPERIENCED PROVIDERS ON PERIOPERATIVE CARE AND SPACEFLIGHT IMPLICATIONS

Arthur Formanek[1], Taania Girgla[1], Gavin Ovsak[2]
[1]*Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States;* [2]*MD Anderson Cancer Center, Houston, TX, United States*

(Original Research)

INTRODUCTION: Delivery of perioperative care is highly resource intensive and requires skilled medical staff, infrastructure, and equipment. Safe perioperative care in spaceflight remains a large potential problem, and a trained anesthesiologist will likely not be readily available. Spaceflight could lead to scenarios requiring airway, cardiovascular,

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and pharmacologic support both in low Earth orbit and exploration class missions. Furthermore, care provided by skilled anesthesia providers versus relatively unskilled providers could necessitate more resources to provide for adequate care. In addition, spaceflight would introduce unique constraints to perioperative care, such as upmass. **METHODS:** Anesthesia induction, emergence, procedure start and end times, level of anesthesia training (clinical anesthesia (CA) years 1-3), case urgency, ASA patient status, intubation attempts, and IV attempts for laparoscopic appendectomies and cholecystectomies from August to October 2021-2023 were extracted from the Epic electronic medical health record at the Brigham and Women's Hospital. 64 cases were identified, and a multivariate linear regression model was created via Eviews statistical software using least squares method to forecast anesthesia relevant task times and were controlled for resident training level, case acuity, and ASA status. **RESULTS:** The multivariate linear regression induction start to intubation complete time in minutes = 2.68 + 2.00(CA1) - 1.79(urgent case) + 2.45(CA3 on call) + 0.81(ASA number) was statistically significant for forecasting intubation time. F-statistic probability was 0.000017 and adjusted R2 0.32. All predictor variables had a p-value <0.05 except for ASA number, which was 0.079. Breusch–Pagan test for heteroskedasticity revealed F-statistic probability 0.95. Number of intubation attempts, IV attempts, and emergence time did not reach statistical significance. **DISCUSSION:** New trainees required a significantly increased time to complete intubation. For perioperative care to be safely administered peri-spaceflight, knowing the impact of relative lack of training and limited resources is needed. Using terrestrial analogues and models to forecast possible spaceflight perioperative needs gives greater insight into possible crew and hardware requirements. Length of time to complete medically necessary tasks, especially with no ability for an experienced provider to rescue, can have profound implications. Further research, including communication delay and inability of a skilled provider to directly intervene is warranted.

Learning Objectives

1. The participant will learn about the effect of inexperienced providers on performance of basic perioperative tasks.
2. The participant will understand the implications of relatively unskilled providers being directed by skilled providers in a spacecraft or remote environment.
3. The participant will learn about methods of delivery of safe perioperative care in remote environments.

[317] HANDHELD POINT-OF-CARE ULTRASOUND FOR GYNECOLOGICAL IMAGING UNDER MICROGRAVITY

Begum Mathyk[1], Shawna Pandya[2], Heather Wright Beatty[3], Matthew L. Anderson[1], Adrian Kohut[1]

[1]*Morsani College of Medicine, University of South Florida, Tampa, FL, United States;* [2]*International Institute for Astronautical Sciences (IIAS), Alberta, BC, Canada;* [3]*National Research Council Canada, Ottawa, ON, Canada*

(Original Research)

INTRODUCTION: Gynecologic emergencies are prevalent across all ages, often presenting with symptoms such as abdominal pain and abnormal vaginal bleeding. Females frequently visit emergency departments more than males, with genitourinary system conditions being a common diagnosis. Given the closed and shared spaces of long-duration spaceflights, it is crucial to anticipate and manage such emergencies in space. This study evaluates the feasibility and effectiveness of astronauts performing self-administered transabdominal gynecologic imaging using handheld Point-of-Care Ultrasound (POCUS) under microgravity conditions, focusing on maintaining the privacy of the subject. **METHODS:** The study utilized a parabolic flight profile to achieve ~20 seconds of microgravity per parabola on the National Research Council's (Ottawa, Canada), Falcon 20 aircraft over the course of a series of parabolas. A female medical practitioner performed a transabdominal self-scan of her lower abdomen during the microgravity phases of parabolic flight using a commercially available handheld ultrasound (HHU) device. **RESULTS:** The subject successfully completed the self-scan of the uterus within 20 seconds of entering microgravity, obtaining clear images of the uterus, fundus, myometrium, endometrial lining, and cervix (video). During the scan, a 3D volume of the bladder was also measured (video). The quality of the images was sufficient to exclude the presence of macroscopic masses, such as fibroids, and to delineate the borders of the endometrial lining. The images were automatically saved to the cell phone application. **DISCUSSION:** This is the first study to report on self-performed handheld POCUS for transabdominal gynecologic imaging under microgravity. The findings confirm the potential of portable ultrasound devices to independently diagnose and monitor gynecological conditions in space, enhancing medical autonomy and preserving privacy.

Learning Objectives

1. Understanding of female anatomy, recognize common gynecologic emergencies, and identify associated symptoms as they might present during space missions.
2. Learning the principles and techniques involved in conducting self-administered handheld Point-of-Care Ultrasound (POCUS) for gynecologic imaging under microgravity conditions.
3. Developing strategies to maintain privacy and enhance autonomy in medical diagnostics during space missions, ensuring ethical standards and crew safety.

Thursday, 06/05/2025 ***10:00 AM***
Regency V

[S-58] WITHDRAWN

[S-76] PANEL: THE GOOD, THE BAD, AND THE UGLY OF ARTIFICIAL INTELLIGENCE

Chair: Estrella Forster
Co-Chair: Annette Sobel

Panel Overview: *Artificial Intelligence (AI) has become ubiquitous in our society. This panel will introduce the subject with a focus on human factors, medical, and allied health sciences professions. It will start with Dr. Stephen Veronneau, who will address the history of AI since the 1950s and how it continues to develop into an integral part of our domestic and professional lives. His presentation will be followed by Dr. Melchor Antuñano with a review of the latest AI advances in technology applicable to medical research and practice. Dr. Annette Sobel will then discuss human factors AI applications involving civilian, military and emerging operations with a focus on the human-computer relationship. The panel will close with Dr. Estrella Forster, who will provide a review of the ethical issues associated with AI, its management, and the attempt to humanize its future capabilities. The panel promises to be a balanced review of AI and how we can best exploit it to enhance aerospace safety.*

[416] HISTORY OF ARTIFICIAL INTELLIGENCE

Stephen Veronneau

FAA, Office of Aviation Medicine, Des Moines, WA, United States

(Education - Tutorial / Review)

INTRODUCTION: Historical Overview of Artificial Intelligence. **TOPIC:** The history of artificial intelligence(AI) began in the 1950s when early computer scientists like Alan Turing and John McCarthy explored the idea of machines that could think. Turing proposed the Turing Test to evaluate a machine's intelligence, while McCarthy coined the term "artificial intelligence" and organized the first AI conference in 1956, marking the official birth of AI as a field. Early AI focused on symbolic reasoning and problem-solving but struggled

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due to limited computing power and data. In the 1980s, "expert systems" became popular in medicine, attempting to replicate human clinical decision-making. However, the AI "winter", the marked decrease in government funding, soon followed due to the PC revolution, the high computational needs of AI software, and unmet expectations and loss of profit seen by businesses. The 1990 and early 2000 decades saw a shift toward statistical methods and machine learning, which advanced as computing power grew exponentially. Breakthroughs like IBM's Deep Blue close defeat of chess champion Garry Kasparov in 1997 demonstrated AI's growing capability. In 2007 IBM's Watson development led to it winning Jeopardy in 2011. In the 2010s, deep learning and neural networks spurred rapid progress in AI, leading to applications in image and speech recognition, natural language processing, and more. This era saw the rise of AI tools like Siri, Alexa, self-driving car technology and image generation. Today, AI continues to evolve, powering applications across industries and inspiring debate over ethics, privacy, and the future of humanity. There are some analogous comparisons between internet search engine history, the infinite monkey theorem, and the development of the internet itself. **APPLICATION:** The use of any technology to assist or replace human intelligence will encompass beneficial, neutral and adverse associations. Understanding the history of the technological development will benefit the end user. Challenges in input data quality and availability, inadequate risk control measures or regulation, escalating power requirements, rising costs, coupled with unrealistic expectations and fears are some of the current issues in AI. **RESOURCES:** 1. ChatGPT. 2. Crossnohere NL, Elsaid M, Paskett J, Bose-Brill S, Bridges JFP Guidelines for Artificial Intelligence in Medicine: Literature Review and Content Analysis of Frameworks J Med Internet Res 2022;24(8):e36823. 3. Gastrointestinal Endoscopy. (Gastrointest Endosc 2020;92:807-12.)

Learning Objectives

1. The audience will learn about Artificial Intelligence history and timeline.
2. The audience will learn about Artificial Intelligence and the non-linear changes in its development and application over time.
3. The audience see an illustrative Artificial Intelligence hallucination example.

[417] THE PRACTICAL APPLICATION OF NEW AI TOOLS IN MEDICINE – CHALLENGES AND OPPORTUNITIES

Melchor Antunano
FAA, Oklahoma City, OK, United States

(Education - Tutorial / Review)

INTRODUCTION: This presentation will discuss the use of AI tools in medicine, current practical applications, regulatory approval, potential applications in Aerospace Medicine, and implementation challenges. **TOPIC:** The first applications of Artificial Intelligence (AI) tools in medicine started in the 60's and 70s using rule-based systems intended to provide support in medical diagnosis and decision making. These foundational AI medical tools included Dendral, MYCIN, Internist-I and CASNET. In addition to their potential benefits, these tools also showed significant technical, ethical and regulatory challenges. Between 1995 and August 2024 the US FDA has authorized nearly 1,000 AI/ML enabled medical devices (hardware and software). More than 75% of them are medical imaging tools. Other specialties being increasingly impacted by AI tools are Cardiology and Neurology. Almost all of the AI medical tools in the US have been cleared through the FDA's less stringent, faster and cheaper 510(k) Pathway. However, the FDA clarified that any AI tools intended to make specific recommendations about diagnosis or treatment must be considered medical devices and certified accordingly. The International Medical Device Regulators Forum published a Possible Risk Categorization Framework to help identify risk categories of Software as a Medical Device based on how it is used for healthcare decisions. **APPLICATION:** Several of the leading medical AI tools include IBM Watson Health, Google DeepMind Health, Zebra Medical Vision, PathAI, Viz.ai, Aidoc, Tempus, Qure.ai, Enlitic, etc. As of today, none of these tools are being used to replace humans for medical decision-making. Several areas to improve healthcare through the use of AI include: 1) Personalized care, 2) Patient access to medical care, 3) Patient monitoring and education, 4) Discovery of new drugs, 5) Targeted Clinical Trial Recruitment, 6) Physician training, 7) Surgical procedures, 8) Surgical effectiveness and efficiency, etc. Any improvements in these areas will have an impact on aerospace personnel and passengers. Potential application of AI tools in Aerospace Medicine include Health monitoring and diagnosis, 2) Predictive analytics for health risks, 3) Mental health and cognitive assessment, 4) Autonomous medical assistance, 5) Radiation exposure management, 6) Adaptive exercise regimens, 7) Telemedicine support and decision-making aid, 8) Medical simulation & training, 9) Fatigue & sleep management, etc. **RESOURCES:** 1. ChatGPT. 2. US Food and Drug Administration. 3. The Medical Futurist.

Learning Objectives

1. The audience will learn about the use of AI tools in medicine.
2. The audience will learn about the most common applications of AI in medicine today.
3. The audience will learn about potential applications of AI tools in Aerospace Medicine.

[418] THE DILEMMA OF AI AND HUMAN FACTORS: ADVANCING THE PARTNERSHIP IN AEROSPACE MEDICINE

Annette Sobel
Texas Tech University, Lubbock, TX, United States

(Education - Tutorial / Review)

INTRODUCTION: The evolution of Artificial Intelligence (AI) over the past seventy years has been punctuated by maturation of a number of enabling tools and increasing integration of human factors considerations that both broaden and limit its application to health care. **TOPIC:** As AI matures and potential applications to aerospace medicine become increasingly apparent, it is beginning to take on many more humanoid qualities. These qualities reflect characteristics such as neurologic dysfunction such as hallucinations and fabrication of information, perceptual difficulties, and illusions. and integration of fake information into real information to enhanced capability for information integration and fusion with varying degrees of validity and reproducibility. Corresponding decision assisting software intended to be task-oriented may lose focus of attention and integrate ancillary data demonstrating relevant human interdependence on information. An essential characteristic of the human's willingness to rely on AI tools is trust. **APPLICATION:** This presentation will demonstrate aerospace medicine examples of the process of developing the human computer relationship and the bond that results in collaborative AI-human decision-making. The audience will gain an enhanced understanding of the pitfalls and opportunities associated with AI and begin to appreciate the multi-domain environment supported by these systems. Specific examples of the end-user's (whether health care provider or patient) opportunities to derive conclusions with human like biases, ethics-based conclusions, and subjective clinical assessments. An introduction to mitigation strategies for effective healthcare use will be presented to enhance the audience's understanding of paths to effective use of this emerging technology.

Learning Objectives

1. The audience will understand the complexities of the AI - Human Bond.
2. The audience will be able to identify some specific concerns regarding AI reliability and trust.
3. The audience will be able to describe qualitative metrics of human performance using AI tools.

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[419] THE PHILOSOPHICAL INTRICACIES OF EMULATING HUMANS

Estrella Forster
Self (retired), San Antonio, TX, United States

(Education - Tutorial / Review)

INTRODUCTION: While Artificial Intelligence (AI), along with the humanoid robots emerging from the same are evolving at astonishing speed, the questions regarding their benefit and management continue to raise concerns by both users and developers. This presentation will discuss the issues associated with AI, including the ethics regarding its use and the extent of its ability to ultimately emulate humans. **TOPIC:** The word robot first appeared in 1942 in Isaac Asimov's science fiction short story titled "Runaround." In this comic, the laws of robotics were first presented and have been known to us since our childhood. Through his work, Asimov set a new standard of plausibility on the likely difficulty of developing intelligent robots and the technical and social problems that could result. These controversies have been considered by all of us and are constantly illustrated by the media, the press, and academia. Studies have found that AI can lead us to new insights and accelerate the pace of innovation, including the realization of Eureka! moments as we conduct scientific research. However, ethical and moral issues such as privacy, accountability, bias, transparency, interpretability, robustness, and reproducibility raise innumerable questions that demand responsibility in the management of AI. Some have asked: "Can AI, which operates through lines of code and algorithmic processing, harbor a 'soul' in some sense similar to humans? While AI can replicate certain aspects of human intelligence and emotional responses, therein lies a critical distinction. Replication is not equivalence. The 'understanding' of emotions by AI is a programmed mimicry, devoid of the subjective quality of phenomena… that keep living beings with 'soul." Will we be able to discern and/or control the implicit camouflage of AI? In some future, Will some of us confuse AI with GOD? **APPLICATION:** This discussion summarizes how AI may be responsibly implemented in aerospace medicine and human performance.

Learning Objectives

1. The participant will be able to understand how issues associated with AI may be managed in aerospace medicine and human performance.
2. The participant will be able to understand the technical and social problems that may result from AI.

Thursday, 06/05/2025 ***10:00 AM***
Regency VII

[S-59] PANEL: UTILIZATION OF ARTIFICIAL INTELLIGENCE-BASED TOOLS TO SUPPORT AUTONOMOUS MEDICAL OPERATIONS

Chair: Jay Lemery
Co-Chair: Kris Lehnhardt

Panel Overview: INTRODUCTION: *This panel summarizes recent activities that the Exploration Medical Capability (ExMC) Element of NASA's Human Research Program (HRP) is utilizing to leverage the power and efficiency of artificial intelligence (AI) tools to reduce human system risk in space medicine operations.* ***TOPIC:*** *The first presentation describes the adaptation and fine-tuning of an open-source large language model (LLM) based on the OpenBIO 8 billion parameter LLM. This "Doc-in-a-Box" (DIB) LLM features multi-modal capability (interactive voice and image acquisition) and following containerization was deployed on an IoT core in collaboration with the Lunar Command and Control Interoperability (LuCCI) Project. The second presentation in this panel outlines the novel approach to development and utilization of the Objective Structured Clinical Examination (OSCE) for evaluating the performance of DIB. Features of the OSCE and performance of the model as scored by physicians trained in Aerospace Medicine will be discussed. The third presentation describes the use of AI-based tools to collect and summarize vast amounts of information necessary to create Clinical Finding Forms (CliFFs) as part of an Evidence Library for use by the IMPACT probabilistic risk assessment tool. Utilizing AI-tools to streamline the labor-intensive process of CliFF development could substantially reduce the amount of physician labor necessary to complete such tasks in the future. The fourth presentation in this AI Panel explores the breadth and depth of AI-related activities currently ongoing or in planning stages within ExMC and HRP. Topics include LLM use at the edge, directed acyclic graph analysis, synthetic clinical data generation. The final presentation presents the possibilities of incorporating Agentic AI to automate tasks and facilitate in the movement of data using integrated data systems platforms. Following a Federated model, an Agent can control the flow of information to maximize the overall performance using AI tools via distribution of computing capacity over multiple APIs.* ***APPLICATION:*** *Taken together, the presentations in this panel summarize the challenges to be overcome and potential solution spaces to be explored and matured to progressively enable autonomous medical operations using AI-based tools.*

[323] DOC-IN-A BOX: ADAPTATION AND FINE TUNING OF AN OPEN-SOURCE LARGE LANGUAGE MODEL TO SUPPORT AUTONOMOUS MEDICAL OPERATIONS

Martin Garcia[1], Giovanni Marchetti[2], Ali Al[3], Jay Lemery[1]
[1]*NASA, Houston, TX, United States;* [2]*Google, Palo Alto, CA, United States;* [3]*KBR, Houston, TX, United States*

(Education - Tutorial / Review)

INTRODUCTION: Autonomous Medical Operations can be enhanced with decision support modalities that leverage the power of artificial intelligence-based tools. **TOPIC:** Here we describe the adaptation and fine-tuning of an open-source large language model (LLM) based on the aaditya/Llama3 OpenBIO 70BN parameter model. This "Doc-in-a-Box" (DIB) model incorporates multi-modal capability (interactive voice using Open AI/whisper-large-3 model and image acquisition using Google PaliGemma open-vision model) with the goal of deployment on an IoT core as part of the Lunar Command and Control Interoperability (LuCCI) Project. The DIB was originally developed in Google Cloud's Vertex AI environment and Colab with code written in Python and structured as a Jupyter notebook to leverage cloud computing resources for efficient execution. The models were loaded and presented via a Gradio-based interface for a user-friendly experience. The server was specifically designed for machine learning-intensive workloads via use of graphics processing units (GPUs). An embedding model was used for retrieval augmented generative processing of data extracted from pdf files. Each individual model was assigned to one of either the eight or four available GPUs to maximize parallel processing capabilities during the early development. Preliminary testing of the model demonstrated high levels of accuracy in response to specific prompts derived from Objective Structured Clinical Exam questioning (results of the testing are detailed in another abstract within this panel). Demonstration of good model performance in a cloud environment was the requirement necessary to move into an edge device application. **APPLICATION:** The DIB model was further reduced to 3BN and 1BN parameter models for containerization and evaluation at the edge. This IoT core edge device was designed to provide on-premise cloud-like computing capabilities for secure IoT applications utilizing data not rated for cloud platforms and hosting containerized applications, e.g., Lunar Surface Operations. The prototype was designed to extend the open-sourced capabilities of the Cloud onto remote, isolated locations such as the Lunar surface to define a loosely coupled, hardware independent, highly automated hosting platform. Further testing, further refinement and validation of DIB on similar IoT platforms are necessary steps toward enabling Autonomous Medical Operations in a variety of settings.

Learning Objectives

1. The participant will be able to identify the constituent elements of a large language model needed to develop a functioning language clinical decision support.

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2. The participant will be able to appreciate the use of the objective structured clinical exam [OSCE] as a benchmark in measuring the success of the AI clinical decision support.
3. The participant will be able to appreciate the limitations of early AI models in processing and memory whose limitations will ultimately serve as preconditions for successful AI clinical decision support in flight.

[324] AGENTIC ARTIFICIAL INTELLIGENCE TO SUPPORT AUTONOMOUS MEDICAL OPERATIONS

David Hilmers[1], Martin Garcia[2], Truong Le[2], Carlos De Los Santos[2], Jay Lemery[2]
[1]*KBR, Houston, TX, United States;* [2]*NASA, Houston, TX, United States*

(Education - Tutorial / Review)

INTRODUCTION: Agentic artificial intelligence (AI) systems can independently plan, make decisions and even "learn" as they manage automated tasks and facilitate the movement of data using integrated data systems platforms. Following a Federated model, an AI Agent can control the flow of information to maximize the overall performance using AI tools via distribution of computing capacity over multiple platforms. **TOPIC:** AI-based tools are being developed at an astounding rate and despite the already vast market, AI is expected to grow at approximately 37% per year from 2023 until 2030. Key to fully realizing the potential of all these new tools is incorporation of AI Agents designed to function with minimal human assistance. The possibilities for Agentic AI in healthcare have been described as revolutionary by enabling round-the-clock monitoring of patient status (e.g., vital signs, laboratory results, electronic records), real-time adjustments to treatment plans and perhaps the capacity to provide a predictive and/or diagnostic function for sub-clinical presentation of disease. Through analysis of multiple data streams from a panoply of sources including wearable sensors, Agentic AI systems have the potential to improve patient monitoring and treatment all while freeing the clinician from many rote, and often mundane tasks. Similarly, by leveraging multiple reference databases, informed, evidence-based decisions can be reached by Agentic AI at speeds and capacity that are far beyond the capability of humans. Critical to the success of these systems and currently a significant barrier for entry in mainstream medical practice is the lack of verification and validation necessary to gain trust from both the patient and the caregiver perspectives. **APPLICATION:** The potential for AI-based systems to task off-load caregivers and provide real-time analysis and treatment recommendations is compelling. Recent examples of such systems at NASA portends giant leaps forward as these systems become more trusted and validated. Paramount in deployment of Agentic AI systems will include assurance of data privacy and security and as discussed in this panel the role of synthetic data must be carefully considered.

Learning Objectives

1. The participant will understand how an AI Agent can control the flow of information to maximize the overall performance using AI tools via distribution of computing capacity over multiple platforms.
2. The participant will be able to describe how Agentic AI-based systems can reduce task loading for caregivers and provide real-time analysis and treatment recommendations.
3. The participant will have a greater understanding of how deployment of Agentic AI systems must include assurance of data privacy and security of personal information.

[325] NASA HUMAN RESEARCH PROGRAM'S USE OF AI TECHNOLOGY TO MITIGATE EXPLORATION MEDICAL RISK

Truong Le[1], Jordan Blackwelder[2], Kurt Berens[2], Carlos De Los Santos[1], Jay Lemery[1]
[1]*NASA, Houston, TX, United States;* [2]*KBR, Houston, TX, United States*

(Education - Tutorial / Review)

INTRODUCTION: NASA's Human Research Program (HRP) has employed a rigorous approach to understanding and mitigating risk through countermeasure development to optimize crew health and performance. The scope of available artificial intelligence (AI) tools continues to expand at a remarkable pace and the use AI technologies to facilitate human system risk management has presented key opportunities including application in clinical decision support systems (CDSS). **TOPIC:** The Exploration Medical Capability (ExMC) Element of HRP is leading the effort to capitalize on the strengths of AI tools through several current projects (e.g., development of space medicine-literate large language models and updating a probabilistic risk assessment (PRA) tool evidence library) are that leverage AI-tools in collaboration with data scientists from Google and Microsoft to improve autonomous CDSS capability. Projects currently in the planning stages seek to foster collaboration across numerous and diverse working groups by removing barriers between organizations and our commercial partners to support the overall Agency AI goals and the vision promulgated by the Agency AI Working Group. Utilizing AI-tools to analyze directed acyclic graphs will help the Human System Risk Board track risks as they evolve from spaceflight hazards to mission-level outcomes. Development of synthetic data sets will allow multi-disciplinary Teams to conduct modeling of astronaut health and performance without the impediments related to data privacy and security. Additional efforts with data systems platforms and improvements to the AI data pipeline are envisioned using the Insight Data platform (a data pipeline "development initiative and process" based on Microsoft best practices). Future endeavors to support CDS involve utilization of commercially available tools and databases using an integrated data systems platform through a Federated, multi-modal AI system. Deployment of such Agentic-AI platforms will considerably benefit the effort to mitigate and ultimately eliminate medical risks while simultaneously reducing crew medical officer cognitive load. **APPLICATION:** Implementation of the ExMC AI strategy has enabled creation of AI prototyping in Agile environments to rapidly assess viability of AI tools to reduce development cycle times and accelerate the path toward infusion for operationally relevant solutions for HRP and its stakeholders.

Learning Objectives

1. The learner will understand the ExMC projects that leverage AI-tools.
2. The learner will be able to describe the strengths and challenges of public-private partnerships surrounding AI research and development.
3. The learner will be able to discuss the need and the barriers to development of synthetic data sets.

[326] OBJECTIVE STRUCTURED CLINICAL EVALUATION OF AN ARTIFICIAL INTELLIGENCE CLINICAL DECISION SUPPORT SYSTEM TOOL

Arianna Nelson[1], Ali Al[1], David Hilmers[1], Jay Lemery[2]
[1]*KBR, Houston, TX, United States;* [3]*NASA, Houston, TX, United States*

(Education - Tutorial / Review)

INTRODUCTION: Clinical integration of artificial intelligence (AI) has revealed the need for novel evaluation frameworks to assess the efficacy and reliability of AI clinical decision support systems (CDSS). Objective Structured Clinical Evaluations (OSCEs) are an established method for summative assessment of clinical skills and decision-making of human clinicians. Employing OSCEs to evaluate AI CDSS offers a promising approach to validating their clinical utility and efficacy in diverse clinical scenarios, and benchmark AI performance using established clinical standards. **METHODS/RESULTS:** We conducted an AI CDSS evaluation under the Lunar Command and Control Interoperability (LuCCI) project. The CDSS "Doc-in-a-Box" (DIB) is an 8 billion (B) parameter large language model (LLM) model (reduced from the 80 B parameter OpenBio LLM) trained on curated aerospace medicine textbooks. DIB was tested across clinical scenarios designed to model real-life spaceflight cases using an OSCE framework adapted to assess the AI tool's medical decision-making. Key evaluation metrics included accuracy of recommendations for diagnoses, medical exams/tests, and therapeutic

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interventions. The OSCE was scored by three physician evaluators using a 100-point rubric designed to align with best practices and standard of care. Descriptive statistics were used to report scores and inter-rater reliability was assessed using a one-way ANOVA. OSCE assessing the psychomotor domain of the DIB resulted in scores between 68-83/100 [Mean: 76, StDev: 6.16], corresponding to "good" clinical competency. There was no significant difference in scores between the raters ($p < 0.05$), suggesting that the assessments were consistent and reliable. **DISCUSSION:** DIB demonstrated accuracy in diagnostic recommendations and decision support across various scenarios. However, certain limitations were noted, including difficulty in suggesting/identifying "can't miss" diagnoses if the presentation was atypical. Additionally, the tool scored higher on the diagnostic portion of the rubric, with lower scores in therapeutic recommendations. These findings highlight the importance of continuous refinement and validation of AI tools specific to deployment in spaceflight through rigorous evaluation frameworks like OSCE. Remaining challenges include ensuring that these evaluations capture the full spectrum of clinical decision-making scenarios that will be confronted by CMOs during missions and adequately reflecting real-world variability of the austere spaceflight environment.

Learning Objectives

1. Participants will gain insight into how Objective Structured Clinical Evaluations can be used in benchmarking AI performance.
2. Participants will understand the key evaluation metrics used to evaluate the performance of a large language model.
3. Participants will realize the limitations observed and the importance of continuous refinement and validation necessary to develop rigorous evaluation frameworks.

[327] ARTIFICIAL INTELLIGENCE (AI) METHODS FOR AUTOMATING THE IMPACT TOOL EVIDENCE LIBRARY

Gina Vega, Ali Al, Kurt Berens, David Hilmers, Chris Zahner, Lynn Boley
KBR, Houston, TX, United States

(Education - Tutorial / Review)

INTRODUCTION: The development of the Evidence Library for use with the IMPACT (Informing Mission Planning via Analysis of Complex Tradespaces) probability risk assessment tool involved a multilayered, time intensive process of data collection and analysis by subject matter experts from the Exploration Medical Capability (ExMC) Element Clinical and Science Team to produce clinical findings forms (CliFFs) for 120 medical conditions. Artificial Intelligence Large Language Models (LLMs) can be leveraged to facilitate this process, thus reducing labor and time. **TOPIC:** CliFFs contain information about medical conditions as they pertain to spaceflight. This includes condition definitions, incidence data, crew task impairment estimates caused by conditions, treatment protocols and references to literature used for gathering condition evidence. Guided by the Evidence Library Methods document [1] and the CliFF development instructions, a team has leveraged Microsoft Azure AI services and open-source documentation to construct an AI-assisted automated pipeline for CliFF development. This process is designed to search, retrieve, and evaluate the applicable data, and ultimately generate a completed CliFF. The LLM evaluates the relevance of each of the source materials to spaceflight, either as direct evidence or as an analog. The model extracts keywords and generates brief summaries to enhance search and retrieval in later stages of CliFF development. For instance, it can calculate epidemiological statistical data, such as incidence rates and the likelihood of best or worst-case scenarios. **APPLICATION:** Large Language Models (LLMs) can efficiently summarize large amounts of text. Leveraging this technology will automate data retrieval and evidence gathering for medical databases, like the IMPACT tool, by aiding in the labor-intensive process of analyzing large bodies of literature and organizing it into a formatted document like a CliFF. This added efficiency will enable expeditious expansion of the Evidence Library with additional medical conditions and update previous CLiFFs as new technology becomes available.

Learning Objectives

1. Participants will gain insight into how use of Large Language Models can significantly reduce the amount of time necessary to summarize literature when building an Evidence Library.
2. Participants will understand the process of building an Evidence Library for probabilistic risk assessment.
3. Participants will be able to describe how AI tools can improve trade space analysis.

Thursday, 06/05/2025 ***10:00 AM***
Hanover F/G

[S-60] SLIDE : VENTILATION BLUES

Chair: Thomas Hoffman
Co-Chair: Barrett Campbell

[328] THE PRESSURE DYNAMICS OF ENDOTRACHEAL TUBE CUFFS WITH REDUCING ALTITUDE

Alicia Tucker, Luke Dimsey
Tasmanian Health Service, Hobart, Australia

(Original Research)

INTRODUCTION: Endotracheal intubation is commonly employed for safe transport of critically ill patients requiring aeromedical retrieval or transfer. There is a paucity of literature demonstrating the relationship between altitude and pressure in endotracheal tube (ETT) cuffs. If intubation occurs in an aircraft at altitude, we theorised that as ambient pressure increases, on landing, there would be a reduction in the volume of the air in the ETT cuff, and ergo, loss of cuff pressure with resultant adverse risks to the patient. We hypothesised that ETT cuffs filled with fluid would maintain their pressure during descent compared with air-filled cuffs. Additionally, fully aspirating the ETT cuff of any residual, manufacturing, air prior to inflation with fluid, would provide further benefit. **METHODS:** This study was undertaken in a hypobaric chamber. Pig tracheas were used to simulate a human trachea given their similar anatomy. ETT cuffs were connected to a pressure transducer for continuous real-time monitoring. The tracheas were intubated at 8000ft and ETT cuffs were inflated with either air (AF), fluid (FF) or fluid post full aspiration of any residual cuff air (AspFF), to a standard cuff pressure of 14-22mmHg (20-30 cmH2O). Pressure readings were recorded at 1000ft intervals during descent to, and including, sea level. Changes in cuff pressure were compared between each of the inflation method used. **RESULTS:** 12 endotracheal intubations at 8000ft were completed for each of the cuff inflation methods. All three groups showed a reduction in cuff pressure with reduced altitude, however, this is most marked in the AF and FF groups. Average starting cuffs pressures were 20, 19.7 and 20mmHg respectively for AF, FF and AspFF methods. Cuff pressures reached 0mmHg in all AF cuffs by 2000ft, and 1+-1mmHg in FF cuffs by sea level (0 ft), $P<0.01$. By contrast, the AspFF ETT cuffs retained a greater cuff pressure, with sea level pressures of 9.8+-0.5mmHg. Although still a significant reduction ($p<0.05$) in pressure, there was maintenance of cuff pressure, to near acceptable levels, when compared to the other techniques. **DISCUSSION:**This study demonstrated that inflating ETT cuffs with fluid during intubation at altitude does not protect against under inflation of the cuff during descent in an aircraft. Full aspiration of air prior to inflation with fluid results in better maintenance of cuff pressures and is advised as a change of practice within this industry.

Learning Objectives

1. Understand that increased ambient pressure on landing significantly reduces cuff pressures in air filled ETTs following intubation at altitude.
2. Learn that for intubation at altitude, aspirating residual air, from manufacturing, from ETTs and inflation of ETT cuffs with fluid leads to better maintenance of cuff pressures during landing in an aircraft and thereby may reduce adverse risks to the patient.

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[329] NON-INVASIVE VENTILATION FOR RESPIRATORY FAILURE: A RETROSPECTIVE CROSS-SECTIONAL STUDY OF A RURAL AUSTRALIAN AEROMEDICAL RETRIEVAL SERVICE

Mina Arsanious, Rebecca Burn, Peter Brendt
Royal Flying Doctors Service Australia (South Eastern Section), Dubbo, Australia

(Original Research)

INTRODUCTION: Respiratory Failure (RF) can be supported either with endotracheal tubing & invasive ventilation (ETTIV) or non-invasive ventilation (NIV). NIV for RF has become commonplace in hospitals yet its uptake pre-hospitally is poorly documented in literature. NIV uses significantly more oxygen which is important for hypobaric-hypoxia and long retrieval times. ETTIV for RF pre-hospitally is done typically to avoid the complications of NIV. Limited space and access to equipment for in-flight intubation, has historically made ETTIV prior to take-off a more attractive strategy. This retrospective cross-sectional study looks at all patients over a 57-month period who suffered RF needing support with either NIV or ETTIV, retrieved by a rural Australian fixed-wing aeromedical service. Feasibility and challenges of NIV in aeromedical retrieval were examined. **METHODS:** Ethical approval was gained, and all missions reviewed. Exclusion criteria included road-retrievals or incomplete records. Demographic data for all eligible patients were collected and retrieval timings compared using two-tailed Man-Whitney U. Primary endpoints were the type of respiratory support received, and any subsequent complications associated with NIV as per Weller et al. 2021 definition. Management strategies for said complications were examined. **RESULTS:** Total doctor-onboard missions = 6,406. For all cases of RF needing support, 56 cases met exclusion criteria. Final n = 90. 69 retrieved with NIV. 21 intubated prior to transfer. Median scene time for NIV = 70 mins (IQR 50-100) & 115 mins (IQR 85-145) for ETTIV (p-value = 0.0004). Median transit time for NIV = 100mins (IQR 70-130) & 110mins (IQR 89-125) for ETTIV (p-value = 0.68). 30% of all NIV cases experienced a complication, all of which were managed in transit, not resulting in significant harm or deterioration. Only 1 patient retrieved with NIV required intubation in-flight. The most common complication was mask intolerance which was successfully managed with medications. All patients who were intubated prior to departure had an observable period of deterioration or complications on NIV prior to retrieval team involvement. **DISCUSSION:** Complications with NIV do occur but are shown to be manageable in-flight with no harm to patients. Patient optimisation with opiates, benzodiazepines or ketamine improves respiratory mechanics and mask compliance. ETTIV still has a role in deteriorating RF which can be largely predicted.

Learning Objectives

1. NIV can be safely used in aeromedical retrievals though the potential complications need to be understood and planned for.
2. Prudent patient selection and optimisation increases the chances of success with NIV for the aeromedical retrieval of respiratory failure.
3. Not all respiratory failure can be retrieved on NIV, and for such patients endotracheal intubation and invasive ventilation is prudent - there are key features that can identify this patient group.

[330] CREATION OF A MOBILE O2 TRANSPORT REQUIREMENTS (MOTR) CALCULATION TOOL FOR AEROMEDICAL EVACUATION

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(Education - Program / Process Review)

BACKGROUND: Transporting patients requiring supplemental oxygen is a critical component of aeromedical evacuation, especially in high-stress military environments. Accurate O2 calculations are essential to ensure that patients receive adequate oxygen throughout transport and enroute care. Current manual calculation methods are time-consuming, prone to errors, and detract from the primary focus on patient care, especially in the Aeromedical Transport enviornment. **OVERVIEW:** The MOTR App is an innovative solution designed to address the limitations of manual O2 calculations in aeromedical transport. This tool automates the process of determining O2 requirements for various transport durations, monitoring tank durations in real-time, and assessing transport capabilities based on available O2 supplies. By streamlining these calculations, the MOTR App enhances resource allocation and operational efficiency. It directly addresses current gaps in O2 management during transport and provides a scalable solution for future needs in military and civilian aeromedical operations. **DISCUSSION:** Operational/Clinical Significance: The MOTR App significantly improves the accuracy of O2 calculations, which is crucial for maintaining patient stability and safety during transport. It reduces the risk of errors and ensures that medical personnel can focus on critical care rather than manual calculations. Advancement in Aeromedicine/Human Performance: By automating O2 requirements, the app advances aeromedicine by integrating technology to enhance decision-making and operational effectiveness. It supports improved human performance by reducing cognitive load and allowing healthcare providers to concentrate on patient care. Cross-Service/International/Military-Civilian Support: The MOTR App is designed for use across various DoD medical transport teams, including Aeromedical Evacuations (AE), Critical Care Aeromedical Transport Teams (CCATT), and Medevac units. Its applicability to both military and civilian settings underscores its value in fostering cross-service and international cooperation, improving patient care standards universally.

Learning Objectives

1. The Participant will be able to understand the factors that go into calculating oxygen supply requirments for patients undergoing long aeromedical transports.
2. The participant will be able to download the app for (free) use - the app is non-monitized, without ads. This is an attempt to dessiminate a useful medical tool to the wider aeromedical community.

[331] AIRWAY MANAGEMENT IN OFFSHORE RESCUE HELICOPTERS: EVALUATING TRACHEAL INTUBATION IN LATERAL AND ICEPICK POSITIONS USING VIDEO AND DIRECT LARYNGOSCOPY

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(Original Research)

BACKGROUND: Effective airway management in offshore rescue helicopters is hindered by spatial constraints and the patient's lateral position, rendering standard intubation techniques unfeasible. Despite the critical need for rapid airway control in these settings, there is a lack of evidence-based guidance on alternative intubation methods suitable for confined spaces. This study addresses this gap by evaluating novel intubation strategies, including the icepick method, using both direct and indirect laryngoscopy under simulated helicopter conditions. **METHODS:** Following ethical approval (Ethics Committee of Carl von Ossietzky University Oldenburg, file number 2023-074), a randomized simulation study was conducted. 20 experienced paramedics, each with at least 5 years of field experience, performed 440 intubation attempts on a high-fidelity manikin replicating helicopter cabin constraints. 7 airway management techniques, including the icepick method, were evaluated in random order using both direct and indirect laryngoscopy (VLS). Participants received standardized training on all techniques prior to the study. Success rates, first-pass success, intubation times,

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and subjective ease-of-use ratings were recorded. Data were analysed using ANOVA and chi-squared tests. **RESULTS:** The standard intubation position (control group) achieved a 100% first-attempt success rate with VLS. Among alternative methods, kneeling sideways with VLS showed a 94.5% first-pass success rate, reaching 100% on the second attempt. The fastest intubation times were observed in the standard position (19.1 ± 9.8 seconds) and kneeling sideways (21.3 ± 9.5 seconds), with VLS being faster in both (16.6 ± 8.8 seconds and 14.6 ± 4.5 seconds, respectively). The icepick position without VLS had the longest intubation time (34.0 ± 13.4 seconds). Significant differences were found between methods ($p < 0.05$). Participants rated the kneeling sideways position with VLS as the easiest alternative method under simulated conditions. **DISCUSSION:** In simulated offshore rescue helicopter conditions, indirect laryngoscopy from the side demonstrated high success rates and efficient intubation times. Participants found this method easy to perform. These findings suggest it may be a viable alternative to conventional intubation in constrained environments. Limitations include the use of manikin simulations and experienced operators. Clinical studies are needed to confirm its efficacy in real-world settings.

Learning Objectives

1. The participant will be able to identify the limitations of standard tracheal intubation techniques in the confined space of an offshore rescue helicopter and understand the need for alternative airway management strategies.
2. The audience will learn to evaluate the effectiveness of alternative intubation methods, including kneeling sideways and the icepick position, using direct and indirect laryngoscopy under simulated helicopter conditions.

[332] A NEW CONCEPTUAL M0DEL OF CARDIOPULMONARY RESUSCITATION BASED ON A LEVER MECHANISM (MMM PROJECT): FIVE YEARS OF EXPERIMENTAL EXPERIENCE.

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(Original Research)

BACKGROUND: Long missions to the Moon and Mars and space tourism on the low Earth orbit (LEO) pose unprecedented risks to astronauts' lives and health. These new challenges are likely to require appropriate medical support soon. Microgravity and hypogravity transform the reality of performing cardiopulmonary resuscitation (CPR) and providing advanced emergency medical care (AEMC). The success of space medical support depends on how effectively emergency medical assistance and CPR are adapted to these new conditions. The main problem for astronauts performing CPR and AEMC is to assume and maintain a stable position of the rescuer vis-à-vis the patient. This study aimed to investigate the possibilities of using the lever mechanism to stabilise rescuers and enable effective chest compression and airway ventilation in microgravity. **METHODS:** An innovative model of the Crew Medical Restraint System (CMRS), called Mobile Medical Module (MMM), was tested. This new construction maintains a stable rescuer-patient position without external handles, additional straps or harnesses. Instead, the MMM uses a new restraint system, called the Atmed Restraint System (ARS), based on the lever mechanism achieved by placing the lower limbs of the rescuer against specially designed handles. Its testing was conducted in 2020-2024 in terrestrial conditions, neutral buoyancy, and a human training centrifuge. **DISCUSSION:** The results demonstrate that the ARS maximises the effectiveness of basic CPR in simulated microgravity in neutral buoyancy and a human training centrifuge. It allows for better stabilisation of rescuers next to the patient compared to the traditional stabilisation system that relies on the "V" belts. The measurement of the rescuers' muscle tension determined the activity of the new muscle groups, generating additional force necessary for effective CPR in microgravity conditions. Regrettably, similar generation of additional force during chest compressions and ventilation does not occur in the traditional CMRS. With the ARS, the stable position obtained by rescuers allows them to perform all advanced terrestrial medical procedures. Using the lever mechanism in MMM improves CPR's effectiveness and facilitates medical assistance in microgravity, compared to the traditional method of attaching rescuers to the CMRS.

Learning Objectives

1. The audience will learn about an innovative system for stabilizing rescuers next to the patient in microgravity conditions.
2. The audience will learn about methods of generating additional force facilitating chest compression and airway ventilation during CPR in microgravity.
3. The audience will learn about a new solution for managing a medical team while providing care to the patient in microgravity.

[333] THROMBOSIS FOLLOWING RECENT COVID-19 INFECTION AND-LONG HAUL FLIGHT: A CASE REPORT

Gordon Cable[1], Tracy Smart[1], Heidi Blain[2]
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(Education - Case Study)

INTRODUCTION: Long-haul air travel is a recognized risk factor for venous thromboembolism (VTE). The prevalence of SARS-CoV-2 has introduced new challenges in managing thromboembolic diseases, as evidence suggests that it induces a hypercoagulable state. This case report aims to highlight the compounded risk of VTE following COVID-19 infection and extended air travel. **BACKGROUND:** SARS-CoV-2 induces a prothrombotic state via inflammation-mediated endothelial activation, which persists beyond the acute infection phase. While the risk of thromboembolism is well-documented in critically ill COVID-19 patients, there is limited literature on VTE in asymptomatic or mildly symptomatic patients, especially following long-haul travel. Air travel itself is a known risk for VTE due to prolonged immobility and environmental factors, such as reduced cabin pressure. **CASE PRESENTATION:** A 60-year-old female presented with dyspnoea, cough, and left calf pain following a 17-hour international flight. She had tested positive for COVID-19 nine days prior and had been treated with PAXLOVID. A repeat rapid antigen test on the day of travel was weakly positive. Her past medical history included a prior 2cm deep vein thrombosis (DVT) of the right soleal vein after knee surgery. On admission, her oxygen saturation was 92%, and a CT pulmonary angiogram confirmed bilateral pulmonary emboli. She was treated with anticoagulation and discharged after two days on oral anticoagulants. Post-discharge ultrasound revealed a non-occlusive DVT in her left leg. Testing for underlying coagulopathies was unremarkable. **DISCUSSION:** This case underscores the elevated risk of VTE in post-COVID-19 patients following long-haul flights. The combination of a hypercoagulable state from recent SARS-CoV-2 infection and the immobility during air travel likely contributed to the development of thromboembolism. The case highlights the need for awareness of DVT risk post SARS-CoV-2 and possibly preventive anticoagulation in at-risk individuals. Further research is needed to establish guidelines for managing travel in post-COVID-19 patients.

Learning Objectives

1. The audience will learn about the possible link between SARS-CoV-2 infection, thromboembolism and long-haul air travel.
2. The participant will be able to consider the requirement for prophylactic anticoagulation for long haul airline passengers recently diagnosed with SARS CoV-2.

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Thursday, 06/05/2025 ***10:00 AM***
Grand Hall East Corridor - Posters Only

[S-61] POSTER : CAN MY BODY HANDLE IT? GZ TO SLEEP TO HYPOXIA

Chair: Jaime Harvey
Co-Chair: Patrick Edwards

[334] DETAILED LOCALIZATION OF SPINAL TRAUMA IN SEVERE ROTARY WING MISHAPS: LESSONS FROM FATAL ACCIDENTS IN GERMAN MILITARY AVIATION BETWEEN 1965 AND 2017

Naomi Kono, Michael Schwerer
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(Original Research)

INTRODUCTION: A significant number of aircraft accidents involve complex forms of interfering impact in the three-dimensional space resulting in severe, frequently lethal blunt force trauma. Detailed knowledge of those injury patterns substantially contributes to understanding the bio-mechanical interactions between the aviator and the cockpit design, including the aircraft's crew protective systems, during the impact. Considering the differences in e.g. the vertical and horizontal speed, obstacle geometry, impact vectors and angles between fixed-wing and rotary-wing crash events, helicopter mishaps, particularly from military aviation, undoubtedly require a distinct scientific evaluation. **METHODS:** The medico-legal records of 115 death victims from 55 lethal rotary wing mishaps in the German military between the years 1965 and 2017 were reviewed for the detailed location and extent of spinal injuries. Information about the helicopter type and accident scenario were correlated. **RESULTS:** In 63 decedents (54.7%), spinal lesions were reported. Twenty-three of these victims (36.5%) demonstrated complex, multi-segmental spinal injury patterns. Two decedents even showed total body fragmentation. In contrast, isolated injuries in the cervical, thoracic and lumbar compartment occurred less frequently. Most common fracture locations were in the cervical and thoracic spine (60.3% and 61.9%, respectively). Injuries of the cervical or thoracic spine alone occurred in 28.5% of the cases. Isolated lumbar spine fractures were found in only 6.3% of the victims. The injury types included simple and dislocated fractures, spinal cord transection, and even decapitation. The helicopter types most often involved in all deadly mishaps were the Bell UH-1D (36%) and the Alouette II (22%). **DISCUSSION:** Successful analysis of spinal injuries in rotary wing accidents in military aviation undoubtedly depends on the comprehensive evaluation of the detailed location and fracture morphology in every respective segment of the spinal cord. The comprehensive reconstruction of three-dimensional blunt force impact, torsion and deceleration provides soil for the improvement of flight crew protective systems. Decreasing numbers of spinal injuries in modern military helicopters compared to the UH-1D or Alouette II emphasizes the positive effects of updated cockpit designs. Further improvements can be expected from the distinct bio-mechanical evaluation of present-day accidents.

Learning Objectives

1. Our results emphasize that most spinal injuries after lethal helicopter accidents are multisegmented.
2. The audience will learn about how the distinct morphological and bio-mechanical investigation of injuries basically supports continuing improvements in cockpit-design and flight-crew protective systems.

[335] WITHDRAWN

[336] FIFTEEN YEARS OF EXPERIENCE IN HIGH-G CENTRIFUGE TRAINING AT THE GERMAN AIR FORCE CENTRE OF AEROSPACE MEDICINE

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(Education - Program / Process Review)

BACKGROUND: With modern fighter aircraft such as the Eurofighter which are capable of sustaining 9 Gz, aircrew are operating at the limit of human performance. A sudden critical reduction of cerebral blood flow can cause pilots to lose consciousness (G-LOC: G-induced loss of consciousness). Human centrifuges (HC) are used to improve and maintain pilots' G-tolerance. 15 years (2009-2023) of HC training at the Air Force Centre of Aerospace Medicine were reviewed and analyzed. **OVERVIEW:** In 2006, the German Air Force HC was upgraded to support the introduction of the Eurofighter. This modernization provided more realistic centrifuge training to cover NATO requirements. An onset of 6 Gz/s, a maximum of 9 Gz and a dynamic flight simulation mode for simulated air combat maneuvering (sACM) are now the standard of training. Between 2009 and 2023, 2863 jet aircrew (age 30 ± 8 years) were trained in the centrifuge.The pilots were equipped either with (five bladder) anti-G trousers or with the Aircrew Equipment Assembly (AEA, full coverage anti-G trousers and positive pressure breathing). The anti-G straining maneuver (AGSM) training is done in a special simulator where pilots get biofeedback about the effectiveness of their AGSM.In the AEA group (n=1347), 9 pilots fell into G-LOC. This is a share of less than 1 %. In the group using only anti–G trousers (n=1519), 74 G-LOC cases occurred, which is a share of 5 %. Due to safety reasons, pilots underwent the runs under medical monitoring: ECG and an ear pulse curve generated by photoplethysmography. This ear pulse curve provides a helpful information of concomitant arterial pressure at brain level.Cardiac arrhythmia (ventricular extrasystoles, bigeminy and couplets) under Gz exposure occurred frequently (20 %), but after completion of the centrifuge runs, the heart rhythm was self-limited and returned to normal in all cases. Common side effects were arm pain and " G measles". **DISCUSSION:** International High-G training in the GAF HC is well established and has shown to be medically safe. The AEA has proven to provide very effective anti-G protection. For future centrifuge training of F 35 pilots, the HC will get an upgraded modular cockpit design to provide a more realistic training. A major research project will be the G-LOC detection by electromyography and ear pulse photoplethysmography to integrate it into physiological sensing technology used in flight and increase the safety of aircrew.

Learning Objectives

1. The audience will learn about the benefits of centrifuge training.
2. The audience will learn about the effectiveness of two different anti-G systems.

[337] COULD HEART AGE SERVE AS A POTENTIAL PARAMETER RELATED TO THE G TOLERANCE?

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(Original Research)

INTRODUCTION: In clinical medicine, the various age measurement—such as chronological age (CA), biological age, and bone age—serve as indicators of the health status. Recently, heart age (HA) estimation based on the electrocardiogram (ECG) data has been established using a deep learning model (DLM). A greater disparity between the HA and CA has been linked to cardiac diseases and poor health outcomes. During the flight maneuvers, the gravitational force (G force), acting from head to toe, places a significant amount of stress on the cardiovascular system of the military aircrew. Consequently, this study primarily aims to investigate as to whether the heart age is related to the G tolerance. **METHODS:** This cross-sectional study was conducted from November 2023 to June 2024, involving military pilots participating in the high G training at the Aviation Physiology Research Laboratory.

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During the registration process, a Watch Series 8 (Apple Inc, Taipei City, Taiwan) was utilized to collect the ECG data, from which the HA was calculated using our DLM as the baseline. The HA was also recorded prior to the centrifuge ride. The relaxed G tolerance (RGT) was assessed under slow acceleration (onset rate: 0.1 G/sec), with the RGT defined as a complete loss of peripheral vision or a 50% loss of central vision. The association between the RGT and HA was analyzed using the SPSS. **RESULTS:** Among the 110 subjects, the average age and RGT were 23.9 ± 1.8 years and 4.9 ± 1.0 G, respectively. The HA increased significantly before the centrifuge ride to 45.4 ± 9.5 years, which corresponded with a rise in the heart rate to 94.7 ± 16.6 beats per minute. A moderate positive linear correlation was observed between the HA and the heart rate prior to training. In the logistic regression analysis using the backward selection, our findings indicated that the military pilots with an elevation in their HA of less than 10 years had a 2.94-fold greater likelihood of achieving a higher RGT. **DISCUSSION:** We believe that this research is the first to illustrate the relationship between the G tolerance and the cardiac status as described by the artificial intelligence technology. However, it is concerning that the HA estimated by the previous DLM was significantly higher than the CA, despite an inverse relationship between the two in relation to the G tolerance. For the military pilot population, we intend to adjust and refine the developed model in the near future.

Learning Objectives

1. Application of clinical artificial intelligence in the high G training.
2. The development status of clinical artificial intelligence technology in our country.

[338] RELATIONSHIP BETWEEN BASELINE AIRCREW CONDITIONING PROGRAM ASSESSMENT METRICS AND PRIMARY ACCELARATION TRAINING PERFORMANCE IN AIR FORCE PILOTS

Justin Reed[1], Alex Kasak[2], John Harrell[2], Derek Haas[3], Sarah Pfahler[4], Hannah Graves[1], Molly Wade[2]

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(Original Research)

INTRODUCTION: High Gz flying is physically demanding for fighter aircrew requiring primary acceleration training for G-qualification. G-qualification requires withstanding up to 7.5Gz and completing simulated aerial combat maneuvers, which may be influenced by one's physiological traits. Since 2022, student pilots have completed a standardized aircrew conditioning program-assessment (ACP-A) upon flying training entry and have access to human performance specialists through the comprehensive readiness for aircrew flying training (CRAFT) program. The purpose of this study is to investigate associations between ACP-A and CRAFT metrics with G-qualification. **METHODS:** G-qualification form 4293, CRAFT specialist utilization rates, and ACP-A results of 97 pilots (89-males, 8-females) were analyzed. Three aerospace physiologists independently scored 4293's to differentiate those who passed all training on the first try (score=0) from those needing extra coaching, and thus higher scores for additional G-exposures. Specialist utilization rates of cognitive performance, strength and conditioning, and dietetics were tabulated. Finally, characteristics of age, height, weight, body composition, broad jump, isometric deadlift, inverted row, plank, and estimated VO2max were taken from the ACP-A. Linear regression and ordinal logistic regression analysis were used to create models to describe the relationship between independent variables and final G-qualification score and score bins. **RESULTS:** Final scores ranged from 0-6 and bin counts were 56, 25, and 16 for ≤0.5, 1-2, >2, respectively. The model did not explain the variance in final score (R2=0.04) and no variables were significant at α.05. A sub-analysis of males retained 8 variables with 55% accuracy predicting score bin. Height was significant ($p<0.01$) indicating that for each additional centimeter in height the odds of a higher score bin increased (Odds Ratio=1.14, 95% Confidence Interval 1.09-1.12). **DISCUSSION:** No metrics from the ACP-A or CRAFT were predictive of G-qualification score. In males, height was significantly associated with G-qualification, as has been previously reported. While characteristics in this study were not predictive of G-qualification score, additional ACP-A metrics tested in the fighter pilot pipeline and associations with G-qualification warrant investigation. Continuing to obtain standardized data throughout the pilot lifecycle is essential for future data-driven decisions.

Learning Objectives

1. Attendees will learn how the aircrew fitness assessment was standardized.
2. Attendees will understand efforts to explore associations between aircrew fitness assessments and centrifuge training.

[339] GZ TOLERANCE AND THE ANATOMICAL AND BIOMECHANICAL PROPERTIES OF THE EXTRACRANIAL VENOUS SYSTEM

William Fraser

Silatyuk Research, Toronto, ON, Canada

(Original Research)

INTRODUCTION: Under 1 Gz, the cranial vasculature dominates cerebral blood flow (CBF) resistance. Mathematical models have shown that with increasing acceleration the collapse of the internal jugular vein (IJV) and the resulting increase in blood flow resistance, GLOC will occur at approximately 4.5 Gz. However, these models did not consider the individual anatomical and biomechanical variability of cerebral venous outflow, nor the changes in vessel biomechanics during complex Gz maneuvers. **METHOD:** A steady-state model of CBF under Gz was developed to take into account blood flow through the IJV and the vertebral plexus (VV). Data from tilt table, Valsalva maneuver, and positive pressure breathing (PPB) studies, and data from in vitro studies on isolated veins were used to determine the variation in the vessel stiffness and changes in the cross-sectional area and shape as a function of the transmural pressure. The resulting system of non-linear algebraic equations relating perfusion pressure, cross-sectional area and flow was simulated with the fsolve function of the SciPy python library. The model was used to investigate the impact of anatomical variation in the IJV and VV among subjects, variability in the biomechanical properties of the veins, and the impact of myogenic and baroreceptor reflex-induced changes in blood vessel biomechanics on CBF during complex Gz exposures. **RESULTS:** Differences in the baseline anatomical and biomechanical properties of the IJV and VV can account for the range of Gz tolerances reported in the literature. Simulated complex Gz profiles, Valsalva manoeuvres, and PPB that impact the neurogenic and myogenic regulation of IJV and VV stiffness, cross-sectional area, and cross-sectional shape resulted in second-by-second changes in CBF. **DISCUSSION:** Routine imaging of the venous drainage pathways and blood flow during tilt table and Valsalva maneuvers may be useful in predicting the Gz tolerance of individuals. The non-linear, time-dependent biomechanical properties of the IJV and VV, which can be affected by repeated pressure loading, circulating hormones, and baroreceptor inputs may explain individual tolerance to the push-pull maneuver, variation of Gz tolerance with repeated exposures, and the efficacy of Valsalva maneuvers and PPB in reducing the risk of GLOC.

Learning Objectives

1. The audience will learn about the importance of mathematical modeling and simulation in investigating the role of the extracranial venous system in regulating cerebral blood flow under complex Gz maneuvers.
2. The audience will learn about the importance of the cerebral venous drainage system in explaining the variability in Gz tolerance.

[340] WITHDRAWN

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[341] EVALUATING EEG DURING HIGH WORKLOAD WHILE ACCOUNTING FOR SLEEPINESS SCORES

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(Original Research)

INTRODUCTION: Measuring cognitive workload with physiological measures can be challenging due to factors that may influence physiology outside of workload manipulations (e.g., fatigue). Electroencephalography (EEG) has been shown to detect changes in brain activity for fatigue such that alpha power spectral density (PSD) increases with fatigue and beta decreases. The Karolinska Sleepiness Scale (KSS) is a subjective measure of sleepiness on a 9-point scale. In this analysis of archival study data, the relationships between EEG variables and KSS scores were evaluated. **METHODS:** Preexisting data from a replication study of psychophysiological indicators was conducted at USAARL were used. Army aviators completed a high workload flight in the UH-60 simulator. KSS was collected before the simulator flight. EEG was recorded during the en route flight task. PSD values for alpha, beta, and theta bands were calculated. The ratio of alpha and beta to theta was also derived. Mixed-effects linear regression models were run predicting the EEG outcomes using workload level and KSS scores (fixed effects) with participant number included as a random intercept. **RESULTS:** The linear regression model was significant for the EEG beta values ($t(15) = 8.82$, $p < 0.001$), indicating for every one unit increase in KSS scores, beta is predicted to decrease by 0.12248 units.The model did not show any significance in KSS and EEG alpha, theta, or ratio values. However, KSS and EEG theta values trended toward significance ($p = 0.056$) and could potentially change with a larger sample size. **DISCUSSION:** Workload manipulations had greater influence on EEG outcomes than KSS scores, with beta values results showing consistency with past literature. The results showed that alpha EEG values decrease as fatigue increases using KSS scores, which is inconsistent with past literature. Measuring subjective fatigue can aid in explaining the variability in the data due to individual differences in experience of fatigue. Limitations in the preexisting data can account for the insignificant results of other EEG outcomes and KSS measure that were not accounted for, such as age, and small sample size. We can possibly find a consistency in fatigue prediction using a different fatigue measure or measuring multiple times throughout data collection.

Learning Objectives

1. The audience will be able to understand the trend in KSS scores and EEG values from the preexisting data.
2. The audience will be able to identify factors that may impact accuracy in fatigue prediction measures.
3. Highlighting the limitations of using fatigue measures to predict EEG outcomes.

[342] PILOTS SUBJECTIVE WORKLOAD AS A RESULT OF PERFORMANCE - TEMPERAMENT INTERACTION

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Military Institute of Aviation Medicine, Warsaw, Poland

(Original Research)

INTRODUCTION: Research on the individual factors that determine workload is important from the perspective of psychological selection of pilots and flight safety. Workload can be described as an effect of task difficulty. The same task may be difficult for one person and easy for another. In addition, difficulty can result from the effort expended on the task. The purpose of our work was to describe the phenomenon of workload as an effect of the interaction of individual operator characteristics and the level of task performance. **METHODS:** The study included 84 participants aged 18 to 24 years (M=19.4; SD=1.4). Workload was assessed using the NASA-TLX, while individual characteristics were assessed using the FCB Temperament Inventory. Executive processes were measured with the SMK Test. Statistical analyses were performed using R software version 4.3.2 with the lme4 package. Analyses focused on a regression model in which mental workload intensity, reported after the SMK test (NASA-TLX score), was treated as a function of task performance level. **RESULTS:** The regression models showed that introducing interactions between performance level and temperament traits significantly improved the model fit, explaining nearly 20% of the variance. Significant interactions were found for Perseverance (B=-14.24) and Persistence (B=11.88). Subjects with high Endurance experienced greater mental workload as their SMK performance declined, whereas subjects with low Endurance experienced high workload during effective performance and lower workload during ineffective performance. A similar pattern was observed for Perseverance individuals with low levels experienced high workload during effective performance and lower workload during ineffective performance. In contrast, individuals with high levels of Perseverance felt low workload during effective performance and high workload during ineffective performance. **DISCUSSION:** For pilots, where high task performance is essential, an optimal temperament profile appears to be high Endurance with moderate Perseverance, potentially reducing fatigue and enhancing sustained functioning. Such individuals experience relatively low strain during efficient task performance, potentially leading to less fatigue and sustained effectiveness. However, those with high Endurance and high Perseverance may show increased strain under low performance, indicating reduced resilience in challenging situations, which could pose safety risks.

Learning Objectives

1. The participant will be able to understand the role of temperamental traits in assessing the workload experienced.
2. The audience will learn about the importance of the interaction between performance and individual differences due to temperamental traits for workload assessment.

[343] CASE OF SUSPECTED OXYGEN PARADOX REACTION DURING AIRCREW TRAINING IN HYPOBARIC CHAMBER

Kristian Thidemann Andersen, Karsten Lindgaard
Danish Defence Medical Command, Vojens, Denmark

(Education - Case Study)

INTRODUCTION: This case report describes a suspected oxygen paradox reaction in a pilot trainee during hypobaric training.**BACKGROUND:** NATO military aircrew must undergo mandatory aviation physiology training to prepare them for physiological changes encountered during flight, which can pose risks to flight safety. Part of this training includes time in a hypobaric chamber, where aircrew are exposed to pressures equivalent to approximately 25,000 feet of altitude, inducing hypoxia symptoms. After hypoxia exposure, participants refit oxygen masks to breathe 100% oxygen, recovering from hypoxia. However, some individuals may experience an acute worsening of hypoxia symptoms during this recovery phase, known as a paradoxical reaction to oxygen. Typically, this reaction causes visual disturbances, although rare cases can result in loss of consciousness. **CASE PRESENTATION:** We present the case of a 22-year-old healthy pilot trainee, who experienced a loss of consciousness during hypoxia training in a hypobaric chamber. The student was exposed to a pressure altitude of 25,000 feet for approximately 2 minutes. Upon refitting his oxygen mask and breathing 100% oxygen, he reported feeling increasingly unwell with a worsening of visual symptoms. Moments later, he lost consciousness for approximately 30 seconds. Chamber technicians reported suspicion of trainee hyperventilation during the hypoxia exposure. Subsequent cardiological evaluations found no underlying pathology, leading to a conclusion that this was a case of paradoxical reaction to oxygen following hypoxia exposure. **DISCUSSION:** The physiological mechanism behind the paradoxical oxygen reaction remains unclear. The risk of this response may increase with hypocapnia, often due to hyperventilation, and may involve a marked reduction in peripheral vascular resistance. This combination could result in an abrupt drop in blood pressure and reduced cerebral perfusion, potentially leading to transient loss of consciousness. Further research is warranted to understand this phenomenon and develop guidelines to mitigate such risks during hypoxia training in military settings.

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Learning Objectives
1. The audience will learn about the physiological mechanisms suspected to be behind the oxygen paradox reaction, which sometimes can be seen during aircrew training in the hypobaric chamber.
2. The oxygen paradox reaction usually limits to visual disturbances, but as the audience will learn, it can also cause loss of consciousness. Especially if the subject has been hyperventilating.

Thursday, 06/05/2025 ***1:30 PM***
Centennial Ballroom I

[S-62] PANEL: CLINICAL APPROACHES TO COMPLEX AEROMEDICAL CASES: ARE THEY SAFE FOR DUTY?

Chair: Brian Hanshaw
Co-Chair: Paul Newbold

Panel Overview: *Clinical cases within the Flight Medicine Clinic can be broad and diverse in nature. The complexity of these medical scenarios is compounded by the persistent and growing demands of operational readiness and unique occupational challenges. This panel comprises clinical cases presented by current clinicians in Aerospace Medicine at MacDill AFB. These presentations embody one theme: approaching complex medical conditions involving aviators and special operators with significant aeromedical and occupational health considerations. The presenters will provide an overview for each case, approach to diagnosis and workup, along with the pathway to an aeromedical waiver. Additionally, current medical standards and policies from each sister service, as well as the FAA, will be discussed. The clinical care approach and insights gained from these presentations will be valuable to other aerospace medicine clinicians, ultimately benefiting the patients they serve.*

[344] SEVERE MITRAL VALVE REGURGITATION IN A KC-135 PILOT

Tyler Pitchforth
U.S. Air Force, Tampa, FL, United States

(Education - Case Study)

INTRODUCTION: This case describes an asymptomatic military pilot who was diagnosed with a heart murmur during his annual flight physical and subsequently required open heart surgery to correct severe mitral valve prolapse/regurgitation (MVP/R). **BACKGROUND:** MVP has a prevalence of 0.6-3% and only 4% of those patients have severe MVR. A majority (70%) of MVP cases have mild to trace MVR and are asymptomatic. MVP is usually identified on physical exam (holosystolic murmur) and diagnosed by echocardiogram. Symptoms are rare, but include exertional dyspnea, arrhythmias, weakness, fatigue, and exercise intolerance. **CASE PRESENTATION:** A mid-30's male KC-135 pilot presented for his annual flight physical, and an incidental murmur was identified on physical exam. He was referred to cardiology and diagnosed with severe MVP/R via transthoracic echocardiogram. Transesophageal echocardiogram confirmed diagnosis with effective regurgitant orifice (ERO) of 0.65 cm2 (severe MR ERO > 0.40 cm2), he was then referred to the cardiothoracic surgeon The pilot underwent open complex mitral valve repair. 3-month post op echocardiogram showed successful repair with only trace MR. An aeromedical waiver was subsequently granted after evaluation by the Aeromedical Consultation Service 12 months after his murmur diagnosis. **DISCUSSION:** Severe mitral valve regurgitation is very uncommon and is asymptomatic in most cases. A thorough physical exam is critical, even on otherwise healthy individuals. If the aviator's MVP had progressed, he may have required a MV replacement. It is crucial to consult the waiver guide early as the type of MV surgery can end a pilot's career. If the member required a mitral valve replacement, he would be ineligible for a waiver due to the increased risk of thromboembolic events.

Learning Objectives
1. The audience will recognize the importance of quality chest auscultation during an annual flight physical on an asymptomatic patient with no complaints.
2. The audience will develop an understanding of the medical standards for mitral valve regurgitation and the importance of referencing the aeromedical waiver guide early to assist aviators in making informed decisions.

[345] FACIAL FRACTURE AND TRAMAUTIC BRAIN INJURY IN A KC-135 PILOT

Michael Klemm
[1]*U.S. Air Force, Tampa, FL, United States*

(Education - Case Study)

INTRODUCTION: This case report describes a military pilot who experienced a depressed right frontal sinus and orbital roof fracture with associated traumatic brain injury (TBI) after a head-on collision. **BACKGROUND:** Pilots are subjected to a variety of environmental conditions with unique risks related to rapid changes in altitude, temperature, and ambient pressure. This elevated risk requires pilots to maintain situational awareness of multiple factors concurrently; any deficits in cognitive processing can lead to catastrophic outcomes. Appropriate evaluation and risk stratification is paramount in determination of a pilot's ability to return to flying. **CASE PRESENTATION:** 27-year-old, male, KC-135 pilot presented to a local ER after a significant facial injury during a sporting event. Initial CT scan showed a depressed fracture of the right frontal sinus with likely fracture of the right orbital roof but no intracranial abnormalities. His MACE2 was positive for concussion but a full neurologic exam and cognitive testing were normal. The patient denied any headache, LOC, amnesia, or dizziness. Local oral & maxillofacial surgeon recommended surgery for cosmetic reasons and member returned home for surgical evaluation at the VA. Member had a repeat CT that confirmed the prior findings and a physical exam notable for diplopia with extreme upward gaze. Member was evaluated by plastics, ENT, and ophthalmology with the ultimate recommendation to not proceed with surgery as diplopia was likely related to swelling and would improve as the swelling decreased. Member continued to deny any sequelae from the injury and was observed for 45 days with a final brain MRI to ensure no long-term injury. Throughout the observation period he continued to report no cognitive deficits and resolution of his diplopia with upward gaze. Member has since had an aeromedical waiver approved and returned to full flight duties without issue. **DISCUSSION:** This case highlights the variability in individual responses to TBI and the aeromedical risks associated with facial fractures. Initial and follow up cognitive testing and physical examinations are essential when monitoring an aviator's response to a significant cranial injury. Utilizing appropriate imaging studies for risk stratification of facial injuries are critical when considering aeromedical implications.

Learning Objectives
1. The audience will learn aeromedical considerations with facial fractures and requirements for returning to flying status.
2. The audience will learn about the value of initial and follow up evaluations for appropriate risk stratification after traumatic brain injuries in aviators.

[346] CHRONIC MYELOGENOUS LEUKEMIA IN A KC-135 PILOT

Vasant Dabhi[1], Paul Newbold[2]
[1]*U.S. Air Force, Tampa, FL, United States,* [2]*U.S. Air Force, Arcadia, OK, United States*

(Education - Case Study)

INTRODUCTION: This case report describes a military KC-135 pilot who was diagnosed with Philadelphia chromosome positive chronic myelogenous leukemia (CML). **BACKGROUND:** CML is a hematological neoplasm characterized by the fusion of the BRC to ABL1 genes (BRC:ABL1), also called the Philadelphia gene, resulting in the

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uncontrolled production of granulocytes. Roughly half of the patients are asymptomatic, however others may develop symptoms such as fatigue, malaise, and excessive sweating. Fatigue as the predominant symptom, can be a major concern for the pilots of military aircraft. The impacts from this disease, in addition to associated treatment modalities, can lead to significant loss in workdays, detriments to mission readiness, and degraded operational capabilities. **CASE PRESENTATION:** The subject was a 33YO male Air Force KC-135 pilot with more than 1000 flying hours. He was a fully trained asset, avid runner, and multiple marathon champion; presented to the clinic with fatigue and decreased stamina. Routine labs revealed elevated white cell count and subsequently referred to a hematologist. Bone marrow biopsy revealed 63% positivity of total ABL1, p210 product. The subject pilot was treated initially with hydroxyurea, then switched over to dasatinib. After 6 months of the treatment, the subject regained his energy, and was able to resume marathons. Since then, the subject remained asymptomatic, highly active, running, and without any evidence of medication side effects. The pilot was recommended for an aeromedical waiver and was granted for 1 year. **DISCUSSION:** This case highlights the importance of addressing even seemingly minor symptoms such as fatigue in aviators. Improper nutrition, inadequate sleep, and dehydration in aircrew are major concerns for fatigue, but rare neoplasms are still a possibility. A thorough history, focused physical exam, along with appropriate laboratory and diagnostic testing is paramount. Life expectancy with CML has improved with the advancement in chemotherapeutic agents, however flying status and operational readiness can be significantly impacted. This case emphasizes the significance of timely and appropriate evaluation and treatment of aviators diagnosed with CML.

Learning Objectives

1. Importance of thorough history, physical and work up for nonspecific symptom like fatigue, which could be a manifestation of underlying neoplasm.
2. CML itself or the treatment can have significant impact on mission readiness in aviators.

[347] PRONATOR TERES SYNDROME IN A MILITARY ROTARY-WING PILOT

Korey Kasper
U.S. Air Force, Tampa, FL, United States

(Education - Case Study)

INTRODUCTION: This case report describes an active-duty helicopter pilot with chronic elbow pain caused peripheral nerve entrapment due to helicopter flight control manipulation. **BACKGROUND:** Maneuvering a helicopter's cyclic requires repetitive resisted wrist movements which predispose pilots to wrist and elbow overuse injuries. **CASE PRESENTATION:** A 40-year-old Army helicopter pilot presented to sports medicine for a 4-year history of right medial elbow pain, unsuccessfully treated as medial epicondylitis with PT and PRP injection. Pain occurred with maneuvering his aircraft's cyclic and doing pull-ups wherein he experienced tearing pain limiting him to just a couple repetitions. He noted tingling in the proximal medial forearm. MRI of elbow showed strains at the common flexor tendon and flexor digitorum profundus. The medial epicondyle was tender, and his common flexor mass was taut, tender, and painful with resisted palmar flexion and pronation. Point-of-care ultrasound revealed the median nerve was edematous and enlarged adjacent to the pronator teres; tracing this nerve distally approximated pain distribution. He was prescribed median nerve glide exercises. At 4-week follow-up, he reported compliance with exercises and significant reduction in pain with flying and ability to complete 10 pull-ups without discomfort. At five months, patient reported no pain with pullups or flying and had stopped nerve glide exercises all together due to lack of pain. **DISCUSSION:** Pronator teres syndrome (PTS) is a median nerve entrapment near the pronator teres resulting in the weakness, numbness, and pain in the forearm and hand. PTS is often misdiagnosed as medial epicondylitis. This patient developed PTS due to piloting helicopters, wherein repetitive and quick pronation movements to maneuver the cyclic caused hypertrophy and/or repetitive contraction of the of the pronator teres muscle, entrapping of the median nerve. Nerve glide exercises focus on alleviating the entrapment by enhancing nerve mobility and reducing compression. Peripheral nerve entrapment should be considered in cases of chronic occupational extremity pain not responding to usual care. Prompt referral to a sports medicine physician can expedite diagnosis and recovery of full function.

Learning Objectives

1. The audience will expand their differential diagnosis for occupational elbow pain in aviators to include nerve entrapments.
2. The audience will understand pathology and treatment options for pronator teres syndrome and the potential value of early referral to sports medicine when caring for flyers.

[348] WOLFF-PARKINSON-WHITE SYNDROME SEEN IN SECURITY FORCES MEMBERS

Melissa Lincoln
U.S. Air Force, Tampa, FL, United States

(Education - Case Study)

INTRODUCTION: This case examines three separate Security Forces Squadron (SFS) members who had a Wolff-Parkinson-White pattern noted on their electrocardiogram (ECG) during their routine occupational health exam (OHE). **BACKGROUND:** Wolff-Parkinson-White (WPW) is a preexcitation syndrome that occurs when abnormal electrical conduction occurs through an accessory pathway, which can lead to symptomatic and life-threatening arrhythmias. It affects 1 to 3 in 1,000 people worldwide, with a lifetime risk of sudden cardiac death (SCD) of 3-4%, mostly occurring with exercise. The frequency of WPW pattern is 10 to 100 times more common than WPW syndrome, with the development of symptomatic arrhythmias over three years seen in as high as 20% of individuals. Currently, only baseline ECGs are required for SFS members and not completed until their first assignment out of technical training. **CASE PRESENTATION:** 26 y/o male came in for his OHE prior to deployment clearance. WPW pattern was noted on his initial and repeat ECG on the subsequent day. He denied any previous palpitations, tachycardia, presyncope, or syncope. He was referred to cardiology, where he underwent a diagnostic electrophysiology study. During the study, he was found to have an easily inducible ventricular tachycardia. He underwent an ablation of typical AVNRT. He remained inducible after the ablation and went into ventricular fibrillation, requiring defibrillation. He was given a life vest and had a follow-up electrophysiology study for re-risk stratification, which was normal, and the life vest was discontinued. 35 y/o male with WPW pattern noted on initial and repeat ECG. He denied any current or previous symptoms. He was referred to cardiology, where a diagnostic electrophysiology study is pending. Lastly, a 24 y/o female with a WPW pattern noted on initial ECG with no reported symptoms. A repeat ECG and echocardiogram were normal, and no further work-up was required.

Learning Objectives

1. The audience will learn about the risks associated with WPW that aerospace and occupational medicine clinicians need to consider for flyers and special duty members.
2. The audience will learn about the prevalence of asymptomatic WPW and the potential risk of life-threatening arrythmias, taking into account occupational and operational considerations.

Thursday, 06/05/2025 ***1:30 PM***
Centennial Ballroom II

[S-22] PANEL: AAMIMO GRAND ROUNDS- CROSS CULTURAL CLINICAL CASES IN AEROSPACE MEDICINE

Chair: Jeffrey Harris

Panel Overview: BACKGROUND: *The Advanced Aerospace Medicine for International Military Officers (AAMIMO) course is a 6-month training program for military flight surgeons from all over the world. The course is*

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conducted by the US Air Force School of Aerospace Medicine. 2025 will be the 63rd edition of the course and will include 10-12 physicians representing 8-10 different countries. The international flight surgeons will present interesting and educational clinical cases from their countries. **DESCRIPTION:** *The panel will consist of 6 case presentations designed to teach about fundamental and/or novel aerospace medicine concepts.* ***DISCUSSION:*** *Attendees will learn the similarities and differences of practicing aerospace medicine in different cultures. The medical flying standards for each country and branch of military will be highlighted.*

[113] AAMIMO CASE PRESENTATION #1 - CHRONIC STIMULANT USE FOR IDIOPATHIC HYPERSOMNIA IN A PILOT

Gerardo Montenegro Urrutia
Chilean Air Force, USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Case Study)

INTRODUCTION: This case report will describe a Chilean female helicopter pilot with idiopathic hypersomnia in treatment with chronic stimulant use. **BACKGROUND:** Idiopathic hypersomnia is a condition that significantly impacts a person's daily life, causing problems not only in health but also socioeconomic and work-related issues. It is classified as a central origin hypersomnia, alongside narcolepsies type 1 and 2. It is primarily characterized by excessive daytime sleepiness despite normal or prolonged sleep duration, and frequent severe sleep inertia. However, its pathophysiology remains unknown, making diagnosis difficult and uncertain, as there is no objective method to perform a specific diagnosis. Its treatment, while varying among published guidelines and lacking a strong base of supporting publications, relies on both non-pharmacological approaches and the use of low-sodium oxybate, modafinil, methylphenidate, and amphetamines, which are not without significant adverse effects. **CASE REPORT:** This case is of a 42-year-old female helicopter pilot, who was diagnosed with idiopathic hypersomnia, characterized by hypersomnia despite sleeping approximately 12 hours a day, a pathology that she had been dragging for some time. She was initially treated with sertraline and modafinil, later changing the latter for lisdexamphetamine. **DISCUSSION:** In this case, we will review the diagnosis of idiopathic hypersomnia, the progress in its diagnosis as well as its treatment, we will review what measures were taken in this particular case in the Chilean Air Force and we will compare it with the guidelines used in the United States.

Learning Objectives

1. The audience will learn about the signs/symptoms, pathophysiology, and/or treatment for an educational patient scenario.
2. The audience will learn about the similarities and differences in practicing aerospace medicine in various countries.

[114] AAMIMO CASE PRESENTATION #2 - AEROMEDICAL DECISION MAKING IN A CASE OF CARCINOMA CAECUM & APPENDIX IN MILITARY PILOT: CASE REPORT

Avinash Krishnegowda[1]; Hasan Alabbasi[2]
[1]*Indian Air Force, USAFSAM, Wright-Patterson AFB, OH, United States;*
[2]*Iraqi Air Force, USAFSAM, Wright-Patterson AFB, OH, United States*

(Education - Case Study)

BACKGROUND: This paper discusses a rare case of military pilot with goblet cell adenocarcinoma of caecum & appendix followed by aeromedical decision making in the case. **INTRODUCTION:** Appendiceal neoplasms account for 0.4-1% of all GI malignancies. Goblet cell tumors are rare tumors of appendix with an incidence of 1-5 per 10 million people per year. The 5yr overall survival is 76% and 33% cases that show recurrence occur within 2-3 years. **CASE SUMMARY:** A 48 years old fighter aircrew of IAF had multiple episodes of abdominal pain and was treated as a case of colitis, but eventually he was detected to have Goblet cell adenocarcinoma of appendix, terminal ileum, colon. He underwent Right hemicolectomy & adjuvant chemotherapy. In the initial assessment, he was given permanent non-flying category in view of potential long term neurological side effects of chemotherapy which could compromise flight safety and poor prognosis of the condition. But the aircrew appealed against the decision. The relook into the case revealed no signs of neurotoxicity due to chemotherapy during the evaluation & minimal risk to flight safety due to goblet cell type carcinoma of appendix & caecum (Operated, Post chemotherapy) as calculated using the recurrence rates from scientific literature. Therefore, he was recommended to restricted flying category. **DISCUSSION:** In a case of carcinoma appendix & caecum once diagnosis and treatment is made, the potential for recurrence becomes important health and aeromedical concern. Also in addition if chemotherapy is instituted its side effects may be a flight safety hazard. These points are considered and assessed in the present case to ensure flight safety.

Learning Objectives:

1. The audience will be able to understand the complexities and intricacies inherent in aeromedical fitness assessment of unusual medical conditions, such as the case presented.
2. The audience will gain insights into the aeromedical risk assessment in case of malignancies.

[115] AAMIMO CASE PRESENTATION #3 - A RARE CASE OF "CONGENITAL ANOMALY OF THE KIDNEY AND URINARY TRACT" IN AN AVIATOR: APPROACH TO AEROMEDICAL DISPOSITION

Kishore Kumar Dalpati
Reconaissance & Observation Flight, Imphal, Manipur, India, USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Case Study)

INTRODUCTION: This case report describes a trained Indian fighter pilot with bilateral malrotated kidneys with left supernumerary kidney. The Congenital Anomaly of the Kidney and Urinary Tract (CAKUT) was detected incidentally on routine ultrasound examination. **BACKGROUND:** CAKUT encompass a range of developmental malformations of the kidneys and urinary tract that arise during embryogenesis, primarily between the 5th and 9th weeks of gestation. Bilateral malrotated kidneys with one sided supernumerary kidney is one of the rarest congenital anomalies of kidney and urinary tract with less than 100 cases reported in literature and the first case detected in an active duty aviator. It poses unique challenges in aeromedical decision making and disposition of aircrew. **CASE PRESENTATION:** A 24 year old asymptomatic male fighter pilot with a total of 200 flying hours in high performance aircrafts, was detected to have CAKUT on routine ultrasound examination. The pilot had no history of recurrent UTIs, dysuria, or hematuria and was normotensive. On further evaluation using CT urogram he was found to have bilateral malrotated kidneys with left supernumerary kidney. Detailed imaging and functional assessments revealed no signs of CKD, evidence of obstruction, or urinary stasis. Considering his asymptomatic status and normal renal function with Gz exposure in high performance aircrafts, the aircrew was medically upgraded to full flying status in fighter stream. However, considering the potential long-term complications, the aircrew was advised monthly BP monitoring at base flight clinic and annual review at nephrology center and Indian Air Force boarding center. **DISCUSSION:** This case of bilateral malrotated kidneys with a supernumerary kidney, a rare CAKUT variant, highlights the challenges of managing such anomalies in military aviation. Despite the anatomical rarity, thorough evaluation confirmed stable renal function, allowing the aircrew to continue flying. The potential impact of acceleration stress in fighter stream and the long-term risks of CAKUT emphasize the need for individualized aeromedical decisions. Reflighting the individual, along with regular follow-up, balances operational demands with effective long-term health monitoring.

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Learning Objectives
1. The audience will learn about the signs/symptoms, pathophysiology, and/or treatment for an educational patient scenario.
2. The audience will learn about the similarities and differences in practicing aerospace medicine in various countries.

[116] AAMIMO CASE PRESENATATION #4 - CASE OF EUSTACHIAN TUBE DYSFUNCTION: CAUSE OF HEARING LOSS IN A YOUNG PILOT

Mbaye Diaw
Senegal Army, USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Case Study)

INTRODUCTION: This case report describes a fighter jet pilot who was found to have barotraumatic otitis due to Eustachian tube dysfunction (ETD) during periodic aviation medical examination and converted in transport pilot with waiver. **BACKGROUND:** The Eustachian tube connects the middle ear to the back of the throat. During flight, or situations where altitude or pressure changes rapidly, if the tube does not function properly, the pilot may experience earache, headache, hearing loss, dizziness. Therefore, a lack of communication can occur and leads to disaster. **CASE PRESENTATION:** The pilot was a 30-year-old man with 6-years of experience in fighter aircraft when ENT clinical examination showed a bilateral tympanic retraction. He also reported a history of humidity feeling in both ears with itching. He was suspended from flight duties for medical treatment and further investigations. The tympanogram was disturbed and the audiogram showed an average hearing loss of 30dB in the left ear. He underwent CT scan which showed bilateral thickening of the tympanic membrane. He was diagnosed eustachian tube dysfunction and benefited from surgical treatment in the form of myringotomy and set of bilateral pressure equalization ear tube. The control with audiogram revealed mild bilateral conductive hearing loss (-15dB on the left, -20dB on the right) and tympanometry showed a curve with reduced compliance on both sides. The follow up CT scan had no sign of otitis and normal ventilation of the tympano-mastoid cavities. He was declared unfit for fighter pilot but obtained a waiver for transport pilot with limitations to fly as, or with, co-pilot and with ENT reassessments every 3 months. **DISCUSSION:** We will discuss the tests allowing the early diagnosis of ETD, the traditional treatment of ear tube and new treatment of balloon tuboplasty which may heal the pilot and keep airmen airborne.

Learning Objectives
1. The audience will learn about the signs/symptoms, pathophysiology, and/or treatment for an educational patient scenario.
2. The audience will learn about the similarities and differences in practicing aerospace medicine in various countries.

[117] AAMIMO CASE PRESENTATION #5 - PROLONGED GRIEF DISORDER IN A FIGHTER PILOT: A CASE REPORT

Shamsul Arafin[1], Tung-Yao Lin[2]
[1]*Bangladesh Air Force, Dhaka, Bangladesh, USAFSAM, Wright-Patterson AFB, OH, United States;* [2]*Taiwan Army, Kaohsiung, Taiwan, USAFSAM, Wright-Patterson AFB, OH, United States*

(Education - Case Study)

INTRODUCTION: This case report describes a Bangladesh Air Force fighter pilot with prolonged grief disorder (PGD) and its impact on his flying career emphasizing the relevance of this disease to the military flying communities. **BACKGROUND:** PGD is the newest mental disorder to be added to the DSM-5-TR in 2022. 7%-10% of bereaved adults experience PGD. Patient shows distinct set of symptoms following death of a family member or close friend. They are preoccupied by grief and feeling of loss to the point of clinically significant distress and impairment which can manifest in a variety of symptoms including depression, emotional pain, emotional numbness, identity disturbance and difficulty in managing inter personal relationships. **CASE PRESENTATION:** A 31-year-old somewhat introvert fighter pilot experienced the death of his copilot who was his closest buddy in an incident of unplanned ejection on ground due to ejection seat malfunction. Following the incident, he stopped interacting with anyone and started being alone. He started blaming himself for the death of his copilot and admitted to be extremely stressed over that. He sometimes felt like life is meaningless and suffered from emotional numbness. He was irregular and unmindful in his office. He lost interest in most of his daily activities. He was suffering from sleep disturbance after the incident. As his symptoms persisted and all relevant clinical examination and lab parameters were within normal limits, base flight surgeon restricted his flying and sent him for psychiatric evaluation. Cognitive behavioral therapy was initiated. Sleep interventions were done. He was provided with social support. In spite of all the interventions he was having pervasive grief response and persistent preoccupation with the deceased after one year and he was labeled as a case of PGD and was temporarily grounded for the condition. He evenutally opted for voluntary retirement considering that he would feel better once he was away from the places full of memories with his deceased copilot. **DISCUSSION:** Risk factors for PGD includes sudden death due to violent or unnatural method and close kinship to the deceased. These factors are commonly encountered in military aviation mishaps that carries a potential risk for someone of close kinship getting affected by PGD.

Learning Objectives
1. The audience will learn about the presentation, diagnosis, and/or treatment of an interesting Aerospace Medicine Case.
2. The audience will learn about the similarities and differences in medical standards and pilot medical clearances for civilian, US and foreign military aviation professionals.

[118] WITHDRAWN

Thursday, 06/05/2025 ***1:30 PM***
Centennial Ballroom III

[S-64] SLIDE : SURVEILLANCE AND COUNTERMEASURES FOR SPACE

Chair: Judith Hayes
Co-Chair: Kayla Jaime

[354] MRI ANATOMIC FEATURES PREDICT INTERNAL JUGULAR VEIN STASIS IN MICROGRAVITY

James Pavela[1], Ashot Sargsyan[2], Stephan Moll[3], Millennia Young[1], Aaron Everson[2], Ryan Dervay[4], Deepak Bedi[5], Larry Kramer[4]
[1]*NASA JSC, Houston, TX, United States;* [2]*KBR, Houston, TX, United States;* [3]*University of North Carolina at Chapel Hill, Chapel Hill, NC, United States;* [4]*McGovern Medical School, Houston, TX, United States;* [5]*University of Texas, MD Anderson Cancer Center, Houston, TX, United States*

(Original Research)

INTRODUCTION: Surveillance for deep vein thrombosis in the internal jugular veins (IJV) was conducted in 31 long duration NASA astronauts aboard the ISS using a standardized ultrasound protocol. Previously reported findings from a smaller subset found flow anomalies in the left proximal IJV in ~20%, suggesting a potentially heightened risk of thrombosis. We hypothesized that certain anatomic features may predispose some individuals to craniocervical drainage reorganization. **METHODS:** Anatomic features of 31 long-duration crewmembers were derived from retrospective 3-Tesla magnetic resonance imaging (MRI) data and included bilateral IJV cross-sectional areas (CSA) at skull base,

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transverse sinus side dominance, and torcula configuration. Values were computed by two analysts independently and averaged. Terrestrial and in-flight ultrasound was reviewed for IJV flow anomalies, defined as more-than-mild spontaneous echo contrast (SEC) grade, unprovoked stasis (UPS), and retrograde flow (RF). Data was modeled with linear mixed models, predictors identified with LASSO variable selection, and receiver operating characteristic (ROC) curves generated. **RESULTS:** No IJV thrombi were detected. Left UPS occurred in 7 individuals, RF in 5, and more-than-mild SEC- in 7. MRI-derived IJV right-to-left CSA ratio at the skull base (IJV CSA R/L) predicted SEC at the optimal threshold of 1.55, with sensitivity and specificity of 0.8 and 0.62, respectively, and an area under the ROC curve of 0.71. For RF, the optimal IJV CSA R/L threshold was 2.19, with sensitivity, specificity, and AUC-ROC curve values of 0.83, 0.76, and 0.8Gend1, respectively. Other preflight measures did not reach this level of prediction. **DISCUSSION:** The MRI-derived degree of preflight asymmetry of the IJV at the level of skull base appears to be the first reported predictor of left IJV SEC and RF in microgravity. Continued improvement of measurement technique and optimization of MRI sequences may increase the specificity of this prediction model. Preflight MRI may be useful in predicting individual thrombosis risk.

Learning Objectives

1. The audience will learn about venous flow anomalies that occur in a significant minority of long duration astronauts.
2. The audience will learn about MRI-derived anatomical measures that predict flow anomaly development in internal jugular vein in microgravity. Right-to-left ratio of IJV cross-sections at the skull base thus appears to predict individuals predisposed to IJV thrombosis.

[355] HEARING ASSESSMENTS AND TYMPANOMETRY IN NASA ASTRONAUTS ON THE INTERNATIONAL SPACE STATION

David Wexler[1], Martin B. Robinette[2], Christopher Coble[3], Azalea Coste[4], Thomas Hoffman[5], Richard Danielson[2]

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(Original Research)

INTRODUCTION: Exposure to prolonged microgravity is associated with cephalad fluid shifts that potentially could affect tympanomastoid ventilation and auditory mechanisms. We conducted a retrospective review of NASA astronaut on-orbit hearing assessments (OOHAs) and middle-ear pressure measurements obtained during ISS missions, to search for evidence of spaceflight-related hearing changes and disturbances of middle-ear aeration. **METHODS:** Nine NASA astronauts conducted OOHAs and tympanometry at least twice while on the ISS missions, at days 16-294 (median 81). Kuduwave audiometric instrumentation was used for self-administered air-conduction tests of pure-tones at 250, 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz, and for the middle ear pressure measurements. Limited bone-conduction data were also obtained. Pre- and postflight audiometric data, obtained under direction of an audiologist, were used for comparison. The data for each frequency were evaluated by ANOVA with repeated measures. **RESULTS:** OOHAs showed modest low-frequency hearing threshold increases only at 250 Hz (9.3+/-10.5 dB, $p<0.01$) and 500 Hz (5.6+/-7.7 dB, $p<0.01$), compared to the preflight Kuduwave baseline. Tympanometry was normal in each of 28 technically adequate measurements. Bone-conduction audiometry, while limited, showed no trend of elevated bone conduction thresholds. At all frequencies, postflight audiograms showed no significant differences from preflight testing. **DISCUSSION:** In this group of astronauts, hearing tests obtained during spaceflight showed a modest low-frequency hearing loss, with thresholds increasing on average no more than 10 dB above preflight baseline measurements. This is unlikely to be of operational significance. The magnitude of these changes did not correlate with length of time on the ISS. As tympanometry was normal, there was no indication of middle ear fluid or other aspect of Eustachian tube dysfunction. Postflight audiometry demonstrated preservation of hearing thresholds across frequencies with no significant difference from preflight levels. The results suggest relative resilience of auditory function and maintenance of tympanomastoid aeration on prolonged orbital spaceflight, but with small, temporary, low-frequency hearing threshold increases in some astronauts. Our findings warrant confirmation and further study with the larger cohort of NASA astronauts for whom hearing data were obtained with earlier OOHA instrumentation.

Learning Objectives

1. The audience will learn about the mild low-frequency hearing decrements that were measured during orbital spaceflight.
2. This listeners will understand the evidence that normal middle ear ventilation was maintained during prolonged spaceflight.
3. The audience will learn that postflight audiometry indicated no significant changes from preflight hearing levels.

[356] SPINE DEGENERATION IN ACTIVE-DUTY MILITARY PERSONNEL: A SYSTEMATIC REVIEW AND META-ANALYSIS FOR NASA MEDB GUIDELINE DEVELOPMENT

Kyle Anderson[1], Benjamin Swanson[2], Hung-I Hsaio[1], Taylor Zuleger[1], Jed Diekfuss[1], Greg Myer[1], Danielle Anderson[3], Richard Scheuring[3]

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(Original Research)

INTRODUCTION: Approximately 60% of NASA astronauts have a military background, which predisposes them to an increased risk of spinal pathology due to cumulative spinal loading from years of rigorous physical training. However, isolating spinal pathology specifically attributable to military service is challenging. This systematic review and meta-analysis aims to evaluate MRI-based spine findings in military personnel relative to an asymptomatic civilian population, in order to better estimate the expected spinal pathology in NASA astronauts with military backgrounds. **METHODS:** PubMed, Scopus, and Google Scholar databases were systematically queried in April 2024, using the MeSH terms: active-duty military, spine, and MRI. Abstracts were screened for inclusion based on the following criteria: military personnel cohorts, MRI of the spine, and reports on average age, sample size, and prevalence of disc degeneration. A mixed-effects meta-analysis was conducted to compare disc degeneration and average age between military personnel and asymptomatic civilians. **RESULTS:** The meta-analysis found moderate heterogeneity ($I^2 = 34.19\%$), with some variability that is not fully accounted for by group and age effects (SE = 0.0686). However, heterogeneity was not statistically significant ($p=0.075$), and the model had a high R^2 value (90.16%) which indicates effective explanation of the variability across studies. Meta-analysis revealed a significant group effect, with military personnel showing higher overall prevalence disc degeneration compared to civilians (effect size = 0.999, CI [0.588, 1.411], $p < 0.001$). Age was also a strong predictor, with age associated with an increased prevalence of disc (effect size = 0.108, 95% CI [0.075, 0.140], $p < 0.001$). **DISCUSSION:** Our findings indicate that military personnel have a higher baseline of disc degeneration compared to civilians, likely due to physical demands of military service. These results may support the inclusion of MRI spine screening in NASA's medical protocol for astronauts with military background, given their evaluated disc degeneration, however caution is warranted as the previous studies have focused on younger military populations with relatively short service duration. Future work should aim to characterize the variety of military duties and their potential contribution to spinal degeneration.

Learning Objectives

1. Understand why MRI spine is a valuable addition to Med B protocols for NASA astronauts to monitor spinal pathology prior to spaceflight and understanding the effects of spaceflight on the spine.
2. Understand that the majority of NASA astronauts have a military background that significantly increases the prevalence of any level disc degeneration.

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3. Understand that by the average age of a NASA astronauts' first flight, almost all astronauts (~99%) with a military background will have disc degeneration as compared to most of civilians (~70%).

[357] EVALUATING THE EFFECTS OF SPACEFLIGHT AND COUNTERMEASURES ON ASTRONAUT SKELETAL HEALTH USING QUANTITATIVE COMPUTED TOMOGRAPHY (QCT)

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(Original Research)

INTRODUCTION: QCT offers a significant advantage over DXA in its ability to separately evaluate cortical and trabecular bone compartments. The purpose of this study was to demonstrate the utility of QCT to delineate specific effects of spaceflight on these distinct bone compartments and to evaluate spaceflight countermeasures to mitigate those induced changes. Based upon evidence that spaceflight affects trabecular bone more profoundly than cortical bone, the primary study hypothesis was that the combination of resistive exercise (ARED) with a circulating anti-resorptive bisphosphonate (BP) provides maximal protection of both bone compartments. **METHODS:** Astronaut data were grouped by countermeasure (Pre-ARED n=18, ARED n=20, and ARED + BP n=7). Measurements of total hip bone mineral density were performed preflight, within 1 week of postflight (R+1 wk), and at 1-year postflight (R+1 yr). Subject-specific random intercepts were included to address the repeated measures within subjects. When the overall F-statistic was significant, pairwise comparisons tested for pre-to-postflight changes within groups, as well as contrasting these changes between countermeasure groups. **RESULTS:** At R+1wk, significant losses in Ct.vBMD and Tb.vBMD were detected except in the ARED+BP group. By R+1yr, Ct.vBMD was restored to preflight in the ARED group while Tb.vBMD was still significantly reduced. Interestingly, while Tb.vBMD was not different than preflight in the ARED+BP group at R+1yr, Ct.vBMD was significantly reduced. In terms of countermeasures, there were no statistically significant differences between groups with regard to Ct.vBMD at either timepoint. In terms of Tb.vBMD changes, ARED was statistically different than Pre-ARED at both R+1wk and R+1yr while ARED+BP was also statistically different from Pre-ARED at R+1wk but not at R+1yr. **DISCUSSION:** At R+1yr, study hypotheses were partially supported as Tb.vBMD was significantly reduced from preflight while Ct.vBMD was recovered in the ARED group. However, there were no detectable differences between countermeasures for either cortical bone and trabecular bone possibly due to insufficient statistical power. Overall, our study further supports the addition of QCT to medically required testing because of the independent assessment of cortical and trabecular bone compartments and the improved evaluation of spaceflight countermeasures of different mechanisms of action.

Learning Objectives

1. Understand why quantitative computed tomography (qCT) is a valuable addition to monitoring astronaut skeletal health and evaluating spaceflight countermeasures.
2. Understand that ARED is sufficient to maintaining aBMD by R+1yr but not trabecular bone mass (Tb vBMD).
3. Understand that ARED + Bisphosphonates was the only countermeasure able to maintain trabecular bone mass.

[358] AN OVERVIEW OF HIBERNATION PHYSIOLOGY AND THE VALUE OF RESEARCH IN SUSPENDED ANIMATION. A POTENTIAL SOLUTION FOR LONG DURATION SPACE TRAVEL.

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(Education - Tutorial / Review)

INTRODUCTION: Hibernation is an adaptive behavioural pattern preserved across many mammalian species which confers significant benefit to their survival in harsh winter months. The adaptive behaviour is characterised by periods of torpor during which animals demonstrate reduction in metabolism and physiological activity and reduced temperature allowing for their preservation and survival. Though characterised by a significant low flow and diminished distribution of blood there is a remarkable restoration of physiological functioning after hibernation has been completed. **TOPIC:** Understanding Hibernation as a physiological process could allow for translational benefits in medical practice on earth. By appreciating reduced metabolism and states of torpor, we may be able to transfer benefits to our critically unwell terrestrial patients, by addressing muscle and bone loss, minimising end organ damage and thrombosis. As well as applications to terrestrial medicine, we will explore the potential for utilising hibernation in long term space travel. **APPLICATION:** We can stimulate further discussion on the types of research that can take place to successfully induce torpor in humans for therapeutic purposes. Given the wide presence of hibernation in the animal kingdom, genetic mechanisms are preserved in humans. Unlocking the mechanism through pharmacological cues, changes in environment and precisely altering genetic and cellular mechanisms could be the keys. A vast array of exciting scientific questions lie ahead, and proposing good hypotheses and finding the means to test them well will allow for progression in this field. From the perspective of critical care medicine, there are hypotheses that humans conserve hibernating phenotypes when critically ill. Indeed if we can discover the human capability to exhibit torpor in their critically ill state, we may learn how to induce it safely for the application of long duration space flight. In the animal kingdom, we are aware of how hibernation provides benefits with regards to radiation protection, hypoxia tolerance, mitigation of thrombosis and maintenance of bone and muscle mass, which may well confer benefits in long term space flight and stasis when crew visit other worlds with inhospitable environments. We propose to examine these scientific possibilities and discuss our own ongoing research in the field.

Learning Objectives

1. The audience will come away with a brief insight into the remarkable physiological adaptation of hibernating animals.
2. The audience will learn about potential therapeutic benefits that could be conferred through understanding the safe induction of torpor in non-hibernating mammals and humans.
3. The audience will gain an insight into the benefits of hibernation for astronaut crew in long duration spaceflight from a physiological, psychological and resource utilisation perspective.

[359] SKIN CANCER IN SPACE: EVALUATING THE PREVALENCE, MORTALITY, AND RISK FACTORS IN ASTRONAUTS POST-SPACEFLIGHT

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(Original Research)

INTRODUCTION: With long-duration space travel on the horizon, understanding the exposure of Astronauts to radiation and the increased risk of skin malignancies is important for mitigating further health risks. This is the first review to systematically evaluate the risk of skin malignancies to Astronauts and the underlying factors for this. **METHODS:** PubMed and MEDLINE (Ovid) were systematically searched in April 2024, with no date limitations. The keywords and Boolean operators include: 1. (astronaut*) OR (cosmonaut*) OR (spaceflight) OR (space flight) 2. (skin) OR (dermatology) 3. (neoplasm*) OR (cancer*) OR (malignancy*) 4. #1 AND #2 AND #3. **RESULTS:** This search yielded 61 articles from PubMed and 25 articles on MEDLINE (Ovid). Two NASA reports were also included. Following exclusions a total of 17 papers were included in the review. N = 12 papers

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focused on the effects of unique environmental factors such as cosmic radiation and microgravity at the cellular level. Other papers (n = 5) focused more broadly on the incidence and mortality of skin malignancies, emphasizing the potential risks and confounders. One paper highlighted the immunosuppression occurring in space.The results showed that there has been a higher incidence of skin cancers among Astronauts, with over 33 reported basal cell carcinomas (BCC) and squamous cell carcinomas (SCC), and 11 cases of melanoma amongst 338 Astronauts. This is well above the global standardized incidence ratio of melanoma globally, predicted at 3.8 for males and 3.0 for women. Cosmic radiation exposure as a cause is cited due to high atomic mass, high-energy (HZE) particles, and their secondary particles were shown to be particularly damaging, creating microlesions and DNA damage. **DISCUSSION:** This systematic literature review was performed to assess the risk of skin cancer post-spaceflight and highlights the increased risk that Astronauts have. The cause of the increase in skin cancer among Astronauts is distorted by confounding factors such as 89.9% of Astronauts being of Caucasian descent, the "healthy-worker effect," and increased ultraviolet radiation exposure due to typical Astronaut lifestyle factors. Knowledge of the risks can lead to advanced mitigation strategies.

Learning Objectives

1. The audience will learn about the effects of Space travel on the development of skin malignancies.
2. The audience will learn the risk to Astronauts of skin malignancies including the rate of these malignancies and how to mitigate them.

Thursday, 06/05/2025 ***1:30 PM***
Centennial Ballroom IV

[S-65] SLIDE : NEUROLOGY & BIOMECHANICS

Chair: John Crowley
Co-Chair: Peter Letarte

[360] WITHDRAWN

[361] WITHDRAWN

[362] COMPARISON OF A COMPUTATIONAL NECK MODEL TO ELECTROMYOGRAPHY DURING PILOT-RELEVANT HEAD MOTIONS WITH HEAD-SUPPORTED MASS

Nathan Pickle[1], Ryan Middle[1], Phil Whitley[1], Paulien Roos[1], Howard Chen[2], Sara A. Harper[2], Hailey N. Hicks[2]
[1]*CFD Research Corporation, Huntsville, AL, United States;* [2]*University of Alabama in Huntsville, Huntsville, AL, United States*

(Original Research)

INTRODUCTION: Neck pain affects military aviators, diminishing mission performance and negatively impacting long-term quality of life. Aviators wear head-supported mass (HSM) including helmets, night-vision-goggles (NVGs), and counterweights (CWs). Despite the prevalence of neck pain, the root cause is still not fully understood. This study aimed to evaluate accuracy of musculoskeletal simulations for use in studying neck pain. Our hypothesis was that the simulated muscle excitations would agree with electromyography (EMG), demonstrating accuracy of the simulated muscle excitation. **METHODS:** Twelve subjects (6M, 6F) were recruited to represent three anthropometric groups (small, medium, large). Subjects were required to produce neck flexion and extension strength greater than the 20th percentile for their age and height. Subjects wore three HSM configurations (helmet, helmet/NVG, helmet/NVG/CW) while looking at targets at 0°, ±30°, ±60°, and ±90° axially, with 3 different head pitches (0, ± 25 degrees) following a slow cadence. Maximum voluntary isometric contraction (MVIC) trials were conducted before and after the motion trials for neck flexion, extension, and left/right lateral bending. EMG and motion capture data were collected. A computational musculoskeletal (MSK) model of the cervical spine, scaled to size and strength based on published population averages, was used to simulate the experimental protocol. **RESULTS:** Data from a single male subject (1.84 m, 83.4 kg, 25 years) were compared to the generic "large male" model. The timing of simulated muscle excitation and EMG showed general agreement. No trends were observed between HSM configuration and magnitude of muscle excitations, consistent with findings in recent studies. Magnitudes of simulated excitations were higher than EMG (10%-40% MVIC versus 10-20% MVIC). The model strength was 9.6% and 26.6% weaker in flexion and extension, respectively, compared to measured subject data. **DISCUSSION:** An MSK model capable of accurately simulating neck muscle excitation has utility in researching strategies for mitigating neck pain. Our preliminary results demonstrate general agreement between simulated and measured muscle excitations (and by extension, muscle force) in response to HSM configurations, although subject-specific strength scaling may be required. Future extensions of this work include analyzing additional subjects, using subject-specific model strength, and analyzing intervertebral loading.

Learning Objectives

1. The progress made in musculoskeletal modeling and simulating high-fidelity neck models and motions.
2. how head-supported mass influences muscle excitations, and how to compare simulated results with experimental data.

[363] GZ LOADING RESPONSES OF INDEX AND ADJACENT CERVICAL SPINE SEGMENTS WITH ANTERIOR CERVICAL DISCECTOMY AND FUSION

Narayan Yoganandan[1], Balaji Harinathan[1], Aditya Vedantam[1], Brian Stemper[1], Hoon Choi[2], Rick Lang[3], Paul Porensky[3]
[1]*Medical College of Wisconsin, Milwaukee, WI, United States;* [2]*Cleveland Clinic, Weston, FL, United States;* [3]*Naval Health Research Center, San Diego, CA, United States*

(Original Research)

INTRODUCTION: Studies including those from the NATO working group and others have reported that cervical spondylosis and neck pain are prevalent and occur earlier in military. Dynamic/high-g scenarios such as ejection and use of head supported mass are attributed as causes for these disorders. Surgical options include anterior cervical discectomy and fusion (ACDF) and/or total disc replacement (CTDR). Almost all studies determining the response of the ACDF/CTDR spines have focused on quasi-static physiological scenarios. Studies are limited with dynamic loading and that include head supported mass conditions. The objective of this study is to evaluate the responses of different spine segments of the ACDF spine under high-g forces. **METHODS:** An intact global human body consortium finite element model was seated upright, Frankfort plane was maintained horizontal (head-neck facing forward in the neutral posture), restrained with five-point restraint system, and donned with a 1.5 kg military helmet. A Gz pulse of peak 6g was applied, and the intact model was validated with human cadaver experimental results. After model validation, ACDF was simulated at C5-C6 (most common level used in military patients), and the spine surgeon author(s) were involved to ensure clinical applicability. The range of motion and facet loads at the index and adjacent segments, and disc pressures at adjacent segments of the ACDF spine were normalized with respect to the intact spine. **RESULTS:** The range of motion and facet force metrics at the index level decreased by two-third and one-third. At the cranial level, disc pressures, motions, and facet force metrics increased marginally (<10%), while the increase was up to 38% at the inferior level. **DISCUSSION:** The is the first study to simulate dynamic high-g Gz loading with intact and ACDF spines. It is known that dynamic and physiological loading induces different intrinsic spinal load-sharing. Results from the experimentally validated finite element model indicate that the patterns of motions, and anterior (disc pressures) and posterior (facet forces) column load-sharing are level dependent and vary inconsistently. The quantified metrics will assist in an improved understanding of this surgical procedure and may assist in evaluating the performance of cervical arthroplasty devices.

Learning Objectives

1. Knowledge about computational modeling of cervical spine as applied to military personnel and loading scenarios.

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2. Knowledge about surgical procedures for treating neck pain/disorders in military personnel.
3. Knowledge about performance of spines with anterior cervical discectomy and fusion under military loading scenarios such as high-Gz forces.

[364] PHASE III TRIAL TO INVESTIGATE THE FEASIBILITY AND FIDELITY OF THE ROYAL CANADIAN AIR FORCE AIRCREW CONDITIONING PROGRAM

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(Original Research)

INTRODUCTION: More than 90% of RCAF aircrew report significant flight-related neck pain (Smith, 2021). As recommended by the NATO HFM RTG 252 (Farrell, 2020) and demonstrated by the RAF and RAAF, the RCAF Aircrew Conditioning Program (ACP) effectively reduces/prevents neck injury, reduces time away from flying and improves performance (Slungaard, 2018 Slungaard, 2019 Wallace, 2019). Building on the results and lessons learned from the Phase II Trial (Smith, 2022), the revised RCAF ACP was implemented at 12 Wing Shearwater (Maritime Rotary Wing), 4 Wing Cold Lake (Fighters) and 3 Canadian Forces Flying Training School (CFFTS FW and RW Training). Implementation required a dedicated Physical Exercise Specialist (PES) and commitment from RCAF leadership to mandate that all aircrew complete a minimum of two RCAF ACP training sessions per week. **METHODS:** Feasibility was evaluated by participation. Fidelity (effectiveness) was measured by a review of physical performance tests, surveys and health record information at baseline, 3, 6, 9 and 12 months. Phase III will also determine optimal means to quantify program effectiveness, by comparing survey results to other means of collecting similar information: individual electronic health record review, physiotherapy referral forms, Monitor Mass and Unit Flying Program Schedules. **RESULTS:** From baseline to 9-months, 12 Wing (Maritime Rotary Wing) aircrew who attended a minimum of 50% of training sessions demonstrated 40% improved deep neck flexor endurance. This group also demonstrated an improvement in core endurance (side plank) of 50% (Right side) and 30% (Left side). There was also a positive correlation (r=0.54, p=0.007) between compliance and performance (cervical spine strength in flexion) after 3 months in this group. The compliant group (>50% sessions attended) were observed to report fewer neck injuries (0%) at 3 months compared to the non-compliant (<50% attended) group (29%). **DISCUSSION:** Objective testing suggests that with compliance, the RCAF ACP significantly improves performance reduction in neck injury was also observed. Further, improved performance is positively correlated with compliance. However, operational tempo, scheduling and compliance continue to be the biggest barriers to success. Chain of Command support is the biggest contributor to success. Future work must include additional efforts to identify/remove barriers in the respective populations, maximizing participation.

Learning Objectives

1. The audience will learn about the revised RCAF ACP and implementation of this program within the RCAF Fast Jet and Maritime Rotary Wing Communities.
2. The audience will learn about the results of the Phase III Trial of the RCAF ACP, the effectiveness and feasibility of the program and future proposed work.

[365] CASE OF MYASTHENIA GRAVIS IN CIVILIAN PILOT

Dragana Dragic Ranisavljevic
Emirates Airline, Dubai, United Arab Emirates

(Education - Case Study)

INTRODUCTION: This is an uncommon report of a civilian pilot who experienced mild distal limb muscular weakness and nonspecific fatigue due to underlying myasthenia gravis (MG). **BACKGROUND:** Fatigue is a common presentation among pilots in commercial aviation and, along with muscle weakness, is not a specific presentation of MG. Therefore, pilots usually ignore fatigue as a part of the job or rostering issue before presenting the problem to medical professionals. This time can be crucial for detecting other underlying causes of fatigue. Consequently, this delay in diagnosis can worsen the outcome of the timely treatment of conditions such as MG. Additionally, the same delay poses the risk of medical conditions negatively affecting human performance, and, on the contrary, the effect of the aviation environment might negatively affect the condition. Finally, early detection of MG symptoms may lessen symptom severity and improve outcomes. **CASE PRESENTATION:** This is a case of a 39-year-old commercial pilot from the USA with an Indian background. Total flying hours are 8000, about 600 hours yearly, a first officer on an Airbus 380. He gave about a 6-month history of increasing muscle weakness in his lower legs, nonspecific tiredness, and some gastrointestinal issues before he was diagnosed with MG. Removal of his mediastinal mass confirmed a thymoma, followed by plasmapheresis, which eradicated his symptoms. However, neurologists debated to what extent further treatment was necessary and not an obstacle to pilot re-certification and return to the aviation work environment. **DISCUSSION:** This presentation highlights possible risks of prolonged fatigue and weakness in pilots that have not been investigated, as well as the challenges of treatment of MG in pilots. It also raises awareness of MG as "the snowflake disease" and difficulties in diagnosing it due to the variety of its presentation and disappearing symptoms. Finally, it improves awareness that MG has rare and various presentations, potentially reducing diagnosing time.

Learning Objectives

1. The audience will learn about the importance of early detection of myasthenia gravis and how fatigue can masquerade its presence.
2. The audience will learn how the treatment with surgery or medications can support aviators in returning to their duties and re-certification.

Thursday, 06/05/2025 ***1:30 PM***
Regency V

[S-66] PANEL: AVIATION MEDICINE IN THE NEW NORDIC NATO FRAMEWORK

Chair: Bobbie Ray-Sannerud
Co-Chair: Karsten Lindgaard

Panel Overview: *The Nordic nations have significantly strengthened their defence collaboration, particularly in military aviation. This panel session will explore the evolving role of aviation medicine within this new defence landscape, focusing on the integration of Finland and Sweden into the NATO Alliance and the unified Nordic approach to air defence. As we adapt to shared responsibilities within NATO, ensuring the health, safety, and performance of aircrews has become a vital component of operational readiness. On March 25th, 2023, the Royal Danish Air Force, the Finnish Air Force, the Royal Norwegian Air Force, and the Swedish Air Force signed an agreement to establish a Nordic air defense alliance. This collaboration has set the stage for a new era of unified defense efforts in the region. As part of this closer cooperation, these nations have formed the NATO Nordic Aeromedical Group (NNAMG), a specialized initiative aimed at advancing aviation medicine and enhancing their joint operational capabilities. This panel session will feature five presentations, each highlighting key aspects of aviation medicine within the Nordic NATO framework: 1. Royal Danish Air Force: Highlighting innovations in pilot adaptation to 5th generation aircraft helmets, focusing on vision challenges with helmet-mounted displays. 2. Finnish Air Force: Discussing aeromedical challenges related to the dual transition of introducing the F-35A in 2025 and integrating Finland's military and aeromedical systems into NATO. 3. Royal Norwegian Air Force: Presenting two key initiatives—Pilot in the Loop and Human Performance Optimization—focused on enhancing aircrew well-being, performance, and*

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mission readiness. 4. Swedish Air Force: Addressing the impact of Sweden joining NATO on aviation medicine, including new demands for medical screenings such as cardiovascular evaluations for aging pilots. 5. Nordic NATO Aeromedical Collaboration: Exploring the NATO Nordic Aeromedical Group (NNAMG), its strategic benefits, current initiatives, and future goals for collaborative aeromedical practices. Together, these presentations will provide a comprehensive view of how aviation medicine is evolving to meet the needs of a rapidly changing defense environment. As these nations continue to deepen their cooperation, aviation medicine will play a critical role in ensuring the resilience, health, and performance of their aircrews, ultimately strengthening the collective air defense of the Nordic NATO Alliance.

[366] NORWAY'S APPROACH: PUTTING PILOTS AT THE CENTER OF CARE

Bobbie Ray-Sannerud
Norwegian Royal Air Force, Oslo, Norway

(Education - Program / Process Review)

BACKGROUND: The Norwegian Armed Forces Joint Medical Services, through the Institute of Aviation Medicine (IAM), provides comprehensive aeromedical services, including education, training, and research, to the Royal Norwegian Air Force (RNoAF). This presentation will focus on IAM´s multidisciplinary approach to improve performance by maintaining and enhancing both the psychological and physical health of aircrew, with an emphasis on placing aircrew at the center of care. Two key programs—Pilot in the Loop and the Human Performance Optimization Program—will be highlighted, illustrating how these initiatives are designed to put aircrew at the center of care to support their well-being, performance, and mission readiness. The approach is inspired by the well-researched principals of person-centered care, which have shown to improve engagement, trust, and resilience by focusing on individual needs and empowering patients to effectively manage challenges. **OVERVIEW:** Aviation medicine at the IAM in the RNoAF integrates prevention, occupational, environmental, and clinical medicine with physiology and psychology to support military aircrew. The Royal Norwegian Air Force (RNoAF), with about 2,500 personnel, operates modern aircraft such as the F-35, P-8, and AW101 in challenging Arctic conditions. NATO's rapidly changing landscape in threat, security, and technology has increased the operational pace for aircrew in Norway. The Institute of Aviation Medicine (IAM) provides medical certification, aeromedical training, policy development, education, and research to enhance flight safety and performance. This presentation will review two aircrew-centered programs at IAM, PIL and HPOP, highlighting their unique approach by 1) integrating specialists in aviation medicine and psychology through a multidisciplinary team, and 2) placing aircrew at the center of care with tailored medical and psychological interventions based on their unique needs and circumstances. This approach enhances engagement, improves treatment adherence, and motivates aircrew toward mission readiness while fostering trust between aircrew and their aeromedical providers. Ultimately, it leads to better health outcomes, reduces stigma and healthcare avoidance, increases satisfaction, and facilitates a more efficient return to flying status. **DISCUSSION:** Like person-centered care, placing aircrew at the center of care in aviation medicine offers a promising approach to improving military aircrew retention, safety, and ensuring a smoother return to flight status. In Norway, the PIL and HPOP programs have been evaluated by medical staff, operational leaders, and aircrew, demonstrating their effectiveness in enhancing well-being, performance, and overall mission readiness.

Learning Objectives

1. Attendees will learn how the Institute of Aviation Medicine (IAM) integrates aviation medicine, psychology, and other disciplines to enhance both the psychological and physical health of militar.
2. Participants will explore the Pilot in the Loop (PIL) and Human Performance Optimization Program (HPOP), gaining insight into how these initiatives are designed to place aircrew at the center of care, addressing their unique needs to improve health outcomes, treatment adherence, and mission readiness.
3. The session will highlight how adopting principles of person-centered care fosters engagement, trust, and resilience in aircrew, leading to improved retention, faster return to flight status, and enhanced overall safety and performance in the Royal Norwegian Air Force.

[367] STRENGTHENING NORDIC AIR DEFENSE: A UNIFIED APPROACH TO AEROMEDICAL COLLABORATION

Anthony Wagstaff
Institute of Aviation Medicine, Oslo, Norway

(Education - Program / Process Review)

BACKGROUND: The Nordic countries' Air Forces—comprising the Royal Danish Air Force, the Finnish Air Force, the Royal Norwegian Air Force, and the Swedish Air Force—have recently strengthened their collaboration in military aviation. With Sweden and Finland joining the NATO Alliance, the Nordic countries have come closer together in their defense initiatives. On March 25th, 2023, the four nations signed an agreement to form a unified Nordic air defense alliance. As part of this closer cooperation, they have established the NATO Aeromedical Group (NNAMG), specifically focused on advancing the field of aviation medicine to enhance their joint operational capabilities. **OVERVIEW:** The Nordic Countries have longstanding tradition of cooperation between their air forces and aeromedical communities, even before Sweden and Finland´s pursuant to NATO membership. While the cultures are closely related and languages similar (except for Finnish), this cooperation, although consistently friendly, has always been limited in scope. With the new Nordic NATO alliance, there is not a renewed focus on collaboration at a far more direct and practical level. Our future plans include regular seminars hosted across the four countries, along with the development of a joint, modular training course for flight surgeons, leveraging shared resources for physiological training, specialist aeromedical assessment, research and operational experience. We also aim to establish standardized procedures for aeromedical support, enhancing interoperability across the Nordic nations within the aeromedical domain. **DISCUSSION:** Despite the differences in aeromedical resources among the Nordic countries' Air Forces, many of the challenges they face are similar. The unique conditions of the High North – characterized by extreme cold, harsh weather, challenging terrain and variable light – demand specialized aeromedical procedures, training, equipment and precautions. Addressing these shared challenges offers an opportunity to strengthen aeromedical capabilities through collective knowledge, research, and resource sharing. Being unified within NATO further amplifies the potential for significant advancements in Nordic aviation medicine, in parallel to the impact of of the joint air forces in an air defense alliance. The progress so fart and the promising outcomes of this cooperation will be explored in greater detail.

Learning Objectives

1. Gain insight into the structure, purpose, and operational goals of the newly established Nordic NATO Aeromedical Group (NNAMG) and how it enhances Nordic air defence.
2. Recognize the specific challenges posed by extreme weather, variable light, and terrain in the North, and learn how collaborative aeromedical procedures and training address these unique conditions.
3. Understand the importance of standardized procedures, modular training, and shared resources to improve interoperability and operational readiness across Nordic air forces within NATO.

[368] DANISH MILITARY AVIATION MEDICINE: CURRENT RESEARCH AND NORDIC COLLABORATION

Karsten Lindgaard
Danish Defence Medical Command, Syddanmark, Denmark

(Education - Program / Process Review)

BACKGROUND: The Danish Military aeromedical organization faces unique challenges as a small branch neutral organization tasked with providing aeromedical services to the diverse branches of the military: Air Force, Navy, and Army. The small size of the organization has strength when it comes to communication and the possibility of fast track case management. On the downside the limited organization size does not

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leave room for medical staff to have full time research or development positions. This fact drives the organization to be engaged with NATO partners for knowledge development and exchange. It would simply not be possible to deliver a sufficient service to aircrews without this network and therefore it is crucial to the daily work. As being a part of Scandinavia, Denmark has a strong connection with the closest neighbors and this being reinforced even more with Sweden and Finland joining NATO in the near future. This presentation will give an introduction to the organization, challenges and current research in the Danish military aeromedical community. **OVERVIEW:** The presentation will cover a brief organizational introduction to the Danish military aeromedical community. The growing collaboration between the Scandinavian countries is to a mutual benefit which has been shown in exchange of flight physiology education, training curriculum and knowledge of prevention of altitude induced decompression sickness. Recent research has focused on potential pilot adaptation issues associated with 5th generation aircraft helmets, particularly concerning vision issues related to the extensive use of helmet mounted displays. During the F-35 transition training, a group of 20 pilots were monitored using questionnaires to assess their adaptation experience. In collaboration with the USAF Operational Based Vision Assessment (OBVA) laboratory, a follow-up evaluation was conducted to assess the precision of individual helmet alignment. A brief overview of this study and findings will be presented. **DISCUSSION:** Perhaps now more than ever the NATO community is important for strengthening knowledge and development of interoperability between our nations. Especially with Sweden and Finland as future new NATO members. This calls for a further development of our existing Nordic collaboration, particularly in regards to flight surgeon training, flight physiology training and general knowledge exchange.

Learning Objectives

1. The audience will get insight into pilot reported issues with extensive use of helmet mounted displays.
2. The audience will get an organizational insight into smaller nations aviation medicine structure.

[369] AEROMEDICAL ORGANIZATION IN THE SWEDISH AIR FORCE: GROWTH, CHALLANGES AND POSSIBILITEIS

Patrik Gustafsson
Swedish Armed Forces, Umeå, Sweden

(Education - Program / Process Review)

BACKGROUND: The military aeromedical organization in Sweden has undergone structural changes over the last decades, and more recently since Sweden's integration into NATO. An emerging and well publicized challenge is military pilot shortage in a growing air force. This presentation will introduce aviation medicine and operations in Sweden as well as the challenges and possibilities faced in the new context of joining NATO. **OVERVIEW:** Sweden's central aeromedical section leads all the aeromedical operations in the air force including implementing aeromedical rules, medical board, medevac, research, education. The Medical Examination Department (MedUA) includes first time medical for all flying duties and training of active air force pilots (high-G in the dynamic flight simulator, hypoxia recognition training, parachute landing training and sea survival training). The changing geopolitical landscape has increased security needs requiring more flying duties in a growing air force. However, meeting this demand presents real challenges due to pilot, other flight crew and combat leader shortages. One way this challenge is being met is synergy within NATO, especially our nordic allies, but also retention of elderly pilots who may remain in active flying duty past the age of retirement. This results in new demands for medical evaluation, such as increased requirements for cardiovascular disease evaluations and other screening tools for an aging pilot population. **DISCUSSION:** Sweden's move into NATO and its increasing aviation medicine operational demands facing an aging pilot population demands careful aeromedical considerations. We want to highlight our multidisciplinary approach to our aeromedical organization, research projects and policies, meeting both the medical and psychological aspects of each pilot and other air crew. Ongoing projects to include hypoxia, spatial disorientation and decompression sickness will be highlighted. As an example, recent research of decompression sickness that resulted in a change of routines with pre oxygenation. Recent Nordic collaborations within NATO creates a platform for connecting aviation medicine specialists thus extending the possibility for solving problems for common goals.

Learning Objectives

1. Identify the key responsibilities of Sweden's central aeromedical section in supporting air force operations, including aeromedical regulations, medical evaluations, training, and medevac services.
2. Describe the current challenges in Swedish military aviation medicine due to pilot shortages, increased security needs, and the aging pilot population, as well as strategies for addressing these challenges, such as collaboration with NATO allies and retention of experienced pilots.
3. Discuss recent aeromedical research and multidisciplinary approaches addressing issues like hypoxia, spatial disorientation, and decompression sickness in Sweden's air force.

[370] MILITARY AEROSPACE MEDICINE IN FINLAND

Roope Sovelius[1], Taija Lahtinen[2], Tuomo Leino[3]
[1]*Finnish Defence Forces, Helsinki, Finland;* [2]*Finnish Defence Forces, Rovaniemi, Finland;* [3]*Finnish Defence Forces, Tikkakoski, Finland*

(Education - Program / Process Review)

BACKGROUND: In Finland, aeromedical Centre in Helsinki and health centres in air bases belong to joint medical corps (Centre for Military Medicine). Air Force Command Finland is military aeromedical authority and responsible for aeromedical standards and waiver decisions. Aeromedical Centre is responsible for military aircrew annual flight physicals, and the selection process of military pilots. Health centres are responsible for daily aeromedical concerns, and annual fitness tests as a part of aeromedical qualification. Current aeromedical matters in Finland include dealing with two big transitions taking place almost simultaneously: introduction of a new platform, F-35A in 2025 and integrating the nation, its military and aeromedical system to NATO. 5th gen aircraft has new human factors elements and our aeromedical professionals need to be prepared for the change. On the other hand, this also brings new possibilities for scientific and operational co-operation in military aerospace medicine. **OVERVIEW:** In international and Nordic co-operation, several new sectors are evolving. A national shortage of military medical personnel in Finland highlights the need of common aeromedical training in blocks in Nordic countries. In pilot training, basic flight training is fully given in Finland. Finland has recently opened phase 3 and 4 flight training with Hawk also for Royal Norwegian Air Force student pilots. Main aeromedical research work consists of prospective long-term follow-up of discus degeneration (DD), 5 gen fighter pilots vision studies and comprehensive research of hypoxia training in flight simulators as well as fatigue management and human factors research. On-going programs are presented in more detail in the panel. Also, lessons learned from Ukraine war need to be at highest priority. In Finland, these lessons include prioritizing the training of Tactical Combat Casualty Care (TCCC), developing walking blood banks, and improving Role 2 Forward capabilities with damage control surgery capability. High North operation area provides international challenge for aeromedical evacuation. **DISCUSSION:** Nordic aeromedical community has new challenges due to increasing importance on Arctic region. Finnish Air Force has been developing and emphasizing the elements needed for Agile Combat Employment (ACE) in training and exercises, and this provides another possibility for future co-operation.

Learning Objectives

1. The participant will understand the structure and responsibilities of Finland's military aeromedical system, including the roles of the Aeromedical Centre, Air Force Command, and health centers on air bases.
2. The participant will understand the specific challenges and changes in Finnish aeromedical practices related to the introduction of the F-35A platform, NATO integration, and collaborative training needs with Nordic allies.

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3. The participant will understand ongoing Finnish aeromedical research efforts, including studies on fighter pilot vision, hypoxia training, fatigue management, and their practical applications in military aerospace medicine and tactical combat casualty care.

Thursday, 06/05/2025 ***1:30 PM***
Regency VII

[S-67] PANEL: APPLICATIONS OF ARTIFICIAL INTELLIGENCE (AI) TO COMBAT AVIATION MISHAPS

Chair: G. Merrill Rice

Panel Overview: BACKGROUND: *The applications for AI regarding Aerospace medicine are broad and have the potential to dramatically improve safety by recognizing hazards and preconditions that may predispose aviators to mishaps. Some of the ways AI may assist aviators in the cockpit include predictive analysis, machine learning for pilot training, data analysis, sensor fusion, real-time monitoring, alert systems, and accident investigation. The panel will provide an overview of the existing research that has utilized AI in extreme environments. The authors will further propose a framework investigators may follow to identify cognitive performance decrements stemming from common aeromedical hazards such as hypoxia, spatial disorientation, and fatigue and then transition the technology to the operational environment . Our second presentation will explore applications of AI with regards to identifying Spatial Disorientation by monitoring real time cockpit control inputs. Our third presentation will evaluate the effects of emotions on performance and the potential for mitigating negative emotional effects by AI enhanced neuromodulation. Finally, we will provide methodologies for using deep learning to systematically evaluate aircraft environmental control systems data to identify conditions which may result in physiologic events or mishaps. Attendees will garner an understanding of the current methodologies in machine learning employed by aeromedical researchers to improve human performance and mitigate mishaps in aviation environments.*

[371] METHODOLOGIES TO UTILIZE AI TO COMBAT AVIATION MISHAPS - A CRITICAL REVIEW

G. Merrill Rice[1], Steven Linnville[2], Dallas Snider[3]
[1]*Naval Safety Command, Norfolk, VA, United States;* [2]*Naval Aerospace Medicine Research Laboratory - Dayton, Dayton, OH, United States;* [3]*University of West Florida, Pensacola, FL, United States*

(Original Research)

INTRODUCTION: Despite significant advancements in aerospace engineering and safety protocols over the last decade, U.S. naval mishap rates have remained essentially unchanged. This presentation explores how researchers may leverage current Artificial Intelligence (AI) technologies to enhance aviation safety. **METHODS:** A critical review was performed identifying aviation research protocols which have incorporated machine learning (ML) to enhance the accuracy of detecting common aviation hazards leading to cognitive decrements. The review proposes a three-step methodology for creating protocols to identify cognitive decrements in aviators: 1) sensor selection 2) pre-processing techniques, and 3) ML algorithm development. **RESULTS:** Several psychophysiological biosensors, enhanced by ML modeling, show promise in identifying cognitive deficits secondary to fatigue, hypoxia and spatial disorientation. The most cited biosensors integrated with ML models include electroencephalographic, electrocardiographic, and eye tracking devices. The application of pre-processing techniques to biosensor data is a critical methodological step prior to applying ML algorithms for data training and classification. ML algorithms utilized were categorized into supervised, unsupervised, and semi-supervised types, often used in combination for more accurate predictions. **DISCUSSION:** Current literature suggests that AI, when used in conjunction with various psychophysiologic sensors, can predict and potentially mitigate common aeromedical hazards such as fatigue, spatial disorientation, and hypoxia in simulated settings. The miniaturization of pre-processing and ML algorithmic hardware is the next phase of transitioning AI to operational environments for real-time continuous monitoring.

Learning Objectives

1. Participants will learn the basic methodologies employed from recent literature to utilize AI to identify cognitive decrements in the cockpit.
2. Participants will be able to identify the primary psychophysiologic sensors utilized, pre-processing techniques and machine learning algorithms applied in existing aeromedical protocols.

[372] ARTIFICIAL INTELLIGENCE AS A COUNTERMEASURE FOR SPATIAL DISORIENTATION

Vimal Vivekanand, Yonglin Wang, James Lackner, Paul DiZio, Pengyu Hong
Brandeis University, Waltham, MA, United States

(Original Research)

INTRODUCTION: Spatial disorientation (SD) is a major contributor to fatal aircraft accidents. Previously, from the same disorienting profile, we found a surprisingly wide range of individual differences in the perception of self-orientation which, to our knowledge, no vestibular model can predict. Could an AI model help? **METHODS:** Blindfolded participants (n=37) were secured into a Multi-Axis Rotation System device that was programmed to behave like an inverted pendulum in the horizontal roll plane, where participants could not use gravitational cues to determine their position because they did not tilt relative to the gravitational vertical. They used a joystick to stabilize themselves about the balance point. All participants exhibited spatial disorientation, poor performance and high rates of crashing (reaching ±60 deg). In a first study, to predict individual differences in performance while disoriented, we used a Bayesian Gaussian Mixture method to cluster participants into three statistically distinct performance groups and then used a Gaussian Naive Bayes method to create predictive classifiers of performance. In a second study, we used stacked gated recurrent units (GRU) to predict impending crashes before they happened. **RESULTS:** In the first study, we could predict a participant's final performance group with 80% accuracy within the first 13 minutes. We also identified a suboptimal strategy that all participants used in the least proficient category. In the second study, we were able to predict crash events 800 ms in advance with an AUC (area under the curve) value of 99%. When we prioritized reducing false negatives we found it resulted in more false positives. We found that false negatives occurred when participants made destabilizing joystick deflections that rapidly moved the MARS away from the balance point. These unpredictable destabilizing joystick deflections were a result of SD. **DISCUSSION:** If our model could work in real time, immediate human action would result in the prevention of 80.7% of crashes. However, accounting for human reaction times (~400 ms), only 30.3% of crashes could be prevented. Therefore, while AI could be helpful, our implementation was limited by the huge variability and unpredictability of individual differences in perception of self-orientation caused by SD

Learning Objectives

1. How did we create a spaceflight analog condition that led reliably to spatial disorientation?
2. How metrics such as the AUC (area underneath the curve) are not always the best way to access the success of the AI model.

[373] IMPROVEMENT OF COGNITIVE PERFORMANCE UNDER NEGATIVE EMOTIONS IN COMPLEX ENVIRONMENTS UTILIZING TDCS AND ARTIFICIAL INTELLIGENCE

Fabre Ludovic, Olivier Bartheye, Tristan Feutren
École de l'air et de l'Espace, Salon-de-Provence, France

(Original Research)

INTRODUCTION: Considering the emotional impact on decision-making processes during aerospace operations is essential to avoid

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negative outcomes and biases, the aim of the present experiment was twofold: (1) to monitor the cognitive state of operators in real-time and assess the impact of emotions on performance and (2) mitigate emotionally induced performance decrements with neuromodulation and explainable artificial intelligence (AI). AI was used to monitor participants in real-time and adapt neurostimulation to each participant. **METHODS:** A single-blind, within-subjects, sham-controlled design was employed. Thirty participants performed three laboratory tasks, each specifically assessing a cognitive control process: the Go/No-Go task (inhibition), the 2-back task (updating), and the set-switching task (shifting). They engaged in a video game used in psychological research, Space Fortress, which simulates a multitasking environment. Emotions were manipulated using the IAPS pictures or the Trier Social Stress Test. Half of the participants received transcranial direct current stimulation (tDCS) over the left dorsolateral prefrontal cortex (DLPFC) for 30 minutes at 2mA, while the other half received a sham stimulation at the beginning and end of the tasks. EEG data were recorded using a 32-channel active electrode cap. **RESULTS:** Behavioral results replicated previous findings, revealing that negative emotions impaired performance in the 2-back task ($p = 0.002$) and switching tasks ($p < .001$). Interestingly, tDCS stimulation interacted with emotions, leading participants to improve their performance under negative and neutral emotional conditions ($p < .001$). For the 2-back task, participants responded faster and made fewer errors in the active stimulation condition compared to the sham condition. ($p = 0.03$). The effect of tDCS on Go trials was not significant for both active and sham stimulation. tDCS reduced the switching cost, resulting in faster response times after the switch. ($p = 0.04$). **DISCUSSION:** The present study examined how a single session of tDCS influenced the effects of negative emotions on cognitive control processes. These findings have important implications for understanding the influence of emotions on cognitive control and multitasking. Moreover, the use of OpenViBE software is promising in designing and implementing Brain-Computer Interfaces (BCIs) that provide real-time feedback and adapt tDCS protocols to individual participants.

Learning Objectives

1. The participant will be able to understand how negative emotions influence the processes of cognitive control.
2. The participant will understand the potential use of BCI, enabling neurostimulation to be adapted to each participant to offset the deleterious effects of emotions on cognitive performance.

[374] DETECTING PRESSURE-RELATED PHYSIOLOGICAL EVENTS WITH DEEP LEARNING

Lucas Haberkamp[1], Stephanie Warner[1], Dain Horning[1], Roy Allen Hoffman[2]

[1]*Naval Medical Research Unit-Dayton, Wright-Patterson AFB, OH, United States;* [2]*Engineering Systems Inc, Peachtree Corners, GA, United States*

(Education - Tutorial / Review)

INTRODUCTION: Physiological events (PEs) resulting from fluctuating cockpit pressure are a significant concern in tactical jet aircraft, particularly in the F/A-18. The specific cockpit pressure features contributing to aircrew symptoms remain unclear. Cockpit pressure dynamics are complex and time-dependent, making them difficult to capture with scalar values. Therefore, researchers should leverage deep learning approaches that automatically extract meaningful features from raw data and achieve state-of-the-art classification performance across several domains. **TOPIC:** Since 2017, the U.S. Navy has collected cockpit pressure data from F/A-18 flights, providing a robust dataset for studying normal cockpit pressure dynamics. Prior analyses relied on thresholds for the rate of cockpit pressure change, with the best performing ±0.6 PSI/sec threshold yielding poor precision (19%) and moderate recall (64%). To date, no deep learning models have been developed to distinguish PE from non-PE flights. However, three promising approaches for this task include unsupervised autoencoders, supervised contrastive learning, and traditional supervised learning with focal loss. Autoencoders compress non-PE data into a lower-dimensional space, capturing key features of normal pressure dynamics. By reconstructing the input data, autoencoders produce low error for normal fluctuations but high error for anomalies, thereby detecting potential PE flights. Supervised contrastive learning identifies discriminative features by projecting time-series data into a representation space where non-PE flights cluster tightly and PE flights are distinctly separated. It handles imbalanced data well by leveraging many unique comparisons between PE and non-PE examples, allowing the model to learn effective representations even with limited PE examples. Traditional supervised learning with focal loss also addresses the class imbalance problem. Focal loss adjusts the contribution of each example dynamically, focusing on hard-to-classify examples and reducing bias towards non-PE flights. **APPLICATION:** These deep learning approaches are expected to significantly improve the precision and recall of pressure-related PE detection. They will serve as benchmarks for developing interpretable machine learning models requiring manual feature engineering. Ultimately, the best performing deep learning model may enhance PE investigations by reliably predicting the likelihood of a pressure-related PE.

Learning Objectives

1. Understand how deep learning models can recognize patterns and automatically learn important features from F/A-18 cockpit pressure data.
2. Provide insights into which deep learning approaches are suitable for datasets with severe class imbalance (i.e., anomaly detection).

Thursday, 06/05/2025 ***1:30 PM***
Hanover C/D/E

[S-68] PANEL: AEROMEDICAL ETHICS PANEL: SPONSORED BY THE AMERICAN SOCIETY OF AEROSPACE MEDICINE SPECIALISTS

Chair: Mark Mavity

Panel Overview: *Aerospace medicine may present an array of potential ethical dilemmas to aviation medicine physicians and other aeromedical professionals that may arise out of conflicts between the interests, rights, and responsibilities of those within our profession, individual patients/aircrew, private employers, and governmental certifying agencies. Case studies will be presented for open audience discussion that address a variety of relevant ethical value conflicts in the current practice of aerospace medicine.*

[375] AEROMEDICAL ETHICS PANEL: SPONSORED BY THE AMERICAN SOCIETY OF AEROSPACE MEDICINE SPECIALISTS

Mark Mavity

EHE Health and Acuity International, McLean, VA, United States

(Education - Case Study)

Aerospace medicine may present an array of potential ethical dilemmas to aviation medicine physicians and other aeromedical professionals that may arise out of conflicts between the interests, rights, and responsibilities of those within our profession, individual patients/aircrew, private employers, and governmental certifying agencies. Case studies will be presented for open audience discussion that address a variety of relevant ethical value conflicts in the current practice of aerospace medicine.

Learning Objectives

1. The audience will explore the process of ethical decision-making and its impact upon the practice of aerospace medicine.
2. The audience will learn about the current foundational resources which form the framework of current medical ethical guidance, particularly the ASAMS Ethical Guidelines as they relate specifically to the practice of aerospace medicine.
3. The audience will be encouraged to provide thought and attention to the ethical issues impacting the practice of aerospace medicine.

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Thursday, 06/05/2025 ***1:30 PM***
Grand Hall East Corridor - Posters Only

[S-70] POSTER : HEAD, SHOULDERS, KNEES & TOES FOR SPACE

Chair: Barrett Campbell
Co-Chair: Jan Stepanek

[379] SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS) OPTICAL COHERENCE TOMOGRAPHY (OCT) CLINICAL GUIDELINES: TRANSITION FROM OCT1 TO OCT2

Sambit Pattanaik[1], Lenexa Morais[2], Carlo Canepa[3], Sara Mason[4], Nimesh Patel[5], Tyson Brunstetter[6]
[1]*Cooper University Hospital, Camden, NJ, United States;* [2]*University of Florida, Gainesville, FL, United States;* [3]*Baylor College of Medicine, Houston, TX, United States;* [4]*Aegis Aerospace Inc, Webster, TX, United States;* [5]*University of Houston, Houston, TX, United States;* [6]*NASA JSC, Houston, TX, United States*

(Education - Program / Process Review)

BACKGROUND: Optical Coherence Tomography (OCT) is the primary modality for monitoring and measuring ocular anatomical changes that are associated with Spaceflight Associated Neuro-ocular Syndrome (SANS) in long- and extended-duration spaceflight. The latest generation Spectralis OCT-2 diagnostic device (Heidelberg Engineering) is currently used onboard the International Space Station (ISS), allowing for improved data collection and diagnostic value compared to the previous generation OCT1 device. As part of a National Aeronautics and Space Administration (NASA) Aerospace Medicine Clerkship project in April 2024, the authors updated the clinical guidelines for OCT-2 for the NASA Flight Surgeons and International Partners. **METHODS:** Literature review of the prior OCT-1 clinical guidelines (NASA internal document) was updated with information obtained from a broad, open-source literature review of current SANS-related journal articles, Heidelberg Engineering technical specifications, and discussion/interviews with SANS Subject Matter Experts (SMEs). Comparison of OCT-1 and OCT-2 protocol demonstrated significant improvements in clinical capability of the OCT-2 device, including higher scan density, increased resolution, deeper tissue penetration, faster scan times, and the new feature MultiColor Imaging (MCI). **DISCUSSION:** OCT-2 is the most critical ocular diagnostic device and primary tool to detect and grade SANS optic disc edema (by measurement of pre- to in-flight change in peripapillary total retinal thickness, ΔTRT). Upgrading from OCT1 to a higher density and faster OCT2 protocol has saved valuable astronaut time, streamlined scans and user capability, and improved data resolution. Additionally, OCT-2 MCI capability has replaced on-orbit fundoscopy for nominal operations, which has saved over 14 hours of crewtime per increment. By summarizing the OCT2 Clinical Guidelines, we hope to demonstrate why OCT is a valuable and clinically relevant data collection and diagnostic tool, and why it should continue being utilized onboard the ISS and beyond. With the increasing extended duration missions on the horizon, a new, mini-OCT device that retains or exceeds the OCT2 capabilities will be needed.

Learning Objectives

1. The audience will better understand the role of OCT in detecting, monitoring, and objectively quantifying the clinical features associated with SANS.
2. The audience will gain a greater appreciation for the increased speed and capability of OCT-2 compared to OCT-1, which will emphasize the importance of continuing to develop OCT devices for use beyond low Earth orbit (LEO).

[380] ASSESSMENT OF RISK FACTORS FOR OPTIC DISC EDEMA IN A SPACEFLIGHT ANALOG

Sarah Ditelberg[1], Sara Zwart[2], Scott Smith[2], Millennia Young[2], Alex Huang[3], Brandon Macias[2], Steven Laurie[2]
[1]*Loyola University Chicago Stritch School of Medicine, Maywood, IL, United States;* [2]*NASA JSC, Houston, TX, United States;* [3]*University of California San Diego, San Diego, CA, United States*

(Original Research)

INTRODUCTION: While ~60% of astronauts develop mild optic disc edema (ODE) during spaceflight, and ~18% develop more concerning ODE, there are likely modifying factors that explain the variability in the magnitude of its presentation. Prior studies involving astronauts during spaceflight and participants exposed to strict head-down tilt bed rest (HDTBR) have focused on optic cup volume, sleep duration, and genetics as single factors to explain the variability in ODE presentation. The purpose of this study was to determine if combining data from all of these factors can improve the ability to predict the severity of ODE. **METHODS:** At the German Aerospace Center, 47 participants (27 males, 20 females) were exposed to 30 days of strict 6° HDTBR. Optic cup volume was quantified from optical coherence tomography (OCT) images, sleep duration from polysomnography, and single nucleotide polymorphisms (SNPs) from blood samples. Change in total retinal thickness (ΔTRT) was quantified from OCT images to assess ODE; ΔTRT >19.4 µm indicates its earliest signs. This project was approved by the NASA JSC IRB and the North Rhine Ethics Committee in Germany. **RESULTS:** HDTBR led to ODE in 37/47 individuals (ΔTRT 19.6 to 193 µm). No individuals with optic cup volumes > 0.4 mm3 developed ODE. One individual with a moderate sized cup volume (0.3 mm3) and ΔTRT > 50 µm had < 5 hours of sleep and possessed 3 of 4 "risk" alleles based on SNPs identified in previous research. The individual with the greatest ΔTRT had normal sleep (~7 hours), but a small cup volume (0.02 mm3) and possessed 2 "risk" alleles. **DISCUSSION:** Evaluation of all three factors together represents a more comprehensive approach to determining the degree of ODE severity. These data highlight that different factors may influence ODE development in different individuals and reveal that combining multiple factors improves our ability to predict ODE development. This more comprehensive understanding of multiple risk factors will allow for targeted approaches in utilizing SANS countermeasures.

Learning Objectives

1. The audience will be able to describe three hypothesized risk factors for SANS.
2. The audience will be able to understand how these factors are being used to identify those at risk for SANS.

[381] WITHDRAWN

[382] REHASHING REHABBING: HOW PRIVATE SPACEFLIGHT COULD CHANGE THE FUTURE OF REHABILITATION IN MICROGRAVITY.

Hamaad Khan, Emily Gansert, Tyler Mistretta
Mayo Clinic, Jacksonville, FL, United States

(Education - Tutorial / Review)

INTRODUCTION: Commercial spaceflight companies like Axiom, Virgin Galactic, and SpaceX are increasing private citizens' access to spaceflight. As this demand grows, the physical conditioning process for the average space traveler will become increasingly difficult. Maintaining bone density and muscle mass in microgravity proves difficult even for highly trained astronauts, many of whom are former military personnel. It is clear that average citizens, often with minimal training and potential comorbidities, will face even greater physical challenges. A thorough review of the current spaceflight rehabilitation regimen is critical to understanding how these methods can be adapted and optimized for future space travel. **TOPIC:** Rehabilitation for space flight currently

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involves three key phases: preflight, in-flight, and post-flight. Preflight focuses on preparing the body for microgravity, with an emphasis on strength, cardiovascular conditioning, and flexibility exercises to build a strong foundation. In-flight exercises work to mitigate the rapid muscle atrophy and bone density loss caused by microgravity with carefully crafted exercise regimens. Post-flight rehabilitation shifts the focus to readapting the body to Earth's gravity, addressing balance, coordination, and overall physical strength after prolonged weightlessness. These regimens have all been designed with career astronauts in mind, and many components will require restructuring for the unique needs of the civilian population. **APPLICATION:** With a rise in the number of private individuals venturing into space, training protocols must become more personalized, accounting for the physical diversity and health variations of private astronauts. Focus on lower body and core muscle groups to strengthen load-bearing bones is crucial, especially in elderly travelers. Progressive loading and joint stabilization exercises will be paramount on Earth to prevent connective tissue injury in microgravity. Additionally, in-flight rehabilitation should incorporate wearable biosensors to provide real-time health monitoring and enable detailed tracking of functional changes throughout the mission. The post-flight phase will need greater support from specialists and experts to address the varied physical responses and potentially slower recovery rates of civilians as they readjust to Earth's gravity. By integrating adaptive and personalized methods, we can create a safer, more inclusive future for human space travel.

Learning Objectives

1. The audience will be able to identify current rehabilitation strategies employed by governmental space agencies to mitigate microgravity changes in astronauts.
2. The audience will acknowledge the challenges faced by private space agencies when employing private citizens.
3. The audience will understand how traditional rehabilitation strategies will be adapted for civilian space travelers for preflight, in-flight, and post flight conditioning.

[383] WITHDRAWN

[384] VOLUME OF INJURIES: A REVIEW OF MSK INJURY INCIDENCE RELATIVE TO SPACECRAFT HABITABLE VOLUME

Ari Epstein
University of Rochester, Rochester, NY, United States

(Education - Program / Process Review)

BACKGROUND: With the anticipated retirement of the ISS (International Space Station) by 2030 and transition back to flights beyond Low Earth Orbit (LEO) via NASA's Artemis Program, future non-commercial spaceflights will expose crew to new operational environments that may increase the risk of MSK injuries. One such change is the decreased habital volume of the spacecraft. Presently, NASA crew fly in capsular craft (Soyuz or Crew Dragon) for limited intervals (i.e. 4-16 hours) in transit to the ISS, but the planned early Artemis missions will require crew to remain in the capsular Orion MPVC for the duration of the flight, like 10 days for all crew on Artemis II or approximately 30 days for half the crew on Artemis III. **OVERVIEW:** This literature review summarizes the Aerospace Medicine literature to identify existing knowledge gaps specific to in-flight musculoskeletal (MSK) injury mechanisms and injury rates relative to spacecraft design or habital volume. A review utilizing select databases (MEDLINE, NASA Technical Report Server, and PubMed) was performed to identify both the mechanisms for and locations of in-flight MSK injuries that occurred on flights between 1959 and 2023. A literature search of original research, technical reports, and conference media (poster/podium presentations and papers) was performed with a combination of keywords: musculoskeletal, MSK, capsule, spacecraft design, and injury[ies]. **DISCUSSION:** MSK injury rates localized to specific mission activities, like extravehicular activity (EVA), translation through modular spacecraft, equipment stowing, and in-flight exercise. However, unpublished data from early, capsule-only programs (maximum mission duration 14 days) demonstrated higher MSK injury rates independent of the latter mission activities. Despite this difference, none of the sources in this literature review specified the mechanisms of the reported MSK injuries in those early programs. Future research may address this operational knowledge gap to better understand if capuslar vehicles with much smaller habital volumes than current, large-volume operating environments (i.e. ISS), may increase the risk of MSK injury independent of in-flight activities, like exercise or EVA.

Learning Objectives

1. The audience will learn about the most common mechanisms for MSK injuries on larger habital volume spacecraft, like the ISS. Specifically, the audience will gain a more nuanced understanding of MSK injury risks to crew from 1) operating both aerobic and resistive exercise devices and 2) EVA suit components.
2. The audience will learn about the capsular design of earlier NASA programs (Gemini X-XII, Apollo, and the Apollo/Soyuz Test Project).
3. The audience will learn about how crew translate about the habital volume of capsules and which countermeasures were implemented to enhance crew safety.

[385] TUTORIAL: REVIEW & PROPOSED MANAGEMENT OF SPACEFLIGHT DERMATOSES

Julian Henke[1], Sana Kamboj[1], Jacob Asmuth[2], Ameya Gangal[1], Justin Cheeley[1], Travis Blalock[1]
[1]*Emory University School of Medicine, Atlanta, GA, United States;* [2]*Johns Hopkins, Baltimore, MD, United States*

(Education - Tutorial / Review)

INTRODUCTION: While multiple reviews of dermatologic conditions associated with spaceflight have been published over the past decade, they often lack standards for managing these conditions in space. Transcriptomic studies have revealed key biological changes including those related to skin health, DNA damage, and repair. This tutorial bridges that gap by focusing on the identification and practical management of dermatologic sequelae of spaceflight, including microgravity-induced skin thinning, xerosis, and contact dermatitis, with specific, evidence-based treatment recommendations and potentially promising management techniques. **TOPIC:** Space missions pose unique challenges to skin health due to microgravity, low humidity, and limited hygiene, leading to issues such as skin thinning, dermal atrophy, and increased incidence of dermatologic symptoms. Skin abrasion and rash are among the most common medical conditions reported in space, as noted by the NASA Human Research Program's Integrated Medical Model. Microgravity also downregulates fibroblast and keratinocyte function, which contribute alongside extracellular matrix composition changes to lead to impaired skin healing and dermal atrophy. **APPLICATION:** To counter these effects, targeted interventions such as retinoids and vitamin A derivatives should be considered to increase collagen synthesis and enhance epidermal turnover. In recent causal gene expression relationship studies, calcitriol and L-asparaginase have been identified as a significant potential countermeasure for targeting skin spaceflight dysfunction. While emollients, barrier creams, corticosteroids, and anti-inflammatory agents have been used for xerosis and contact dermatitis, occlusive dressings may combat the established low efficacy of treatments during missions. Additionally, hydrogels and negative pressure wound dressings are proposed as effective options to mitigate decreased wound healing by promoting a diffusive environment enhanced for tissue regeneration.

Learning Objectives

1. Identify and understand the unique dermatologic challenges posed by spaceflight.
2. Evaluate and apply evidence-based treatment strategies for dermatologic conditions in space.
3. Incorporate new research findings into dermatologic care for spaceflight.

[386] WITHDRAWN

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[387] EVALUATION OF ACUTE AIRWAY CHANGES DURING SHORT-DURATION SPACEFLIGHT

Taania Girgla[1], Amran Asadi[2], Kaleigh Stabenau[2], Marissa Rosenberg[2], Brita Mittal[3]
[1]*Mass General Brigham, Boston, MA, United States;* [2]*SpaceX, Hawthorne, CA, United States;* [3]*Stanford University, Palo Alto, CA, United States*

(Original Research)

INTRODUCTION: It is theorized that microgravity-induced fluid shifts may cause airway edema, however, no direct observations have been published. This poses major challenges for developing protocols, training, and medical systems capable of supporting airway emergencies in spaceflight. This study aims to characterize acute airway changes during short-duration spaceflight via in-flight transnasal endoscopy, front-of-neck ultrasound (U/S), Mallampati scores, and voice recordings. **METHODS:** This is an IRB approved, prospective, observational pilot study of commercial astronauts in orbital spaceflight. Four subjects underwent a longitudinal training protocol consisting of didactics, hands-on skills sessions, and just-in-time training. In flight, procedures were self-administered under remote supervision. Endoscopic video of 10 key airway structures were assessed, including tongue, hypopharynx, vallecula, epiglottis, subglottis, aryepiglottic folds, arytenoid complex, posterior commissure, true vocal cords, and false vocal cords. Front-of-neck U/S included laryngeal, supraglottic, subglottic, submental, and hyoid views. Mallampati scores and voice were recorded. Data was acquired pre-flight (L-30), in-flight (FD 2, 4, and 5), and 24h after return to 1G (R+1). **RESULTS:** A one-point increase in Mallampati score was noted on FD2 (N=2) but resolved by FD4 (N=2). Preliminary review via paired T-tests of the U/S data revealed an increase in tongue thickness from FD4/5 to R+1 (N=3), a decrease in pre-epiglottic space depth from L-30 to R+1 (N=4), and a decrease in skin to cricothyroid membrane distance from L-30 to R+1 (N=4) and FD4/5 to R+1 (N=3). Endoscopic video was assessed for airway edema, erythema, dynamic function, and laryngeal inlet positioning (N=2). Voice recordings will be evaluated with the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) protocol. Completion of analysis is expected by early 2025. **DISCUSSION:** Understanding microgravity-induced airway changes is needed to prepare for airway emergencies in spaceflight. Our results show that Mallampati scores increased in the acute inflight period but appeared to normalize by FD4. The preliminary U/S results show that the dimensions of airway structures typically associated with difficult airway management did not increase on FD4 compared to preflight baseline. This study also reports the first successful use of transnasal endoscopy and advanced airway U/S by a non-physician crew in spaceflight.

Learning Objectives

1. The audience will learn about our longitudinal training protocol to conduct remote just-in-time guided advanced airway ultrasound and endoscopy in spaceflight.
2. The participant will be able to understand the changes and resolution of microgravity-induced acute airway changes during spaceflight compared to pre-flight baseline.
3. The participant will be able to understand the changes and resolution in auditory-perceptual assessment of voice during spaceflight compared to pre-flight baseline.

[388] SUBORBITAL DEPLOYABLE TROOPS AND FLIGHT RISKS AND COMPLICATIONS IN CARDIOVASCULAR, NEUROVESTIBULAR, AND NEUROMUSCULOSKELETAL SYSTEMS, AND FLUID SHIFT

Gavin Ward[1], Danielle Anderson[2], Richard Scheuring[2]
[1]*Mayo Clinic, Rochester, MN, United States;* [2]*NASA JSC, Houston, TX, United States*

(Original Research)

INTRODUCTION: There is an increasing demand to rapidly deploy US service members in case of a crisis. Suborbital flight may serve as a useful strategy to address this demand. It is critical to understand physiological and mechanical risks and complications to evaluate time to operational readiness after landing. Therefore, the aim of our review was to evaluate suborbital flight risks and complications associated with cardiovascular (CVS), neurovestibular, and neuromusculoskeletal (NMSK) systems, and fluid shift, to discuss their relationship to deployable troops. **METHODS:** A systematic review using PubMed, Scopus, and NASA Technical Report Server Publicly Available Content was performed to identify original research containing suborbital flight risks and complications associated with CVS, neurovestibular, and NMSK systems, and fluid shift. Articles discussing centrifuge simulated suborbital flight were also evaluated. **RESULTS:** Seven suborbital flight and 6 centrifuge simulated suborbital flight articles were included in the review. In suborbital flights, astronauts demonstrate increased risk to elevated CO2 levels of 15 mmHg and 10 mmHg at 1 hour and 24 hours in-flight, respectively, where terrestrial research indicates cognitive decline starts at 1.9 mmHg; elevated orthostatic rise in heart rate and drop in systemic blood pressure post-flight with symptoms lasting 7-19 hours; and fatigue peaking at 12 hours post-flight. There is negligible risk to NMSK and neurovestibular systems. In centrifuge simulated suborbital flights, there are significant increases in post-flight vertigo in up to 34% of flyers, causing significant ($p \leq 0.002$) imbalance and unsteadiness, after undergoing up to 6 flights in short periods of time. **DISCUSSION:** Deployable troops may be at greatest risk for minor CVS symptoms, elevated CO2 levels resulting in impaired decision-making capacity and decrease in performance for mission objectives, significant vertigo after undergoing multiple suborbital flights in a short period of time, and fatigue. Overall, there is little risk to CVS and NMSK systems, but precautions should be taken for the neurovestibular system and fluid shift. There is a paucity of literature characterizing suborbital risks and complications. Future research should place greater emphasis on evaluating suborbital flights. Current data suggests suborbital flights for deployable troops is feasible with symptoms resolving in 24 hours or less.

Learning Objectives

1. The audience will learn about the risks and complications affecting the cardiovascular, neurovestibular, and neuromusculoskeletal systems, as well as fluid shifts, in astronauts undergoing suborbital flights.
2. The audience will understand the increasing demand for rapid deployment of U.S. service members.
3. The audience will explore the connection between suborbital flight risks and the readiness of deployable troops, emphasizing the need for more focused suborbital flight data in future research.

[389] REVEALING NON-TECHNICAL SKILLS THROUGH SIMULATION FOR HIGH-STAKES SELECTION

Dana Herrigel[1], Diego Garcia[2], Teo Dagi[3], Leigh Speicher[1]
[1]*Mayo Clinic, Jacksonville, FL, United States;* [2]*Embry-Riddle Aeronautical University, Daytona Beach, FL, United States;* [3]*Mayo Clinic, Rochester, MN, United States*

(Education - Program / Process Review)

BACKGROUND: Selecting high-performing individuals, like astronauts, for high-stakes missions requires a robust understanding of behavioral attributes such as resilience and anti-fragility under stress. Non-technical skills (NTS) are essential for safety-critical, high-consequence teams, and present significant assessment challenges, especially in non-operational settings. Existing approaches lack the unobtrusive, real-time observational fidelity necessary to evaluate these skills accurately. This is a growing concern, as the operational demands for commercial and international astronauts increase. **OVERVIEW:** We developed an immersive simulation method for observing and assessing key non-technical skills required for astronaut candidates. This approach focuses on eight NTS domains identified by NASA for commercial astronaut roles. We adapted validated behavioral

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anchors from an inter-professional assessment tool to create a point-of-care interface that captures real-time behaviors using a Likert scale, and we propose scoring criteria. This methodology was tested with 18 trainees enrolled in an aerospace medicine course. Subjects participated in a structured, group-based problem-solving simulation designed to elicit behaviors in domains such as Self-Management, Teamwork, Decision-Making, Communication, Leadership-Followership, and Conflict Management. The simulation's stressors—time pressure, social observation, ambiguity, task saturation, and communication challenges—were designed to replicate conditions of operational complexity. **DISCUSSION:** This simulation-based platform advances human performance assessment by providing operationally relevant insights into candidates' NTS in a controlled, observable setting. This methodology can facilitate comparisons across disciplines where conventional subjective measures may be insufficient. By incorporating biometric monitoring (heart rate variability) and self-assessment tools, such as the IPI-NEO-120 personality inventory and the NASA task load index, the methodology captures a holistic view of both perceived and physiologic responses to stress. This initiative supports cross-sector applications, including military-civilian and international astronaut selection frameworks. The promising results from this index simulation will inform next steps, aiming to correlate behavioral observations with physiologic markers, and refine selection processes across high-stakes, safety-critical professions.

Learning Objectives

1. Describe the advantages and applications of group interactive simulation in the context of high-stakes candidate selection.
2. Apply NASA non-technical skills standards to create group problem solving exercises.
3. Evaluate candidates' non-technical skills (NTS) performance revealed by direct observation.

Thursday, 06/05/2025 ***3:30 PM***
Centennial Ballroom II

[S-72] PANEL: MAKING SENSE OF SPECIAL SENSES IV: SENSORY CHALLENGES

Chair: Harriet Lester
Co-Chair: Benisse Lester

Panel Overview: *Making Sense of Special Senses IV: Sensory Challenges Vision, equilibrium, and hearing are special senses processed by the cranial nerves, thus intertwined with the brain and human factors. Critical and vulnerable, these special senses mitigate aviation safety risk when functioning well. When malfunctioning or challenged, they contribute to safety risk. Intact visual, vestibular, and auditory perception; and accurate interpretation of these inputs, enable aviators to fly and survive. Adaptations through training and technology help over-ride sensory misperceptions and compensate for gaps in perception. Perceptual gaps are worsened by sensory pathology. Aeromedical standards enable regulators to identify critical sensory deficiencies, in order to reduce accident risk. New generations of medications enable some pilots to fly who would previously have been grounded permanently. However, medical conditions can cause sensory deficits that cannot be rectified, and when significant, the pilot does not meet medical standards as pilot in command. We will discuss laser strikes, which interfere with vision, can cause injury, and are a worsening aviation nuisance and potential hazard. We will present binocular visual field loss and monocular acuity loss in a commercial balloon pilot, in the context of the new FAA rule, RIN 2120–AL51. We will review the treatment of retinal vascular pathology with anti-VEGF injections in USAF pilots. We will discuss UAV sensory human factors challenges and a proposed way to better understand these challenges. Beyond the medical and technical, there is human judgment. Prohibited substances exacerbate sensory challenges. We will report research findings for toxicology in fatal general aviation spatial disorientation fixed wing accidents. Pilots with intact sensory apparatus can have misperceptions, and pilots with abnormal sensory apparatus can sometimes be well adapted. Failure and deficiencies of the special senses can be lethal. Aeromedical standards help mitigate risk but are not absolute. Judgment and adaptations are important. Safe flight depends upon intact special sensory systems, correct sensory interpretation and judgment, training, experience, technology, and compliance with regulatory requirements designed to mitigate safety risk. Special Senses are an inextricable part of the Human Factors aviation puzzle.*

[396] THE EXPANDING AND OMNIPRESENT LASER BEAM THREAT TO AIRCRAFT OPERATIONS AND THE EYE

Douglas Ivan[1], Harriet Lester[2]
[1]*ADI Consultants, San Antonio, TX, United States;* [2]*FAA, Jamaica, NY, United States*

(Education - Tutorial / Review)

INTRODUCTION: Lasers remain one of the most remarkable technological achievements of the modern era with a broad and ever-growing range of applications in medicine and industry. Reduced system costs, design improvements, expanded wavelength options, portability and increasing beam power have not only broadened their accessibility and capabilities, but have increased the risks associated with their use. Whether pointed indiscriminately by naïve users or deployed with sinister intent by bad-actors, laser beams have the potential to be a disruptive threat across the spectrum of civil, commercial, and military air operations, as well as being a significant hazard to the eye. **TOPIC:** This tutorial will review pertinent historical events, potential bioeffects, and update applicable developments related to lasers in the modern aviation environment, especially the threat they pose to vision and visual performance. It will present FAA data regarding current exposure incidents involving civil and commercial aviation and some example cases involving military aircraft. **APPLICATION:** The issues addressed in the tutorial will heighten awareness of the current laser threat impacting worldwide air operations and existing defensive strategies available to aircrew to mitigate the impact of an exposure on flight safety.

Learning Objectives

1. Update attendees on the nature of the laser threat and its potential to disrupt air operations.
2. Familiarize attendees on the potential bioeffects of laser beams to the eye.

[397] BINOCULAR VISUAL FIELD LOSS IN A COMMERCIAL BALLOON PILOT: A CASE REPORT

Harriet Lester[1], Doug Ivan[2], Benisse Lester[3], Leo Hattrup[4]
[1]*FAA, Jamaica, NY, United States;* [2]*Retired, San Antonio, TX, United States;* [3]*Retired, Washington, DC, United States;* [4]*No institution, Alexandria, VA, United States*

(Education - Case Study)

INTRODUCTION: This report describes a balloon pilot with dense binocular visual field defects subject to the FAA rule signed 11/16/22 mandating that airmen must hold at least second class medical to exercise the privileges of a commercial pilot certificate in a balloon for non-instructional flight. **BACKGROUND:** NTSB DCA16MA204 involved a hot air balloon that struck power lines near Lockhart, TX on 7/30/16, resulting in 16 deaths. The pilot was exercising the privileges of a commercial pilot on this part 91 flight. NTSB concluded that impairing medical conditions and medications; and no FAA requirement for a medical certificate for commercial balloon pilots, were contributing factors. Prior to this accident, no commercial balloon accidents in the United States were specifically attributed to medical deficiencies. Following implementation of the new FAA rule, this pilot was no longer eligible to fly due to dense binocular visual field defects and monocular loss of visual acuity. Literature review indicates that balloon accidents are most commonly associated with ground impact and collision with objects, including power lines—these risks would be exacerbated by the pilot's deficits. **CASE PRESENTATION:** A 63 year old pilot with approximately 2000 hours, and over 35 years of flight experience without

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accidents, applied for an FAA Class 2 medical certificate in compliance with the new FAA rule. He lost visual field in both eyes and central acuity in the left eye approximately 20 years prior, attributed to non-arteritic ischemic optic neuropathy (NAION). The right eye was 20/20 uncorrected, the left eye corrected to 20/400. The right eye had a dense inferior defect, and the left eye had three quadrants of field loss, also involving inferior field. Optic nerve findings were consistent with field defects. **DISCUSSION:** Review of balloon related case fatalities in the FAA database revealed a single fatal accident subsequent to the new rule requiring Class 2 medical certificate, and the preliminary NTSB report did not suggest medical attribution. NAION causes permanent visual loss, which can be bilateral, as in this case. Notwithstanding his successful balloon flying history and apparent adaptation to his significant deficits, the loss of useful visual acuity in one eye, combined with dense overlapping binocular inferior field defects, were deemed incompatible with aviation safety. The airman was issued a final denial.

Learning Objectives

1. Have knowledge of the FAA rule signed November 16, 2022 mandating that airmen must hold at least second class medical to exercise the privileges of a commercial pilot certificate in a balloon for non-instructional flight.
2. Understand the need for visual field functionality in aviators, including balloon pilots.
3. Be aware of the 2016 fatal accident that led to the FAA rule mandating that airmen must hold at least a second class medical to exercise the privileges of a commercial pilot certificate in a balloon for non-instructional flight.

[398] ANTI-VEGF INJECTIONS IN USAF AIRCREW: IT'S WORTH A SHOT!

Michael Parsons
FAA, Beavercreek, OH, United States

(Education - Tutorial / Review)

INTRODUCTION: Manned aviation has from its inception required excellent visual perception. While there have been many advances in aiding the human weapon system when it comes to flight, the human sense of vision remains essential to safe, efficient and effective functioning. When vision is compromised or challenged, this impaired special sense contributes to safety risk. **TOPIC:** Retinal vascular disease is a common cause of decreased vision in the United States and around the World. In the population of US Air force aviators it is relatively uncommon, however when it happens, it threatens mission success and it threatens permanent vision loss. While there have been medical interventions for this problem for decades, it only relatively recently that carefully engineered medications called anti-vascular endothelial growth factor (VEGF) can be delivered to the site of pathology and alter the course of disease for the better. These medications directly bind the growth factors that cause new and leaky blood vessels to form in the aftermath of ischemic disease, preventing retinal bleeding, fluid leaking, retinal scarring and retinal detachment. As the sensory tissue of the eye, the human retina does not often heal well from scarring. These medications aim to minimize this damage and preserve the eye's ability to help turn light into vision. **APPLICATION:** Discuss the use of anti-VEGF therapy for retinal vascular diseases and potential sensory challenges for duties in the aviation environment.

Learning Objectives

1. The participant will learn about the unique visual challenges associated with retinal vascular disease in its relationship to the unique demands of manned flight.
2. The participant will be able to describe several ways to manage retinal vascular disease, along with their relative risks, benefits and shortcomings.
3. The participant with leave with a better understanding of the role of anti-VEGF in the treatment of retinal vascular disease.

[399] BALANCE, HEARING AND UNMANNED AERIAL VEHICLE OPERATIONS

John Allen[1], Harriet Lester[2]
[1]*Star Harbor, Dagsboro, DE, United States;* [2]*FAA, Jamaica, NY, United States*

(Education - Program / Process Review)

BACKGROUND: The use of Unmanned Aerial Vehicles (UAV) is growing exponentially in the US and around the globe. The safe operation of UAVs may be impacted by health conditions, but are hearing and balance among those concerns? The USAF requires UAV operators to meet the requirements of AFI 48-123, which spells out hearing standards, while the FAA has no specific medical requirements for UAV operations. **OVERVIEW:** Statistics show a rapid increase in UAV demand, both in the military and for civilian/commercial purposes. Civilian/commercial applications may be conducted in open field conditions, with virtual reality headsets, or with video screen displays. Military applications typically employ video screen displays. Traditional aviation piloting includes the entirety of sensory modalities (visual, auditory, vestibular, kinesthetic, proprioceptive) which contribute to situational awareness in flight. However, piloting a UAV is dependent largely on just the visual system. This raises the question of to what degree will the absence of these other stimuli impact performance and overall safety of flight. There is significant literature that addresses the impact of UAV operations on behavioral health, but not on hearing or balance. Anecdotal reports suggest that UAV operation results in "dizziness" which adversely impacts operations. These reports are from individuals operating their own drones, largely for entertainment purposes. There is an absence of rigorous studies of vestibular impacts by commercial and military operators. Additionally, there is no evidence that hearing loss impacts UAV operations. **DISCUSSION:** The absence of literature indicating the potential negative impact of UAV operations on vestibular or auditory function should not suggest that these impacts do not occur. The presence of Menier's Syndrome may have significant challenges in or concerns about drone operation. Nor should the absence of data suggesting that degraded auditory function adversely impacts the ability to pilot UAVs. In fact, significant hearing loss may be present in an individual who very effectively controls UAV operations. Of course, in a military operational environment this would not be acceptable. In addition, there are several reports suggesting the potential impact of drone noise on hearing and on annoyance to communities where they are used. These will be reviewed. In addition, a proposed survey of UAV operators focused specifically on individual sensory systems (auditory, vestibular, visual) will be presented. Recommendations where further investigation is needed will also be discussed.

Learning Objectives

1. Participants will understand the breadth of UAV use in the US and across the globe.
2. Participants will understand the impact of hearing and balance problems on drone operations.
3. Participants will understand federal regulations that pertain to UAV operations.

[400] TOXICOLOGY FINDINGS IN FATAL GENERAL AVIATION SPATIAL DISORIENTATION ACCIDENTS

Jason Sigmon, Hannah Baumgartner, Austin Ciesielski, Russell Lewis
FAA, Oklahoma City, OK, United States

(Original Research)

INTRODUCTION: Spatial disorientation (SD) mishaps are a well-documented threat in general aviation (GA) and altered cognitive states due to the use of alcohol or other prohibited drugs (illicit, over the counter, and prescription) may enhance a pilot's susceptibility to SD in flight. A retrospective review of toxicology findings in fatal SD accidents was undertaken to begin to document the link between these potentially altered mental states and the incidence of SD accidents. **METHODS:** The National Transportation Safety Board's CAROL database was queried for final accident reports in GA fixed-wing operations from 2003-2021

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that contained the term "spatial disorientation" in the factual narrative, probable cause, or finding text. Final accidents reports meeting this criterion were evaluated for overall trends across reports, including toxicology findings if available. Ethanol results potentially due to microbial formation were excluded. **RESULTS:** Out of 367 final reports that involved fatal GA accidents with SD, 30% (n = 109) included positive toxicology findings for the pilot. The most frequently identified drug classes included sedative antihistamines (n = 28), antidepressants (n = 22), and tetrahydrocannabinol (n = 14). Out of 33 positive ethanol cases, 4 were consistent with antemortem consumption of alcohol. There was a slight increase in positive toxicology findings over the 18-year period, with a peak of 9 accidents in 2021. While most pilots had valid FAA medicals on file, the majority of pilots without valid FAA medicals or BasicMed requirements had positive toxicology results (n = 10 of 13). **DISCUSSION:** Determining the current incidence between positive toxicology findings for potentially impairing substances in SD fatal accidents in GA is a critical to understanding SD vulnerabilities. Nearly a third of all fatal SD accidents in GA were associated with positive toxicology results, some of which, such as antidepressants, suggested a non-reported, potentially impairing condition. However, the presence of these positive toxicology findings does not necessarily imply impairment at the time of the SD accident. Future research should further examine the link between the use of prohibited substances and how that may impact the risk of SD.

Learning Objectives

1. The participant will learn about the findings for this original research and the NTSB Safety Research Report on Drug Use Trends in Aviation.
2. The participant will learn about the current trends in general aviation accidents involving fatality and post-mortem toxicology for potentially impairing medications, illicit drugs and alcohol.
3. The participant will learn about current incidence and highest injury level in fixed wing general aviation accidents involving a probable cause of spatial disorientation.

Thursday, 06/05/2025 ***3:30 PM***
Centennial Ballroom III

[S-73] SLIDE : SUPER MODELS: PREDICTING RESPONSES TO SPACE

Chair: Kristian Mears
Co-Chair: Michael Harrison

[401] IMMEDIATE MEDICAL EMERGENCY MANAGEMENT IN SPACE: A SYSTEMATIC REVIEW OF STRATEGIES AND PRACTICES

Susana Alves, Mariana Peyroteo, Luís Lapão
NOVA School of Science and Technology, Almada, Portugal

(Original Research)

INTRODUCTION: With plans to return to the Moon and explore Mars, long-duration missions beyond Low Earth Orbit (LEO) will soon become a reality. Medical self-sufficiency will be vital as astronauts operate far from Earth, where crews can't depend upon reliable logistic depots, and early return might not be feasible. While studies have discussed medical autonomy, no prior research has analysed the current strategies for the immediate management of medical emergencies in space missions in LEO and beyond, specifically examining preparedness and response strategies as defined by the Federal Emergency Management Agency. **METHODS:** This systematic review adheres to Joanna Briggs Institute and PRISMA guidelines using the PICO framework. To answer the question "How are astronauts' medical emergencies managed during human Spaceflight?" a literature research was conducted across three databases: PubMed, Scopus and Web of Science. Publications from the last 40 years, including journals, conference proceedings, and books, that address any aspect of managing medical emergencies on space missions, were included. Exclusions applied to articles not published in Portuguese or English, those focused on mitigation or recovery phases, and physiological studies. **RESULTS:** Out of 4868 articles, 84 articles met the inclusion criteria. Preparedness was addressed by 61 articles (62.9%), and response by 36 (37.1%), with overlap in some studies. Studies were categorised into personnel, procedures, and equipment. For preparedness, 17 studies (14.3%) explored personnel training, 39 (32.8%) focused on contingency planning, and 44 (36.9%) examined medical kits and diagnostic tools. For response, 12 studies (10.1%) focused on personnel's ability to manage emergencies, 10 (8.4%) on protocols, and 24 (20.2%) on equipment effectiveness. **DISCUSSION:** Preparedness dominated the literature, yet more attention is needed to test decision-making, protocol adequacy, and equipment functionality under realistic, high-stress conditions. Although injuries and fractures are the most probable emergencies in space, future research should prioritize preparedness and response strategies for more critical medical events such as decompression sickness and complex multi-astronaut events. Another finding was the focus on mitigation, leaving gaps in immediate emergency management research. Additionally, advancing medical technologies and decision-support systems will be critical for deep-space exploration.

Learning Objectives

1. Learn the current preparedness and response strategies for managing medical emergencies in space missions.
2. Identify the gaps in research and practical application of immediate emergency management in space.

[402] ARTEMIS II MISSION MEDICAL RISK: A COMPARISON OF THE IMPACT AND IMM MODELING TOOLS

Arian Anderson[1], Ariana Nelson[2], Derek Nusbaum[2], Gina Vega[2]
[1]*University of Colorado School of Medicine, Aurora, CO, United States;* [2]*UTMB, Galveston, TX, United States*

(Original Research)

INTRODUCTION: The Artemis program aims to return astronauts to the Moon to test novel technologies and maintain a long-term presence off planet in preparation for human missions to Mars. NASA has developed modeling tools that predict medical events and outcomes to aid mission planners in the development of medical systems for these complex mission profiles. While the Integrated Medical Model (IMM) tool was operationalized for medical system development on the International Space Station (ISS), it does not have the capability to model lunar surface missions. As a result, NASA recently developed the Informing Mission Planners via Assessment of Complex Tradespaces (IMPACT) tool to meet this need. This presentation aims to compare the IMM and IMPACT results of a simulated Artemis II mission to demonstrate its capabilities. **METHODS:** The IMM and IMPACT tools were used to independently model the Artemis II mission. This mission was composed of 4 crewmembers, 1 female 3 males, on a 9-day mission aboard the Orion capsule with a 13.3kg medical system. Outcome metrics for both tools included medical events, crew mortality, medical evacuation, effects on crew performance, and medical resource requirements. Conditions specific to extravehicular activity (EVA), partial gravity, and long duration flight were removed. Both tools were optimized for crew performance with 500,000 trials performed to reach risk metric convergence. **RESULTS:** IMM and IMPACT had similar risk profiles for crew mortality (0.0002 vs 0.0001 events/mission) and performance effects (95.64% vs 94.062%), but different rates of medical evacuation (0.003 vs 0.006 events/mission). Outputs from both tools revealed the conditions most likely to impair performance were space adaptation related. Mortality and medical evacuation risk were most influenced by infectious conditions in IMM and environmental exposures in IMPACT.

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DISCUSSION: Both tools performed similarly and predicted a very low overall mission medical risk for Artemis II, however both had limitations. IMPACT likely overpredicts conditions for short missions that are typically associated with long duration flight while IMM cannot model more complex profiles. For future missions, the IMPACT tool is anticipated to produce more valuable results for mission planners developing medical systems for missions beyond LEO.

Learning Objectives

1. Understand the utility of medical risk modeling tools applied to human health and performance in spaceflight.
2. Compare and contrast the IMM and IMPACT results and methodology.
3. Understand the limitations of each tool and how they may be used for future human spaceflight missions.

[403] WITHDRAWN

[404] WITHDRAWN

[405] EVALUATING THE USE OF GENERATIVE AI FOR LARGE SCALE LITERATURE SCREENINGS IN SPACE MEDICINE: A COMPARTIVE STUDY OF LLMS AND HUMAN REVIWERS

Satyam Patel[1], Christopher Janssen[2], Johnathan Szeto[3], Krishi Korrapati[4], Cooper Lytle[4], Stephen Kunkel[5], Ghufran Syed[6]

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(Original Research)

INTRODUCTION: The rapid development of commercial spaceflight has created a need for comprehensive medical screening protocols, particularly in fields like immunology, microbiology, and radiation oncology. The AsMA Commercial Spaceflight Ad-hoc Committee's Immunology working group conducted a scoping review of existing literature, assessing over 10,000 abstracts. The high volume led to the exploration of artificial intelligence (AI) and generative Large Language Models (LLMs), Gemini 1.5, LLaMA 3.2, and Claude, to streamline and support the preliminary screening process. This study evaluates the effectiveness of LLMs in facilitating large-scale literature reviews and reducing traditional time and resource demands. **METHODS:** The LLMs were built to classify abstracts into "include," "exclude (do not review)," or "exclude but review for discussion", based on specific criteria related to immune dysregulation, microbiology, and radiation oncology in spaceflight context. A structured prompting framework was utilizing few-shot learning, chain-of-thought reasoning, and self-consistency techniques to guide the decision-making process. Human medical reviewers screened abstracts to establish an accuracy benchmark for comparison. **RESULTS:** Preliminary findings demonstrate that Gemini 1.5 can manage large-scale abstract screenings effectively, offering significant time savings. The models showed varying degrees of accuracy and consistency in comparison to human reviewers. Generative AI models performed well in excluding irrelevant papers, achieving a precision of 99.6% and a recall of 80.3%. However, they exhibited limitations in more nuanced classifications, such as "exclude but review for discussion" (precision: 0.54%) and "include" (precision: 7.69%). The overall accuracy of the LLMs was 79.3%, with a total of 10,200 abstracts reviewed. **DISCUSSION:** When deployed within a structured framework, Generative AI, such as LLMs models can be effective tools for high-volume literature screening. Human oversight remains critical for addressing ambiguities and ensuring accuracy in complex cases. This study supports the feasibility of a hybrid human-AI workflow, where LLMs handle initial screenings, allowing human experts to focus on more intricate classifications. Future research will explore refinements to LLM prompting strategies and assess their adaptability in specialized medical fields, aiming to establish best practices for AI integration in medical literature reviews.

Learning Objectives

1. Understand the Role of LLMs in Literature screening - Explain how generative Large Language Models (LLMs) such as Gemini 1.5, LLaMA 3.2 and Claude can be utilized to assist in large scale medical screening for fields relevant to commercial spaceflight.
2. Identify Workflow Integration Strategies - Describe the benefits and limitations of integrating LLMs into the literature review process, focusing on a hybrid human-Ai workflow where Ai handles the primary screenings and human experts manage complex decisions.
3. Discuss the necessity for human oversight to ensure accuracy and ambiguities in literature screening with using AI tools.

[406] BASELINE MEDICAL SYSTEM TRANSLATION FOR THE IMPACT MEDICAL DATABASE

Eric Kerstman[1], Shane Schwartz[2], Gina Vega[3], John Arellano[4], Binaifer Kadwa[5]

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(Original Research)

INTRODUCTION: As a successor to the Integrated Medical Model (IMM), NASA has developed a new evidence-based data-driven probabilistic risk assessment and tradespace analysis tool, known as IMPACT (Informing Mission Planning via Analysis of Complex Tradespaces). Whereas IMM focuses on medical risks and resources associated with International Space Station (ISS) and low earth orbit (LEO) missions, IMPACT estimates the frequency and consequences of medical conditions anticipated on exploration missions. IMM offers a series of baseline medical systems associated with typical mission types or Design Reference Missions (DRMs) as alternatives to optimized medical systems. The unique nature of IMPACT poses challenges to efficiently reproduce baseline medical systems in a compatible format. This effort seeks to define a practical, repeatable process for generating baseline medical systems suitable for typical DRMs within IMPACT, allowing requestors to prioritize questions pertaining to mission parameters independent of the available medical supplies. **METHODS:** While optimized medical systems can be expected to outperform a baseline system, they must be generated and validated for each request. Baseline systems will serve as standard reference points, performing consistently well across variations of an associated DRM, reducing time spent beyond the scope of the request generating medical kits. Prototype baseline systems were translated from ISS medical resources in IMM, and a preexisting medical system designed for the Orion vehicle. In consultation with subject matter experts, the provided resource lists were matched to similarly purposed resources in IMPACT. **RESULTS:** This approach preserved medical system integrity, offering the same treatment capabilities and reconciling differences in the medical resources and medical conditions between IMM and IMPACT. **DISCUSSION:** Demonstrating the practicality of this process and generalizability of the baseline medical systems establishes a framework for future translations. Each baseline system generated expands the scope of DRMs for which mission-focused analyses can be conducted. Previously identified resources can be quickly substituted for established equivalents in IMPACT, expediting the analysis of future NASA and commercial crew medical systems. This initial approach will ease future analysis of unique and proprietary medical systems likely to be proposed by commercial crew space programs.

Learning Objectives

1. The audience will understand the importance of developing baseline medical systems for medical probabilistic risk assessment models.
2. The audience with learn the process used to generate baseline medical systems for the IMPACT (Informing Mission Planning via Analysis of Complex Tradespaces) model from the IMM (Integrated Medical Model) for the ISS (International Space Station) and the Orion vehicle.

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Thursday, 06/05/2025 ***3:30 PM***
Regency V

[S-75] PANEL: WHEN AVIATION MEDICINE IS GOING BEYOND CARE MEDICINE

Chair: Olivier Manen
Co-Chair: Jonathan Monin

Panel Overview: *The content and the approach of periodical examinations in aircrew have changed since the application of the European (EASA) regulations, one could say fewer medical considerations but more administrative procedures for the AME and AeMC. In parallel, care medicine has been developing for decades, particularly in terms of diagnostic techniques and therapeutical considerations. However, depending on the country where the aircrew is working or flying, the access to the GMP and/or specialized practitioners may be difficult, all the more as they may not have enough time or they may express few interests for asymptomatic patients because their first task is to treat whereas the AME's first objective is to prevent acute events. Finally, recommendations in care medicine may not be sufficient for aircrew. In that context, we should wonder if the only role of AME is to make assessment of aircrew suffering from pathologies with a diagnostic and treatment performed in care medicine. Couldn't we talk about a "super GMP" who is sometimes going beyond the classical recommendations for the screening, evaluation, treatment and follow-up, in order to improve the medical condition of aircrew and to optimize the fitness decisions? The panel will consist in five presentations: two of them will deal with coronary artery disease and the need to develop a specific protocol of screening in asymptomatic aircrew, including cardiac imaging modalities. The third presentation will be focused on sleep apnea syndrome and the role of AME in the early detection leading to more favourable decisions. A fourth presentation will express the major place of the aviation psychiatrist in the diagnosis and the follow-up of aircrew. As a synthesis, the fifth talk will use many examples in aircrew to explain why aviation medicine is a very exciting mode of modern medicine practice to promote the health and so a long life for patients in aviation.*

[412] THE CALCIUM SCORE : ADDED VALUE FOR THE AEROMEDICAL EXPERT OR FOR THE AIRCREW ?

Nicolas Huiban[1], Mélanie Gehant[1], Sébastien Bisconte[2], Laëtitia Marion[2], Jonathan Monin[3], Olivier Manen[3], François-Xavier Brocq[1]
[1]*French Military Health Service, Toulon, France;* [2]*French Military Health Service, Clamart, France;* [3]*French Military Health Service Academy, Clamart, France*

(Original Research)

INTRODUCTION: The coronary artery calcium score (CACS) is a key test for the risk stratification and an essential screening tool for coronary heart disease (CHD) in asymptomatic patients. In aviation medicine, the benefits could be extended to monitoring methods and determining the flight fitness of aircrews, as well as to optimized primary prevention. **METHODS:** A descriptive single-centre, cross-sectional study with retrospective data collection was carried out between June 2022 and August 2024 in our AeMC. The patients included were civilians and military in renewal visits. The risk factors included age, body mass index, cardiovascular heredity, smoking, diabetes, arterial hypertension and LDL hypercholesterolemia. The overall 10-year risk was estimated using SCORE 2 and MESA models. The CACS results defined the primary outcome. **RESULTS:** During this period, 31 subjects were included, exclusively men with a mean age of 54.4 years (sd 6.9) ranging from 40 to 74 years. Two-thirds were pilots and 61.3% [42.2-78.2] had a SCORE 2 of "high" to "very high". On the basis of the MESA score, mean coronary age was estimated to be 6.9 years older than physiological age and 7.8 years older using CACS. The Agagston score ranged from 0 to 3028, and was greater than 400 in 26.7% [95% CI: 12.3-45.9] of cases. It was above the 75th percentile of the reference population in 50% [95% CI: 31.3-68.7] of cases, leading to lipid-lowering treatment in 11 patients. Following a cardiological opinion, 7 coronary angiographies were performed, resulting 6 times in revascularisation procedures. In univariate statistical analysis, the SCORE 2 and MESA models had a correlation coefficient of 0.86 ($p<10\text{-}8$). For CACS, it was 0.41 with the SCORE 2 model ($p=0.028$) and 0.48 with the MESA one ($p=0.0084$). In the multivariate analysis, no statistically significant association was found between the risk factors tested and the CACS value or thresholds. **DISCUSSION:** The CACS is emerging as a valuable tool for promoting aircrew health and flight safety. In addition to providing a clearer level of cardiovascular risk, it appears to be a genuine screening test with direct consequences for the prevention and treatment of CHD.

Learning Objectives

1. The audience will understand that as part of a personalized approach to cardiovascular risk stratification, the calcium score can be considered as a genuine risk factor in its own right.
2. The audience will learn that, when assessing the fitness to fly of aircrew, the calcium score can be used to reclassify intermediate risk as low or high, and also contributes to raising awareness about the need for preventive measures.

[411] CORODIAG: A CORONARY ARTERY DISEASE SCREENING PROTOCOL FOR AIRCREW BEYOND THE RECOMMENDATIONS

Sébastien Bisconte[1], Gaëtan Guiu[1], Sonia Houssamy[1], Jonathan Monin[2], Erik Rebiere[1], Caroline Brescon[1], Mustapha Khezami[1], Nicolas Huiban[3], Laetitia Marion[1], Eric Perrier[2], Olivier Manen[2]
[1]*French Military Health Service, Clamart, France;* [2]*French Military Health Service Academy, Clamart, France;* [3]*French Military Health Service, Toulon, France*

(Original Research)

INTRODUCTION: Screening for CAD in asymptomatic patients is not standardized. However, many new tools are available, such as the Coronary artery calcium score (CACS). Nevertheless, an early diagnosis and appropriate risk stratification of CAD are essential for aviation safety. The aim of this study was to discuss the role of different cardiovascular assessment techniques (ESC SCORE 2 and CACS) to screen for CAD and predict treatment adjustments. **METHODS:** From October 2023 to April 2024, a prospective, monocentric study was conducted in aircrew with a significant SCORE 2. They underwent a CACS and treadmill stress test and/or CT scan for high cardiovascular risk. **RESULTS:** 241 subjects were included (97% male, mean age: 56.7 yo +/- 6.14, range 39-73 yo, 81.3% civilians). 52.6% had more than one cardiovascular risk factor (10% family history of CAD, 33% HBP, 4.4% diabetes, 7.5% with treated hypercholesterolaemia, 15% smokers). The mean SCORE 2 was 5.56% +/- 1.9 (79% high or very high risk) and the mean CACS was 126 +/- 284 (22% high risk). Investigations included calcium score (90.8%), stress test (83.8%), CT scan (34.4%), MRI or stress scintigraphy (15.3%) and/or coronary angiography (4.6%). We found 29% of coronary lesions or ischaemia. SCORE 2 was only predictive of the presence of a coronary lesion ($p<0.01$). CACS was clearly predictive of a coronary lesion and an impact on treatment and fitness ($p<0.001$). Stress test was not significant for either criterion. The findings have an impact on the aeronautical fitness in 16% of AM. **DISCUSSION:** In asymptomatic aircrew, the AME should play an important role in the screening and diagnosis of CAD. Indeed, coronary lesions may be found at early stage with a direct benefit when a preventive treatment is prescribed as it may avoid acute events, reduce the impact on the flight safety and lead to less disqualifications. Public health medicine could be inspired by this approach.

Learning Objectives

1. To have a clear idea of the hierarchy of screening tests for coronary artery disease in asymptomatic subjects.
2. To understand the distribution of cardiovascular risk factors among pilots.

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[413] OBSTRUCTIVE SLEEP APNEA SYNDROME IN AIRCREW MEMBERS: IS OUR ROLE LIMITED TO FITNESS DECISION?

Jonathan Monin[1], Erik Rebiere[2], Gaëtan Guiu[2], Laëtitia Marion[2], Sébastien Bisconte[2], Nicolas Huiban[3], Caroline Brescon[2], Mustapha Khezami[2], Eric Perrier[1], Olivier Manen[1]
[1]*French Military Health Service Academy, Clamart, France;* [2]*French Military Health Service, Clamart, France;* [3]*French Military Health Service, Toulon, France*

(Original Research)

INTRODUCTION: Obstructive sleep apnea syndrome (OSAS) is a major issue in aviation medicine because it is responsible for sleepiness and higher cardiovascular risk, which could jeopardize flight safety. The aim of this study is to describe the management of OSAS in our AeMC, in order to study our role in both diagnosis and aeromedical assessment. **METHODS:** This is a monocentric retrospective study. The included population is composed of all aircrew members (AM) (civilian and military, pilots and others specialties) who had an examination in our AeMC between 2011 and 2024, with a history of treated OSAS. **RESULTS:** Our population consists of 206 AM with OSAS, 99% males, 72% civilians, 77% pilots, mean age 50,6 +/- 9yo. The AeMC prescribed the investigations which posed the diagnosis of OSAS in 42% of cases, especially in atypical situations: when there was no symptom (p=0.023) or only rare ones like nycturia (p=0.014) in comparison to those diagnosed elsewhere. Cardiovascular assessment was performed in 87% of cases, and maintenance of wakefulness tests (MWT) in 66% of cases, particularly in the last 5 years (p<0.01), and when the AM were not already unfit for another disease (p<0.01). MWT were <40min in 15 AM (11%) despite a normal Epworth score in 10 AM and an AHI<10/h in 14 AM. Finally, 86% of them were declared fit with limitations. The main predictive factors of unfitness were residual sleepiness (p<0.001) and psychiatric disease (p<0.001). Being diagnosed thanks to the AeMC seemed to be a protective factor (p=0.036). **DISCUSSION:** AeMC and AME should be involved in the diagnosis of OSAS, with a good knowledge of criteria. Indeed, this diagnosis can be performed before the onset of symptoms or complications, which can lead to more fit decisions. In accordance with the French Sleep Society guidelines, systematic MWT should be prescribed as the rate of residual sleepiness is comparable to the general population.

Learning Objectives

1. To understand the role of AME and AeMC in the diagnosis of OSAS.
2. To understand how to evaluate the risk of sleepiness in aircrew members with OSAS.

[414] THE AVIATION PSYCHIATRIST: AN ASSET FOR FITNESS DECISIONS BUT ALSO A MAJOR ROLE IN THE DIAGNOSIS AND FOLLOW-UP

Laëtitia Marion[1], Erik Rebiere[1], Sébastien Bisconte[1], Nicolas Huiban[2], Jonathan Monin[3], Olivier Manen[3]
[1]*French Military Health Service, Clamart, France;* [2]*French Military Health Service, Toulon, France;* [3]*French Military Health Service Academy, Clamart, France*

(Original Research)

INTRODUCTION: Military aircrews' psychological aspects are assessed, as somatic disorders, by military flight surgeons. Sometimes they must refer aircrews to an aviation psychiatrist. In this study, we focused on the contributions of this specialist for the flight surgeon, the aircrews and the command. **METHODS:** This is a retrospective study of the aircrews referred for the first time to the aviation psychiatrist of our AeMC between January 2022 and September 2024. We were interested in the characteristics of this population, the reasons why they were addressed, the diagnoses adopted, the fitness decisions and the indications of referring to the AeMC multidisciplinary concertation panel (AMCP) or to the French Military Aeromedical Board (FMAB). **RESULTS:** The population was composed of 105 aircrews (81% males, 69% officers, 58% pilots, mean age 35.9 +/-8.5yo). 63% of them were referred by a flight surgeon and 37% by an AeMC, for symptoms (59%), long sick leaves (7.6%), and behavioral disorder as in case of positive drug testing (5.7%). 68% did not have a past psychiatric medical history, and the aviation psychiatrist made 73% of the diagnoses. Adjustment disorders were diagnosed more frequently by the psychiatrist (p<0.001) in contrast to behavior disorders (p<0.01). 69% of the population had a specific follow-up by the aviation psychiatrist. Concerning fitness assessment, 59% of these cases were discussed in the AMCP and 42% were referred to the FMAB. 54% of aircrews were fit for fly. Adjustment disorders (p=0.01), neurodevelopmental disorders (p=0.041), personality disorders (p=0.041) and psychoses were risk factors for unfitness. **DISCUSSION:** We showed that aeronautical psychiatrists have a major role to play in diagnosis in a population that has no past psychiatric history for the most part. They are also important to take an aeromedical decision and provide psychiatric follow-up, which is to underline in this population often described as reluctant by fear of being declared unfit. It appears that follow-up by aviation psychiatrists is not synonymous of unfitness: except in cases of serious psychiatric disorders, it may help military aircrews to fly again after a psychiatric issue, always in concertation with the AeMC.

Learning Objectives

1. To highlight the importance of the aeronautical psychiatrist in terms of diagnosis, follow-up and aviation fitness.
2. To describe the population of aircrew addressed by flight surgeons and experts in aviation medicine to the aeronautical psychiatrist.

[415] SCREENING, PREVENTION, DIAGNOSTIC PROCESS, FOLLOW-UP… WHEN THE AEROMEDICAL EXPERT BECOMES A SUPER GMP

Olivier Manen[1], Sébastien Bisconte[2], Erik Rebiere[2], Gaëtan Guiu[2], Laetitia Marion[2], Nicolas Huiban[3], Mustapha Khezami[2], Caroline Brescon[2], Jonathan Monin[4], Eric Perrier[4]
[1]*French Military Health Service Academy, Clamart, Hauts-de-Seine, France;* [2]*French Military Health Service, Clamart, France;* [3]*French Military Health Service, Toulon, France;* [4]*French Military Health Service Academy, Clamart, France*

(Education - Program / Process Review)

BACKGROUND: In consideration of the periodicity and content of the aeromedical examinations, screening and prevention have not been considered very much by EASA. In some countries including France, the demographic medical population has led to difficulties to consult some specialized practitioners who sometimes have not time for asymptomatic patients. The cost of modern technologies can be a bar for GMP to prescribe investigations when firstly indicated by aeromedical concerns. Besides, medical recommendations frequently give the opportunity to the patient or practitioner to adopt an expectative attitude. Finally, many patients are far from the expected therapeutical objectives (diabetes, high blood pressure, CAD). In that context, we should question about the correct place of AME within the medical team of aircrew. **OVERVIEW:** In many medical situations, the AME will have to interfere with the GMP or to act as a medical expert to prescribe, check, explain, advise and perform the follow-up of aircrew as a potential or confirmed patient. In cardiology excluding CAD, asymptomatic atrial fibrillation, ventricular preexcitation and other rhythm or conduction disorders are clearly detected during the periodical examinations, as well as valvular heart diseases, for which investigations will be managed by the AME first. A complete physical exam gives the opportunity to look for clinical signs of (pre-)malignant conditions (skin cancers, lymphomas, thyroid or testicle lesions) but also conditions that lead to an earlier medical or surgical treatment (cardiovascular risk factors, hernia, varicose vein). Investigations that are prescribed for aeromedical reasons first (kidney stones, OSAS, deep veinous thrombosis) will finally have an impact on the health for the aircrew. **DISCUSSION:** AME not only are trying to optimize the flight safety but also have clearly a complementary role of GMP when acting in the following tasks: to promote an earlier or better screening, to push for a more complete checkup,

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to advise a medical or surgical treatment, to check for sequelae, to require a perfect respect of the therapeutical objectives, to participate in the optimal follow-up, and finally to make the difficult but essential synthesis of a thick and complicated medical file with many investigations and a wandering diagnosis.

Learning Objectives

1. The audience will be aware of the limits of care medicine to optimize the flight safety and the health of the aircrew.
2. The audience will learn about the different modalities of interaction between the AME and the medical team of the aircrew before and after a medical condition.

Thursday, 06/05/2025 ***3:30 PM***
Hanover C/D/E

[S-69] PANEL: AMERICAN ASSOCIATION OF AEROSPACE MEDICINE SPECIALISTS'- AEROSPACE MEDICINE BOARD REVIEW COURSE

Chair: Jeffrey Jones
Co-Chair: Thomas Jarnot

Workshop Overview: EDUCATION: *Aerospace Medicine Board Review Panel* **INTRODUCTION:** *To assist American Society of Aeromedical Specialists members prepare for periodic written examinations for those educated on the topics defined by the American College of Preventive Medicine GME requirements and wishing to become certified or re-certified under the American Board of Preventive Medicine, and to provide education on relevant topics to anyone interested in Aerospace and Preventive Medicine, the ASAMS education committee assembles topics for review by knowledgeable invited experts in the field. TOPICs and Speakers: Introduction to the Aerospace Medicine Board Exam- Jeff Jones; The Atmosphere- James Elliott; Hypoxia- Thomas Jarnot; Flight Dynamics- Dwight Holland; Q&A moderator- Jeff Jones* **APPLICATION:** *The knowledge gained in this panel can be applied by the attendee to preparation for the knowledge examination in both the preventive medicine core and the aerospace medicine specialty examination. Others considering their possible involvement in clinical Aerospace Medicine or AM applied research may find the review topics interesting and educational. Preventive Medicine Core Content Outline: 25% - I. Clinical Preventive Medicine 25% - II. Public Health/Population Health Medicine Knowledge 20% - III. Epidemiology, Biostatistics, and Informatics Knowledge 15% - IV. Environmental Medicine 15% - V. Strategic Healthcare Leadership Knowledge Aerospace Medicine Content Outline: 40% - The Flight Environment 30% - Clinical Aerospace Medicine 20% - Operational Aerospace Medicine 10% - Management and Administration RESOURCES: American Board of Preventive Medicine – American Board of Preventive Medicine – The American Board of Preventive Medicine was established to promote the health and safety of the American people through our high standards in the certification and maintenance of certification in the profession of preventive health. (theabpm.org) American College of Preventive Medicine- American College of Preventive Medicine | ACPM*

[376] THE ATMOSPHERE

James Elliott
FAA, Fort Worth, TX, United States

(Education - Tutorial / Review)

This presentation will review the composition and physical properties of the atmosphere, including the common gas laws, altitude physiology, and regulatory guidance for supplemental oxygen use.

Learning Objectives

1. Describe the relationship between the volume, the pressure, and the temperature of a gas per Boyle's and Charles' Laws.
2. Given the atmospheric pressure at a specific altitude, calculate the partial pressure of oxygen at that altitude.
3. List the cabin altitudes where supplemental oxygen is required IAW 14 CFR Part 91.211.

[377] AIRCRAFT CONTROL SURFACES, AERODYNAMICS AND CONSIDERATIONS

Dwight Holland
Human Systems Integration, Roanoke, VA, United States

(Education - Tutorial / Review)

This presentation will review the key topics on theory of flight—aerodynamics for fixed and rotary winged aircraft, and the factors affecting lift, thrust, and drag (different types). Other topics include the physics of producing lift, wing camber, and how lift and angle of attack are related, and what factors can degrade lift. Review will also be offered on how modern aircraft and helicopters are controlled with various control surfaces will be highlighted, and countering torques produced by spinning propellors or rotors, whether single engine, multiengine, or helicopter operations.

Learning Objectives

1. This presentation deals with various aspects of aircraft and helicopter control in three axes. The learner will understand basic aircraft control aspects and surfaces after attending this presentation.
2. This presentation looks at the aerodynamics and basic physics of propellors, control surfaces, and the concepts of lift and different aspects of drag. These basic aerodynamic properties will be covered at the appropriate level for the Aerospace Medicine Board exam.

[378] HYPOXIA

Thomas Jarnot
USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Tutorial / Review)

This presentation will review typical categories of hypoxia, associated physiology, common examples with signs and symptoms, and operational significance/considerations for the aerospace medicine practitioner.

Learning Objectives

1. Describe four basic types of hypoxia and associated physiology.
2. Discuss common chronic hypoxia situations with corresponding signs and symptoms.
3. Review the operational significance of hypoxia in the aerospace environment.

FRIDAY, JUNE 06, 2025

Friday, 06/06/2025 ***7:00 AM***
Hotel Lobby

[S-77] WORKSHOP: TROPICAL AND SUBTROPICAL MEDICINE: OPERATION STONE MOUNTAIN

Chair: Brian Pinkston
Co-Chair: Cheryl Lowry

Workshop Overview: INTRODUCTION: *Aerospace Medicine practitioners find themselves in austere environments around the world, from providing critical care patient support to recovering aircraft or spacecraft. Atlanta is considered a subtropical climate which provides a laboratory environment for tropical as well as temperate zone medical topics. Topic: Members of the aerospace medicine community may be called upon to provide travel medicine counseling, conduct medical mission planning, or unexpectedly find themselves in a survival situation in these environments.*

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The tropics and subtropics pose unique challenges to the health of travelers, adventure-seekers and operational forces. They also provide unique opportunities that assist in survival and treatment of patients. For example, people living in rural parts of the Amazonian region use over 1300 plant species in their traditional remedies. Though water may be plentiful in tropical and subtropical areas, sources can contain hazardous flora and fauna, requiring treatment to ensure potability. Plentiful foliage and moisture provide ideal conditions for vector-borne diseases and other health threats. Thick brush and flowing rivers present challenges for patient stabilization and movement. An understanding of the health threats in this environment is critical for creating appropriate austere medical kits, performing emergency patient care, and providing appropriate medical advice for people working, traveling and recreating in the tropics and subtropics. This workshop will be conducted with lectures, hands-on skill stations and activities in an outdoor environment. Application: Understanding this environment is a key tool in the kit for the medical professional providing support in austere locations. This workshop is intended to be an introductory, hands-on experience focused on medical care and safe medical operations in tropical and subtropical environments. It will cover the following: 1) Procurement and treatment of water as well as field preparation of intravenous fluids for an injured or ill patient. 2) Prevention and treatment of major tropical diseases 3) Common medicinal plants and their preparation in the tropical environment 4) Improvised medical care and improvised patient transport both on land and riverine environments 5) Field hemorrhage control and pain management 6) Medical and survival kits for the tropical environment

[420] TROPICAL AND SUBTROPICAL MEDICINE: OPERATION STONE MOUNTAIN

Brian Pinkston[1], Cheryl Lowry[1], Jim Fike[2], Bonnie Posselt[3], Michael Jackson[1]

[1]*Kinetic Adventure Medical Education, St. Petersburg, FL, United States;* [2]*Fike Global Health, Alexandria, VA, United States;* [3]*RAF Centre of Aerospace Medicine, Henlow, United Kingdom*

(Education - Tutorial / Review)

INTRODUCTION: Aerospace Medicine practitioners find themselves in austere environments around the world, from providing critical care patient support to recovering aircraft or spacecraft. Atlanta is considered a subtropical climate which provides a laboratory environment for tropical as well as temperate zone medical topics. **TOPIC:** Members of the aerospace medicine community may be called upon to provide travel medicine counseling, conduct medical mission planning, or unexpectedly find themselves in a survival situation in these environments. The tropics and subtropics pose unique challenges to the health of travelers, adventure-seekers and operational forces. They also provide unique opportunities that assist in survival and treatment of patients. For example, people living in rural parts of the Amazonian region use over 1300 plant species in their traditional remedies. Though water may be plentiful in tropical and subtropical areas, sources can contain hazardous flora and fauna, requiring treatment to ensure potability. Plentiful foliage and moisture provide ideal conditions for vector-borne diseases and other health threats. Thick brush and flowing rivers present challenges for patient stabilization and movement. An understanding of the health threats in this environment is critical for creating appropriate austere medical kits, performing emergency patient care, and providing appropriate medical advice for people working, traveling and recreating in the tropics and subtropics. This workshop will be conducted with lectures, hands-on skill stations and activities in an outdoor environment. **APPLICATION:** Understanding this environment is a key tool in the kit for the medical professional providing support in austere locations. This workshop is intended to be an introductory, hands-on experience focused on medical care and safe medical operations in tropical and subtropical environments. It will cover the following: 1) Procurement and treatment of water as well as field preparation of intravenous fluids for an injured or ill patient. 2) Prevention and treatment of major tropical diseases; 3) Common medicinal plants and their preparation in the tropical environment; 4) Improvised medical care and improvised patient transport both on land and riverine environments; 5) Field hemorrhage control and pain management; 6) Medical and survival kits for the tropical environment

Learning Objectives

1. This workshop will be conducted with demonstrations and activities in at Stone Mountain Park Georgia including a controlled water environment.
2. By the end of the session, participants will be able to name three commonly found tropical plants and their medicinal uses.
3. By the end of the session, the attendees will be able to identify and use resources for medical expedition planning In tropical and subtropical environments.

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Scientific Program



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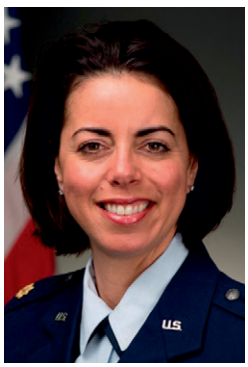
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Slides



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Adam Sirek—Deputy Chair
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Katie Samoil—Slides
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For Registration Committee members, please see p. 778.

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Abridged Minutes of the 95th Annual Business Meeting

Tuesday, June 3, 2025, Hyatt Regency Atlanta Hotel, Atlanta, GA, United States



Orford



Sventek

Call to Order (Jeff Sventek): A quorum of more than 100 members in attendance was met and the meeting started at 12:00 pm EDT on Tuesday, June 3, 2025.

In Memoriam (Jeff Sventek): Attendees paused to reflect and remember those members of AsMA who passed away since the last AsMA conference in 2024.

Recognition Of Past Presidents (Jeff Sventek): Past Presidents were asked to rise and be acknowledged.

Recognition Of Past Executive Directors (Jeff Sventek): Past Executive Directors were asked to rise and be acknowledged.

President's Remarks (Bob Orford): It has been an amazing year. I have very much enjoyed writing the monthly President's Pages for the AsMA journal. We had a great meeting in Chicago last year with excellent attendance, over 1700 attendees. However, because of expenses we didn't have a significant increase in revenue. We are very pleased with this year's venue in Atlanta.

We are transitioning from Jeff Sventek as Executive Director to John Peters, who will continue as the Executive Director of UHMS. A Collaborations Committee was established to enhance communications between the two organizations, composed of five members from each organization. The Collaborations Committee approved a memorandum of understanding (MOU) between AsMA and UHMS and an employment agreement with John Peters as AsMA Executive Director. John was hired as a Consultant from January to June to plan the Annual Scientific Meeting in Atlanta and prepare for the transition. After 1 July, John Peters will be the Executive Director and Jeff Sventek will be consulting informally as needed. In October 2025 he will become Secretary General of the International Academy of Aviation and Space Medicine.

John Peters will be handling finances and outside communications. The Deputy Executive Director, Gisselle Vargas, will be responsible for much of what Jeff has been doing with respect to member communications, AsMA staff management, liaison with AsMA's Committees, planning of AsMA Council, Scientific Program Committee, and Executive Committee meetings and organization of the Annual AsMA/UHMS Annual Scientific Meeting (ASM) jointly with John Peters and UHMS staff. John Peters will be responsible for working with the AsMA President, Officers, Executive Committee (ExCom), and Council, AsMA/UHMS Collaborations Committee, Chairs of AsMA Committees as needed, including the reconstituted AsMA Finance Committee, executive management of AsMA staff and services, AsMA financial management, the AsMA strategic financial roadmap, new product and service development, and member satisfaction and growth.

Several important events occurred, or will occur, in 2024–2026. ICAM 2024 was held in Lisbon, Portugal. ICASM 2025 will be in Singapore October 27–30, 2025. ICAM in 2026 will be in Istanbul, Turkey. The AsMA Council Meeting and Scientific Program Committee, with a new process for abstract review, were held in Alexandria in November 2024. The Council meeting in November 2025 will be virtual this year, while the Scientific Program Meeting will be held in North Palm Beach, where John Peters is located, in late January 2026.

Warren Silberman and I traveled to Orlando, FL, for the SpaceCom convention. I spent a day before SpaceCom at the Kennedy Space Center, and we both joined John Peters and Jeff Sventek (Jeff by Zoom) in North Palm Beach for a Presidential Transition meeting, which was very helpful for all. The AsMA Executive Committee met in Scottsdale, AZ, in early March 2025, preceded a day earlier by an Executive Committee trip to Biosphere 2, which was opened in 1991 north of Tucson as an Earth analog. We met Kai Staats, Ph.D., who developed a Mars analog at Biosphere 2 used for research purposes and highlighted by an annual international Analog Astronaut Conference in late April or early May each year. Kai Staats will be a guest speaker at the AsMA Annual Scientific Meeting in Denver in 2026.

Working groups in 2024–2025 included one on Mental Health chaired by Dr. Billy Hoffman and Dr Quay Snyder, and another on the FAA Emergency Medical Kits, chaired by Dr Jim DeVoll and Dr Paulo Alves. A report on mental health research in aerospace medicine was published last fall, and the EMK report will be published in our journal soon.

The speaker for the Louis H. Bauer Lecture was Jeffrey R. Davis. The Eugene G. Reinartz speaker will be Mark N. Sirangelo, Ph.D. The Harry G. Armstrong/George B. Hart Memorial Lecture will be a panel chaired by Joseph Dervay with Richard Moon, Michael Gernhardt, Jon Clark, and Mitch Garber.

Report of the AsMA Foundation Chair (Mark Campbell): Mark Campbell thanked the members of AsMA, noting that it is 'your AsMA Foundation' and the work of the Foundation could not continue without the members' support. The Foundation had a very good year in 2024 and increased the managed brokerage account from 660,000 to 870,000. We have managed a 9% return on these accounts for the past ten years. We give 20 awards and scholarships annually to grow the organization. Matching donors of $2.00 for every dollar donated to the Foundation during the month of June.

GOVERNANCE (Warren Silberman)

Bylaws Committee: There are no new Bylaw or Policy and Procedures changes reviewed at the AsMA council.

Scientific Program Committee: An excellent report was given yesterday at the opening ceremony by Amanda Lippert. We appreciate Amanda Lippert's report.

Report of the Executive Director (Jeff Sventek): Mr. President, officers, and members of the Aerospace Medical Association, it is my pleasure to report that this past year was extremely

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active, successful, and laid the foundation for new and exciting opportunities for the Aerospace Medical Association. There are many within the Association responsible for this success including elected officers, AsMA Committees, Constituent Organization leaders, Affiliated Organization leaders, and all who volunteered this past year to help move the Association forward. Thank you for your continued strong support of the Aerospace Medical Association. I'd also like to recognize the Headquarters Office Staff and our journal independent contractors. Please stand as I introduce you so our members can put a face to the name. The next AsMA Executive Director, John Peters, the AsMA Deputy Executive Director, Gisselle Vargas, who has been employed by AsMA for 19 years. Our Director of Member Services is Sheryl Kildall, a 24-year employee of AsMA. Managing Editor for the journal is Rachel Trigg who has been with AsMA for nearly 22 years. Stella Sanchez has been with AsMA since January 2023 and serves as our Assistant Managing Editor for the journal. We also have two outstanding contract employees. Dr. David Newman serves as the Editor-in-Chief for our AsMA journal and Sandy Kawano works as the Assistant to the Editor-in-Chief. All of our employees and independent contractors work hard every day to provide a high-quality scientific journal as well as outstanding customer service and administrative support to our members. Thank you all for your outstanding work.

AsMA finished 2024 in good financial shape. We were able to meet all 2024 obligations but had to withdraw $50,000 from the AsMA reserves to meet all obligations. The 2024 Annual Scientific Meeting in Chicago was very well attended with 1,714 registrations. However, expenses in Chicago were higher than anticipated and excess revenue from that meeting was $390,434 or $149,000 less than the excess revenue for the 2023 AsMA meeting in New Orleans. AsMA finished 2024 with net excess revenue of $28,986. This year's Annual Scientific Meeting registrations are also lower than anticipated. Travel funding restrictions for US government employees and contractors combined with concerns over enhanced screening of non-US travelers at the US borders reduced this year's meeting registrations to 1,775. We anticipated total registrations close to 2,000 since this is a joint meeting with the Undersea and Hyperbaric Medical Society. Post-meeting analysis may require rescoping of future joint Annual Scientific Meetings.

AsMA recently completed the annual financial audit for 2024. The published audit report provides the auditors' opinion:

"We have audited the accompanying financial statements of Aerospace Medical Association (the Association) (a nonprofit organization), which comprise the statements of financial position as of December 31, 2024 and 2023, the related statements of activities, functional expenses and cash flows for the years then ended, and the related notes to the financial statements. In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of Aerospace Medical Association as of December 31, 2024 and 2023, and the changes in its net assets and its cash flows for the years then ended in accordance with accounting principles generally accepted in the United States of America."

AsMA membership is stable. As of this report, AsMA membership totals 2,087. That represents a 3.3% decrease from this same time last year. Despite the decrease in membership, AsMA finished 2024 with membership revenues of $418,285 versus the budgeted amount of $366,350.

AsMA collaborated with the International Academy of Aviation and Space Medicine (Academy), the European Society of Aerospace Medicine (ESAM), and the Portuguese Society of Aerospace Medicine (SMAPor) in hosting the 2nd International Congress in Aerospace Medicine (ICAM), October 3-5, 2024 at the Aula Magna in Lisbon, Portugal. Registration for the ICAM 2024 was strong and finished with total registrations at 890. Net excess revenue for the ICAM 2024 was €125,493. Each of the four organizations shared the excess revenue equally with each organization receiving €31,373.39 or $32,595.23.

Planning for ICAM 2026 is now underway. The ICAM 2026 is scheduled for October 1-4, 2026 in Istanbul, Turkey.

As of this morning, total registration for this meeting is 1,775, compared to 1,752 at the same time for the 2024 meeting. Of that total, 1,695 were registered in advance of the meeting and 80 attendees registered here on site. Of the 1,695 total, 1,306 were AsMA registrants, 316 were UHMS registrants, and 146 registered as both. The AsMA registrants plus those who registered as Both totaled 1,452. This represents a decrease of 300 AsMA attendees or 17% below the 2024 meeting in Chicago. Revenue from our Annual Scientific Meetings represents a large portion of our annual operating budget and we thank all participants.

Since 2014, AsMA Staff have been working remotely. In 2014, AsMA Staff worked 3 days per week in the AsMA building located at 320 South Henry Street, Alexandria, VA 22314 and 2 day per week from home. This arrangement reduced the number of days each week spent in the traffic congestion around DC and northern VA. When the COVID-19 pandemic hit in March 2020, all AsMA Staff members were directed to work from home. After 2 weeks of this work arrangement, we decided to have one person work from the AsMA building each day. That person would work from the office until the mail was delivered and distributed. Anything urgent would be scanned and sent via email to the appropriate AsMA Staff member. This arrangement worked extremely well and prevented AsMA Staff from being exposed to the COVID-19 virus at work.

Even after the COVID-19 threat had diminished and many people were returning to work at the office, we decided to retain the work procedures. We found that work productivity was maintained and AsMA Staff only had to fight traffic congestion one day per week. As a result, we found the AsMA building in Alexandria to be unnecessary.

AsMA was recently approached by the Alfred Street Baptist Church about the possible sale of the building. The Alfred Street Baptist Church is located across the street from the condo association complex where the AsMA building is located. In recent years, the Alfred Street Baptist Church has purchased several of the business buildings within the association complex. AsMA Executive Committee discussed the potential sale of the AsMA building in detail. Since the AsMA Staff no longer requires a physical office building to conduct AsMA business, the AsMA Executive Committee approved the Executive Director to engage with the Alfred Street Baptist Church on the potential sale of the AsMA building. The AsMA Council reviewed the draft Purchase Agreement with the Alfred Street Baptist Church and approved the AsMA Executive Committee to continue working toward the sale of the AsMA building for $1.6 million. After closing costs are paid, remaining proceeds from the sale will be invested for use in support of future AsMA mission requirements.

Finally, this report to membership will be my last as the Executive Director for the Aerospace Medical Association. It has been an absolute honor and a privilege to serve our Association for

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more than 15 years. I am confident that John Peters and Gisselle Vargas will pick up the executive leadership roles and move the Association to new and greater heights in the years to come. I will continue to participate in the Aerospace Medical Association as a member, but it is time for me to step aside and relax. Thank you for the opportunity to serve as your Executive Director.

Nominating Committee Report (Susan Northrup): The Nominating Committee meets several times per year and does a tremendous job. The slate of officers is: President-Elect: Anthony Wagstaff, MB, BCh, BAO, LRCP&SI, DipAvmed, PhD, MBA; Vice Presidents: Eilis Boudreau MD, MPH (2-Yr Term) and Ian Mollan, MBChB, DAvMed (2-Yr Term); Secretary: (2-Yr Term): Amanda Lippert MS; Members-at Large: Jaime Harvey (3-Yr Term), Roger Hesselbrock (3-Yr Term), Brent Klein (3-Yr Term), and Winton Laslie (3-Yr Term). The vote on nominated officers was unanimously approved.

AsMA Treasurer's report (Casey Pruett): 2024 Final Results/ 2025 YTD Preliminary/Highlights: The Year-End view of AsMA's 2024 costs and revenue (pending the annual audit) that shows a positive result for the year slightly better than predicted. Also presented, when relevant, are the 2025 YTD financial results. The investment data is shown as of 21 May 2025.

2024 Net Income: We had a slight increase of $3K in revenue for the 2024 Chicago meeting initial results, which is the primary driver of AsMA financial data. Despite Chicago yielding higher than expected revenues. It also had higher expenses. Net Income (including investments) is currently $29K compared to $23K budgeted. Membership exceeded its target (which helped offset the higher expenses and withdrawal from the investment account) and Journal revenue is lagging.

2024 Annual Meetings: The AsMA Scientific Annual meeting in Chicago is showing a slightly higher than previously stated positive result of $390K (was $388 in November). Not the highest net result, but definitely the highest Revenue – Much to be said about Chicago as a major hub, so we have big hopes for Atlanta.

2024 Membership and Operations: Membership hovers around 2100 (slight increase in 2024, likely due to more attendance at Chicago) dues paying members and remains the second largest contributor to AsMA revenues. 5 Life Members in 2024 is 4 more than the expected one per year and corresponds to an additional $20K recognized for the year. Chicago did translate into higher membership. However, multi-year and lifetime memberships do result in less overall membership revenue for AsMA long term. We have incurred slightly higher expenses than projected, due to repairs, bank, and IT charges and much higher convention expenses. Importantly, there was a need for $50K from the investment account, as approved at the November AsMA Council meeting.

2024 Journal: The approved budget accounts for the funding that supplements the journal expenses, though it may appear that the journal operates at a net loss. That is not the case. By the end of each year, the journal typically slightly overperforms in revenue, including open access and classified advertising that were better than expected. One part of AsMA's mission is to educate/publish the journal, so this is part of achieving that mission. However, we are behind expected revenues for 2024 YTD, given a decrease in royalties, subscriptions, display ads, open access, and classified ads. However, there is a significant decrease in expenses since moving primarily to the digital platform. Thus, the printing costs continue to decrease as we move towards an emphasis for online access. The primary expenses for the journal include staff salaries and as well as printing and mailing costs, both of which are within budget. The journal staff continue to make efforts to cut expenses, particularly with Editorial Manager. Savings are increasing with the cessation of the print journal and continued reduction in printing/mail/handling costs are subsequently recognized.

2024 Income and Expenses by % slide: In 2024 YTD Income – Meeting (62%) is the primary source of revenue, followed by Membership (25%), Journal (6%), then Investment (4%), then Other (rent/web ads/item sales at 3%). = 100%. Expenses – Management (47%), Convention (39%), and Journal (14%) expenses are the primary contributors thus far. = 100%.

UBS Performance 21 May 2025: The highlight here is the increasing trend in our portfolio value, despite the $50k withdrawal and subsequent volatility.

Return Rates: Rates show a 4.37% rate of return on all the combined accounts since inception in 2010, 4.29% return in the last quarter, 5.48% YTD return, and 3.84% return in the last 30 days.

Annual Financial Statements Audit: As part of AsMA's preparation and verification of its financial statements, each year the treasurer and executive director are required to join a video conference interview. This year's interview focused on revenue recognition, succession planning with the new Executive Director, and management controls. The final results are all positive with zero findings.

Summary: 2024 Preliminary results are positive! [$29k Net Operating Income]. Very Positive result from Chicago. 2025 U.S. markets charging positive for now. Expect volatility over the next year. UBS Investment Portfolio is AsMA's lifeline. There was a $50K withdrawal in November – this is the value of having the investment account to weather storms. Despite the withdrawal from the UBS investment fund, we are still gaining towards the $1M reserve in the UBS investment accounts. We are maintaining a strategy to keep $1M as backup funding for convention down years due to pandemics or other events. Recommendation to hold steady and maintain the long horizon view, time, discipline, and patience. We hope to replenish some funds into the UBS investment account after the 2024 year-end audit.

Recommendations are to potentially replenish UBS accounts and adjust asset allocation. There is a possibility of selling the AsMA headquarters property in Alexandria. Continue to develop strategies for increased revenue including a Virtual Scientific Meeting and incentives for membership.

REPRESENTATION AND ADVOCACY (Anthony Wagstaff)
Communications Committee: Chair Diego Garcia, with the social media subcommittee, has worked to develop better task coordination with AsMA Headquarters to ensure AsMA social media has the right content and presentation.

Resolutions Committee: Chair Luis Rivero has three resolutions in process: AsMA Resolution 2024-01–An Integrated Health and Safety Program; AsMA Resolution 2024-02–Establish a New Defense Safety Agency; and AsMA Resolution 2024-03–Equipping Air Carrier A/C for GPS-Based Instrument Approaches to Prevent Controlled Flight Into Terrain (CFIT)

EDUCATION AND RESEARCH (Fred Bonato)
Aerospace Medicine Residency: There is a lack of funding for U.S. residency programs in aerospace medicine. We have sent a

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letter to Capitol Hill. Amy Kreykes and Fred Bonato will be representatives on any future collaborations on this front.

Scientific Program Committee (Amanda Lippert): The Scientific Program Committee had 133 reviewers completing online review of abstracts. Abstracts that were on the cusp were reviewed in person. Each abstract had an average of 7.2 reviews. The abstracts will now be submitted later, December 31st in alignment with UHMS.

Amanda presented changes to the abstract review process. Abstracts submitted as a panel will only be accepted or declined as a panel. 692 abstracts were submitted this year. We would like to have constituent organization endorsements for 2026. Encourage submission of individual abstracts that can be converted into slide sessions. Timeline has shifted; abstract submission deadline will be December 31 with initial virtual reviews in January and final in person reviews end of January or February. Notifications will go out in February.

MEMBERSHIP (Susan Fondy)

Membership Committee: Chair Sparky Matthews. There is a mentorship program with the majority of the mentees coming from AMSRO and the mentors coming from the Fellows and Associate Fellows Group. Survey for mentors has been distributed. Please sign up to mentor eager young mentees. Associate Fellows will get points towards Fellowship for mentoring. The commitment is for mentoring once a quarter for one year, however, there is no mandatory end.

Why I Love aerospace medicine videos. The format is to talk about how you got into aerospace medicine and why you love it. The videos are being completed in the registration area. Clips to help motivate. Please help with diversity of professions and countries.

Awards Committee: Chair Mark Sheehan and his committee have selected wonderful awardees.

Corporate and Sustaining Membership Committee: Could use additional members to contribute.

Unfinished Business: None

New Business: None

Acknowledgement of Jeff Sventek's tenure as Executive Director by AsMA President, Bob Orford. Jeff will be funded to the European Human Factors Symposium in addition to the presentation of a gift at the President's Reception. He plans to become a voting member of AsMA and potentially run for office in addition to being the Secretary General of the Internation Association of Aerospace Medicine (IAASM).

Motion made by Brent Klein to adjourn. Seconded by multiple members in the meeting. Annual Business Meeting adjourned at 1253 CDT.

Respectfully submitted,
Jeffrey Sventek, MS, FAsMA, CAsP, Executive Director
J. Karen Klingenberger, MD, MPH, MS, Secretary

Erratum

Ryder VE, Williams ES. Revisions to limits for propylene glycol in spacecraft air. Aerosp Med Hum Perform. 2022; 93(5):467–46.

DOI: https://www.doi.org/10.3357/AMHP.6037.2022

In the above article, in the second paragraph of the section on SMAC Development, the authors stated "Importantly, this value (32 ppm) for pure propylene glycol exceeds the saturated vapor concentration for most propylene glycol/water mixtures being considered as thermal control fluids in exploration spacecraft." This is inaccurate. The saturated vapor concentration for PG is 171 ppm at standard temperature and pressure, and the vapor pressure increases as water is added to the mixture.

The authors and the journal apologize for this misstatement.

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Bylaws of the Aerospace Medical Association
(Revised May 24, 2022)

ARTICLE I. NAME
The name of this association shall be the Aerospace Medical Association.

ARTICLE II. VISION, MISSION, AND GOALS
A. Vision: The international leader in aerospace medicine and human performance.
B. Mission: Apply and advance scientific knowledge to promote and enhance health, safety, and performance of those involved in aerospace and related activities.
C. Definition: As used in this document, Aerospace Medicine is the multi-disciplinary application of professional and scientific knowledge, training, and research to promote and maintain the health, well-being, safety, and performance of those involved in aerospace activities.
D. Goals:
(1) Provide opportunities for education and promote research.
(2) Provide members opportunities for professional growth and development.
(3) Represent the discipline of Aerospace Medicine to professional, commercial and governmental organizations and advocate policies and standards.
Governance of the Association is necessary to maintain a sound financial structure and ensure continuity of the Association in service to its goals.

ARTICLE III. MEMBERSHIP
SECTION 1. Categories, Qualifications, and Election for Membership.
A. Categories: There shall be the following categories of membership: (1) Member, (2) Life Member, (3) Emeritus Member, (4) Honorary Member, (5) Corporate and Sustaining Member, (6) Technician Member, (7) Student Member, and (8) Resident Member.
B. Qualifications: An applicant for membership shall have one or more of the following minimum qualifications:
(1) Be a duly licensed physician or nurse in the country of residence; or
(2) Hold a designation as an aviation medical examiner, a flight medical officer, an aviation medical director, a flight nurse, or a submarine or diving medical officer, or have held such rating in federal or national government services and normally shall be actively engaged in related capacities; or
(3) Be a graduate of a college or commissioned in the armed services with equivalent qualifications, working in or contributing to the field of aerospace medicine, aeronautics, astronautics, undersea medicine, or environmental health; or
(4) Be a scientist or engineer concerned with the life sciences in the field of, or related to, aerospace medicine, aeronautics, astronautics, undersea medicine, or environmental health; or
(5) Be engaged in teaching, research, or the applications of such research in the field of, or related to, aerospace medicine, aeronautics, astronautics, undersea medicine, or environmental health.
C. Election for Membership
(1) Application for membership shall be accompanied by the full amount of the annual membership dues. The Executive Director shall review the application. If it meets all requirements for qualification without question, the applicant shall be notified that the application has been approved in the appropriate category. If there is a question as to the qualification or category of the applicant, the application shall be referred to the Executive Committee. The Executive Committee shall review the application and shall take such action as its findings warrant. The Executive Committee may refer the application to the Council, which shall then determine whether the applicant meets requirements and in which category. Any applicant refused membership for any reason will be informed of the refusal and the reason for the refusal in writing from the Executive Director and shall be informed of their right to appeal the refusal to the appropriate level.
(2) Members shall have the rights to attend all meetings of the Association, shall be entitled to vote at the business meeting and hold office and to receive the official journal.
(3) Those on the list of active members shall continue as active members as long as they retain their membership in good standing to include payment of dues appropriate to their membership category as established by the Council.
D. Life Member: The Executive Director shall have the authority to grant Life Membership in this Association as consistent with the conditions and appropriate fee for Life Membership as established by the Council. These Life Members shall be entitled to vote and hold office and to receive the official journal.
E. Emeritus Member: The Executive Director shall have the authority to grant Emeritus Membership in this Association as consistent with the conditions and appropriate fee for Emeritus Membership as established by the Council. At age 65, those individuals who have been members for a minimum of 25 years are eligible to apply. Such Emeritus Members shall be entitled to vote and hold office and shall retain all rights and privileges of regular members in good standing. Membership entitles Emeritus Members to the electronic version of the official journal of the Association via the Aerospace Medical Association website. The print version of the official journal of the Association shall be available to Emeritus Members via a subscription at a rate to be determined by the Executive Committee.
F. Honorary Member:
(1) Honorary Members shall be elected from among those individuals who have made outstanding contributions to the advancement of aerospace medicine, aeronautics, astronautics, undersea medicine or environmental health activities. Honorary Members shall not receive the official journal of the Association except by personal subscription.
(2) The Council shall have the power to select not more than four Honorary Members in any one year. The President of the Association, with the concurrence of the Executive Committee, shall propose nominees to the Council for approval. However, any member of this Association may submit such nominations in writing to the Executive Director for transmittal via the Executive Committee to the Council.
G. Corporate and Sustaining Member:
(1) The Executive Committee shall admit as Corporate and Sustaining Members those companies, associations, foundations, groups, or individuals contributing minimum annual dues and who meet other eligibility requirements as established by the Executive Committee.
(2) Upon their approval and acceptance by the Executive Committee, Corporate and Sustaining Members shall receive such other services as the Executive Committee may deem appropriate.
(3) Corporate and Sustaining Members shall have the privilege of attending all meetings of the Association. However, they shall not be eligible to vote or hold office.
H. Technician Member:
(1) An applicant for Technician Membership must be a technician in the field of, or related to, aerospace medicine, aeronautics, astronautics, undersea medicine, or environmental health.
(2) Technician Members shall make application in the prescribed ways indicated in Section 1, C of this Article.
(3) Technician Members shall pay prescribed dues, receive the official journal of the Association, and may participate in all activities of the Association including the Annual Business Meeting, holding office and voting.
I. Student Member:
(1) An applicant for Student Membership must be enrolled full-time in an accredited college or university and have an express interest in aerospace medicine or allied sciences.
(2) Student Members shall make application in the prescribed ways as indicated in Section 1, C of this Article. Members seeking Student status beyond five years shall submit evidence of full-time student status at the time of application.
(3) Student Members shall pay prescribed dues and are entitled to the electronic version of the official journal of the Association via the Aerospace Medical Association website. Student Members are entitled to participate in all activities of the Association including the Annual Business Meeting, holding office and voting.
J. Resident Member:
(1) An applicant for Resident Membership must be enrolled full-time in an accredited residency or equivalent training program and have an express interest in aerospace medicine or allied sciences.
(2) Resident Members shall make application in the prescribed ways as indicated in Section 1, C of this Article. Members seeking resident status beyond five years shall submit evidence of full-time resident status at the time of application.
(3) Resident Members shall pay prescribed dues, receive the official journal of the Association, and may participate in all activities of the Association including the Annual Business Meeting, holding office and voting.
SECTION 2. Review of Ethical Concerns
A. The Ethics Policy of the Association, as defined in the Policies and Procedures Manual, shall apply to all categories of Association members.
B. Ethical Concerns:
(1) An ethical concern should be resolved at lowest level possible within the Association.
(2) Should the ethical concern not be resolved at lower levels, the concern may be elevated to the Executive Committee using the process delineated below.

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(3) Ethical concerns addressed through this process shall be limited in scope to conduct deemed contrary to the best interests of the Association, to include the business and governance of the Association, the annual scientific meeting, and the Association's official journal. The Executive Committee shall determine if the concern is within the scope of this process.

(4) Any member may raise an ethical concern regarding another member who is believed to have violated the Ethics Policy of the Association, to include the business and governance of the Association, the annual scientific meeting, and the Association's official journal. The Executive Shall determine if the concern is within the scope of this process.

(5) The Executive Committee shall initially review the written ethical concern to determine the validity of the concern and whether a formal investigation is warranted. The Executive Committee may dismiss the concern if it is deemed not valid or outside the scope of this process.

(6) If the Executive Committee determines the ethical concern has validity and is within the scope of the process, the concern will be referred to the Ethics Body for investigation as described in the Policies and Procedures Manual.

(7) The respondent shall be advised in writing of any ethical concern regarding him or her and be provided an opportunity to respond to the Ethics Body and the Executive Committee.

(8) Once the investigation is complete, the Ethics Body shall provide a summary report of the investigation to the Executive Committee.

(9) For any ethical concern regarding a member of the Executive Committee, the Council will assume the role of the Executive Committee in this process.

C. Administrative Action:

(1) Upon receipt of the report from the Ethics Body, the Executive Committee shall determine the appropriate administrative action.

(2) The Executive Committee shall have, but not be limited to, the following powers: dismissal of the ethical concern, censure, probation for a period not to exceed two years, suspension for a period not to exceed three years, or expulsion of a member, as the findings warrant.

(3) A two-thirds vote of the full membership of the Executive Committee is required for any ruling.

D. Appeal Process:

(1) Proposed administrative actions may be appealed to the full Council and shall be submitted in writing to the Executive Director.

(2) Should an appeal be requested, no administrative action shall proceed until the appeal process is complete.

(3) A two-thirds vote of the full membership of Council is required to modify or reverse the action of the Executive Committee. Failing to achieve modification or reversal from the Council, the action of the Executive Committee is confirmed. Action of the Council is final.

ARTICLE IV. Corporate Forum

SECTION 1. Titles, Structure, Representation, and Relationship to AsMA Committee

A. Titles: The Corporate Members shall constitute the Corporate Forum.

B. Structure: The Corporate Forum may have an internal governance structure of its choosing, with officers and procedures appropriate to its activities.

C. Representation: The Corporate Forum shall choose one of its members to represent the Forum at Council meetings. The representative shall serve as a liaison between the Council and the Forum. The Corporate Forum is aligned under the Vice President of Member Services.

D. Relationship to Corporate and Sustaining Membership Committee: The Corporate Forum will work in coordination with the Corporate and Sustaining Membership Committee as described in Article XII of these Bylaws.

SECTION 2. Membership

All members of the Corporate Forum shall be Corporate Members as determined in Article III of these Bylaws.

SECTION 3. Activities

A. Forum Events: The Corporate Forum will plan and conduct an annual Advisory event, in coordination with Council. The purpose of the Advisory will be an exchange of information and goals between the Association leadership and the Forum to facilitate good relations and advances in the field of Aerospace Medicine and Human Performance. The Forum may also sponsor a speaker or other similar event(s) for the general Association membership.

B. Forum Budget: The Association budget will consider and plan for reasonable expenses in connection with Forum events.

ARTICLE V. FELLOWSHIPS

A. There shall be the following categories of Fellows: (1) Fellow, (2) Associate Fellow, and (3) Honorary Fellow.

B. Fellow:

(1) Fellows of the Aerospace Medical Association will be selected from among the active members who have made outstanding contributions to aerospace medicine, aeronautics, astronautics, undersea medicine, or environmental health, in the practical usage of research, or by precept and example.

(2) All those now holding the grade of Fellow, or who may be hereafter elected to such, shall constitute the group of Fellows. The group shall meet and shall elect annually, its chair, who shall hold office until a successor is elected.

(3) Nominations for Fellows shall be made by the Fellows who are active members.

(4) Fellows shall be elected annually through a published process developed by the Fellows and approved by Council.

C. Honorary Fellow:

(1) Honorary Fellows shall be elected by the Fellows from among persons who have rendered outstanding service or made outstanding achievements in aerospace medicine, aeronautics, astronautics, undersea medicine or environmental health activities. Honorary Fellows shall not normally be elected from members in good standing. Honorary Fellows shall be nominated and voted upon as prescribed for the election of Fellows. However, a two-thirds majority of votes cast shall be required for election. If required for any reason, additional voting may be conducted at the time of the annual meeting of the group of Fellows.

(2) Honorary Fellows shall not be entitled to vote or hold office. They shall pay no dues and shall not receive the official journal of the Association except by personal subscription.

(3) The election of Honorary Fellows is limited to no more than two in any one year.

D. Associate Fellow:

(1) Selection as an Associate Fellow shall honor members of the Aerospace Medical Association who have contributed to the Association in a positive manner.

(2) All those holding the grade of Associate Fellow, or who may hereafter be elected to such, shall constitute the group of Associate Fellows. The group shall meet annually during which the election of officers will be announced.

(3) A candidate for Associate Fellow shall have been a member for at least five years.

(4) Applications for Associate Fellowship shall be reviewed by the Associate Fellows and submitted to the Executive Committee for approval.

ARTICLE VI. OFFICERS

SECTION 1. Elected Officers

The elected officers of this Association shall be a President, President-Elect, four Vice Presidents, Secretary, and Treasurer. The President-Elect shall be elected annually to serve one year or until a successor is elected and assumes office at the close of the Annual Business Meeting of the Association. The Vice Presidents, Secretary, and Treasurer shall serve for two years or until their successors are elected and assume office at the close of the Annual Business Meeting of the Association. The President-Elect shall automatically succeed to the office of President at the close of the Annual Scientific Meeting.

SECTION 2. President.

The President shall chair all meetings of the Council of the Association and the Executive Committee. The President shall appoint chairs of Association committees unless provided otherwise in these Bylaws. The President has the authority and obligation to provide specific tasking to committees and other functionaries doing work for the Association. The President is an *ex officio* member of all Standing Committees except the Nominating Committee. In the event an officer or elective member resigns, is incapacitated, or is otherwise unable to act, the President may appoint, with approval of the Executive Committee, an acting officer or elective member to perform those duties until the next Annual Business Meeting or for the period of the incapacity.

SECTION 3. President-Elect.

The President-Elect shall become familiar with the duties of the President and shall perform such other functions as the President may designate. In the event that the President is incapacitated or otherwise unable to act, the President-Elect shall perform the functions of and act as President for the period of such incapacity.

SECTION 4. Vice Presidents.

The four Vice Presidents shall perform such duties as designated by the President.

SECTION 5. Secretary.

The Secretary shall be responsible for reviewing the minutes of the Council and Executive Committee meetings and shall perform those duties as directed by the President. The Secretary shall have other duties usually performed by a Secretary which are not accomplished by the home office staff.

SECTION 6. Treasurer

The Treasurer shall have duties usually performed by a Treasurer and shall perform those duties as directed by the President, Council, or Executive Committee. The Treasurer shall be the chair of the Finance Committee and custodian of

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all monies and securities and hold same subject to the direction and disposition of the Executive Committee under the direction of the Council. The Treasurer shall perform the duties in cooperation with the Executive Director.

SECTION 7. Unbudgeted Expenditure of Funds.

No Officer may make or authorize any unbudgeted expenditure without approval of the Executive Committee or the Executive Director. The Executive Director shall not make or authorize any unbudgeted expenditure exceeding the amount stipulated by the Policy and Procedures Manual without approval of the Executive Committee.

ARTICLE VII. EXECUTIVE DIRECTOR.

SECTION 1. Appointment

The Executive Director shall be appointed by the Council, and shall not hold an elective office.

SECTION 2. Duties.

A. The Executive Director shall be the chief operating officer of the Association and shall keep its records, and a file of its publications. The Executive Director shall notify all members of the time and place of meetings, notify Council members of the time and place of Council meetings, and shall prepare the programs of the meetings under the direction of the Council.

B. The Executive Director shall cooperate with the chairmen of various groups and committees of the Association in the execution of the policies of the Association as outlined by the Council, shall coordinate the work performed by the various committees of the Association, shall perform such duties as are assigned by the Council, and shall act under instruction of the Executive Committee.

C. The Executive Director is authorized to provide such assistance as is necessary for the proper conduct of the Association headquarters office, subject to the directives of the Executive Committee and the Council. The Executive Director shall employ and supervise the staff, authorize purchase of supplies and equipment, arrange for office and other facilities for operating purposes, within the budget and as approved by the Executive Committee, and is empowered to sign contracts and enter into agreements on behalf of the Association and within the policies established by the Council and the Executive Committee.

D. The Executive Director shall, with the Treasurer, prepare a budget covering estimated annual expenses, to be submitted to the Council for adoption.

E. The Executive Director shall serve as the general coordinator and organizer for the Annual Scientific Meeting and shall direct the chairmen of the committees appointed for the planning, preparation, and operation of the Annual Scientific Meeting of the Association subject to the supervisory authority of the Executive Committee.

F. The Executive Director may retain legal and professional services as may be required with the prior approval of the Executive Committee.

G. The Executive Director shall prepare for the Annual Business Meeting a concise and summarized report on the activities of the Association for the year, its membership, and other matters of importance to the Association.

H. The Executive Director shall report in writing the total membership of the Association as of January 1 each year to the chair of the group of Fellows prior to the annual meeting of the Fellows.

I. The Executive Director shall be insured in an amount approved by the Executive Committee.

ARTICLE VIII. COUNCIL OF THE AEROSPACE MEDICAL ASSOCIATION AND EXECUTIVE COMMITTEE

SECTION 1. The Council of the Aerospace Medical Association.

The governing body of this Association shall be the Council of the Aerospace Medical Association, hereinafter referred to as the Council. Council members shall conform their conduct and perform their duties in a manner consistent with a published Ethics Policy adopted by the Council.

SECTION 2. Membership of the Council.

Membership of the Council shall consist of the President, President-Elect, the immediate Past President, the four Vice Presidents, the Secretary, the Treasurer, 12 elective members, one member selected by each of the Constituent Organizations, one member selected by the Fellows group, one member selected by the Associate Fellows Group, the Aerospace Medical Association Delegate to the American Medical Association, the Aerospace Medical Association Delegate to the American Osteopathic Association, a student or resident representative selected by the Aerospace Medicine Student Resident Organization, the Editor-in-Chief of the Association's official journal (*ex officio* member without vote; appointed by the President and approved by Council), a representative from the Corporate Forum (*ex officio* member without vote), and the Parliamentarian (*ex officio* member without vote; appointed by the President and approved by Council). The Executive Director shall be an *ex officio* member without vote. Of the 12 elective members, 4 shall be elected to the Council each year for three-year terms. No such elected member shall be eligible for more than two successive terms as an elective member. In the event an elected member of the Council resigns or is otherwise unable to complete a term on the Council, the Nominating Committee shall propose a nominee or nominees for election to fill the remaining year or years in that term. In the event a non-elected member resigns, is incapacitated, or is otherwise unable to attend a Council meeting, the appointing entity may designate an alternate by notifying the Executive Director or Secretary. All voting members of the Council must be members of the Association.

SECTION 3. Powers of the Council.

A. The Council establishes policy for the Association. The Council shall be vested with the management of the funds, properties, and the affairs of the Association and shall act in the capacity of a board of directors. The Council shall adopt such regulations as may be appropriate for governing the Association including an Ethics Policy for its members. It shall have the power to approve proposed budgets, authorize expenditures, seek and accept contributions, authorize contracts in the name of the Association, define and promote the activities of the Association, approve applications for constituency or affiliation with the Association, determine special classifications of membership and the eligibility of applicants for membership, authorize employment of auditors, and provide for issuance and distribution of the official educational scientific publications of the Association, including the official journal of the Association. The Council shall have the power to approve the appointment of an Executive Director and the Editor-in-Chief of the official journal of the Association, or any educational or scientific journal or other publication, on recommendation of the Executive Committee.

B. The Council shall provide for the business and conduct of the annual special meetings, and through its Executive Committee shall be responsible for the program of the annual scientific sessions and shall approve and grant any award given by the Association.

C. The Council shall establish such rules and regulations for the election of Associate Fellows as it deems advisable and which are not in conflict with the provisions of the Bylaws

D. The Council may delegate powers and duties to officers and employees of the Association.

E. The Council may assign responsibility to the Executive Committee for the management of the Association's finances and the investment of the Association's funds.

F. The Council may establish standards and procedures for certification of the professional competence of individuals within the special disciplines of the Association. Certification shall be made by action of the Council.

G. The Council may, at any time, on its own initiative, propose resolutions.

H. The Council shall perform such other duties as provided by the Bylaws.

SECTION 4. Meetings of the Council.

A. Regular Meetings: The Council shall have at least three regular meetings a year at the time and place called by the President as follows:

(1) Not more than 30 days before the Annual Business Meeting of the Association.

(2) Not more than two days after the Annual Business Meeting of the Association. If such a meeting is called before the close of the Annual Scientific Meeting, the President for the succeeding year shall be installed as Chair of the Council by the then President. The new Chair, the succeeding President, shall preside during the reorganization of the Council and consider any new business or items directed to the Council by the membership at the Annual Business Meeting.

(3) Not more than eight months nor less than four months after the Annual Business Meeting.

B. Special Meetings: Special meetings of the Council shall be held at the time and place called by the President, or the Executive Director may call a meeting upon written request of any 12 members of the Council.

C. Attendance and Quorum:

(1) Attendance at any regular or special meeting of the Council may be in person or in any manner consistent with procedures published in the Policies and Procedures Manual.

(2) Forty percent of the Council shall constitute a quorum at any duly called meeting of the Council.

SECTION 5. Executive Committee.

A. The Executive Committee shall consist of the President, the President-Elect, the four Vice Presidents, Secretary, Treasurer, Executive Director (*ex officio* without vote), and three members of the Council nominated by the President for the succeeding year, who shall be elected by a majority vote of the Council at its first meeting following the annual election of officers and councilors.

B. Except as otherwise provided in these Bylaws, the Executive Committee shall have the power to exercise all the functions of the Council between Association meetings and when the Council is not in session. The Council may delegate to such Executive Committee any or all of the powers granted to the

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Council by law or by these Bylaws, and not specifically delegated to any other committee or reserved to the Council by law.

C. The Executive Committee shall act as a Committee on Credentials.

D. The Executive Committee shall be responsible to the Council for the program of scientific meetings. The Executive Committee shall follow the guidelines in the Policy and Procedures Manual for review and acceptance of proposed exhibits for the Annual Scientific Meeting.

E. The Executive Committee shall be in charge of the finances of the Association and the investment of funds of the Association under the direction of the Council. It shall regulate and approve the budgets of all other committees.

F. The Executive Committee shall have the power to appoint the Editor of the official journal of the association, or any educational scientific journal or other publication, with the approval of the Council, and may recommend the members of the Editorial Board to the Council after consulting with the Editor.

G. The Executive Committee shall have the power to appoint a Managing Editor and such Assistant Editors as it deems necessary.

H. The Executive Committee shall approve changes to the Aerospace Medical Association Policies and Procedures Manual as necessary to be consistent with the Bylaws and Council direction.

I. The Executive Committee shall select the time, place, and format of the Annual Scientific Meeting.

J. Meetings: Attendance at any meeting may be in person or in any other manner consistent with procedures published in the Policies and Procedures Manual. A majority of the Executive Committee shall constitute a quorum at any duly called meeting of the Committee. The President shall call such meetings of the Executive Committee as the business of the Association may require, or a meeting shall be called by the Executive Director upon written request of a majority of the Executive Committee.

ARTICLE IX. ORGANIZATIONS.

SECTION 1. Constituent and Affiliated Organizations.

A. Qualifications:

(1) All Constituent and Affiliated Organizations shall have a similar mission and goals to those of the Aerospace Medical Association as outlined in Article II; have the objective of furthering the goals of this Association through local meetings, acquaintanceship, and discussion by the members, embraced within the group, of matters relating to aviation, space, or undersea medicine, or their allied sciences; increasing the value of this Association to its members, and helping maintain and increase its membership. The mission, goals, limitations, and activities of such group shall not be inconsistent with those of the Aerospace Medical Association. The Bylaws or other instruments of organization of such group shall be in conformance with the general provisions of the Bylaws of this Association and shall be approved by the Council of the Aerospace Medical Association.

(2) Constituent and Affiliated Organizations shall make formal written application through its responsible officers to the Association through the Council of the Aerospace Medical Association. Such application shall indicate the name of the group and the proposed area of its jurisdiction.

(3) A copy of the Constitution, Bylaws or other instruments of organization and amendments thereto of such group shall accompany its application. The application shall be presented to the Council of the Aerospace Medical Association. When the Council has approved the application by a two-thirds vote, a formal notification recognizing the Constituent or Affiliated Organization shall be issued to the group by the Council and such notification shall include a statement of the mission and goals of the Aerospace Medical Association as set forth in Article II.

B. Discontinuance of Constituency or Affiliation: Discontinuance of an existing organization shall be referred to the Executive Committee for study, whereupon the Executive Committee shall make a recommendation to the Council for appropriate action.

C. Constituent Organizations:

(1) Constituent Organizations must have a minimum membership equivalent to 2% of the active membership of the Aerospace Medical Association as determined and communicated in accordance with the Policies and Procedures Manual. With its application for constituency, each Constituent Organization shall furnish the Executive Director a current roster of its members in good standing, giving name, residence, and connection with aerospace medicine or its allied sciences. All members of the Constituent Organization shall be members of the Aerospace Medical Association. A Constituent Organization may have sustaining partners, however, that are not active members of the Aerospace Medical Association. These sustaining partners are not members and do not count toward the 2% criterion for Constituency status. By January 1 of each calendar year, each Constituent shall furnish the Executive Director a current roster of its members.

(2) Each Constituent Organization shall be represented on the Council by an individual who is a member of the Association designated by the Constituent Organization. Each such organization shall present the name of its designated primary representative to the Executive Director during the Annual Scientific Meeting. In the event the primary representative cannot attend a Council Meeting, the name of an alternative representative shall be presented to the Executive Director or Secretary.

D. Affiliated Organizations:

(1) Each Affiliated Organization shall furnish the Executive Director with a current demographic description of its membership with its application for Affiliated status.

(2) Each Affiliated Organization shall communicate with the Association at least once per year to indicate its desire to remain an Affiliated Organization of the Association.

SECTION 2. Regional Subdivisions and Chapters.

It is the policy of the Association to encourage and recognize the establishment of local chapters and subdivisions of its members. The Council shall have the authority to control the establishment, guidance, and termination of regional chapters and subdivisions and may establish regulations for this purpose upon such terms and conditions as it may deem appropriate in order to further the mission and goals of the Association. The provisions of the certificate of incorporation and of these Bylaws shall be equally binding upon the Association and all its regional sections, subdivisions, or chapters.

ARTICLE X. CERTIFICATION BOARDS.

SECTION 1. Certification Boards.

A. Titles: The Association may sponsor Certification Boards.

B. Qualifications: All Certification Boards shall have a similar mission and goals to those of the Aerospace Medical Association as outlined in Article II; have the objective of furthering the goals of this Association through evaluation and examination of individuals seeking certification by the Association on matters relating to aviation, space, undersea medicine, or their allied sciences; increasing the value of this Association to its members, and helping maintain and increase its membership.

SECTION 2. Membership.

All members of a Certification Board must be members of the Association and be approved by Council. The Council shall select one of its members to represent each Certification Board at Council meetings. The representative should be certified in an appropriate field and will serve as a liaison between the Certification Board and the Council.

SECTION 3. Discontinuance of a Certification Board.

Discontinuance of an existing Certification Board shall be referred to the Executive Committee for study, whereupon the Executive Committee shall make a recommendation to the Council for appropriate action.

ARTICLE XI. ELECTIONS.

Elections shall be held at the Annual Business Meeting of the Association. Only active members in good standing shall be entitled to vote in the election of officers and members of the Council. These shall be elected by a majority vote of those voting members present at the Annual Business Meeting. If there is more than one nominee for an office, the nominees shall be excused and the vote shall be by show of hands.

ARTICLE XII. COMMITTEES

SECTION1. Standing Committees.

A. There shall be the following standing committees:

(1) Aerospace Human Performance, (2) Aerospace Safety, (3) Air Transport Medicine, (4) Arrangements, (5) Awards, (6) Bylaws, (7) Communications, (8) Corporate and Sustaining Membership, (9) Education and Training, (10) Finance, (11) Global Liaison and Outreach, (12) History and Archives, (13) Membership, (14) Nominating, (15) Registration, (16) Resolutions, (17) Science and Technology, and (18) Scientific Program.

B. Other committees of the Association may be established as provided in the Bylaws or determined by the Council.

SECTION 2. Appointment and Duties.

A. The President, in consultation with the President-Elect and with the concurrence of the Executive Committee, shall appoint all chairs of standing committees except as otherwise provided in the Bylaws.

B. The chair of each committee may be directed by the President of the Association to accomplish specific tasks and reports relative to the area of expertise of that committee. Committee Chairs shall identify at least one Deputy Chair. Committees may have such subcommittees as the President and the committee may deem necessary to carry out their purposes. The Policies and Procedures Manual describes the committees' reporting responsibilities and details of their activities and function.

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SECTION 3. Standing Committees Functions.

A. Aerospace Human Performance Committee: This committee shall be responsible for establishing an integrating function and forum sponsoring panels and seminars, preparing reports, resolutions, and recommendations concerned with personnel selection, human performance, and human factors input in the concept, design, development, test and evaluation, and operational deployment of aerospace programs and systems. The committee will seek to promote research and application of human performance knowledge in every phase of systems development and deployment. Human performance and systems integration require a multidisciplinary approach involving decision-making, behavioral, biomedical, psychosocial, physiological, and engineering factors. The goal of the committee is to produce recommendations for improving aerospace systems performance.

B. Aerospace Safety Committee: The goal of this committee shall be to improve the safety of aviation and space activities. The committee shall direct its efforts to identifying specific, important aviation and space safety issues, national or international in scope that represents a significant threat to the health and safety of people involved in aviation and space activities, either as crew members or passengers. The objective of the committee shall be the resolution of aviation and space safety issues through either educational or regulatory processes. The committee may, with approval of the Council or Executive Committee, recommend research projects, prepare reports and scientific papers, sponsor panels and seminars, or formulate recommendations and resolutions to accomplish this objective.

C. Air Transport Medicine Committee: This committee shall be responsible for performing studies and preparing reports, resolutions, and recommendations on biomedical aspects of air transport operations. This committee shall concentrate its efforts on the promotion of international health, safety, and care through the mechanism of collecting information, analyzing data, and recommending solutions leading to improving health and safety in air transport operations.

D. Arrangements Committee: The Arrangements Committee works with the Association Headquarters Staff to make logistical arrangements for the Annual Scientific Meeting.

E. Awards Committee: The Awards Committee shall obtain and review all nominations for the various awards and honorary citations presented by the Association and make recommendations to the Council in such manner as the Council may prescribe.

F. Bylaws Committee: This committee shall be a fact-finding committee on matters pertaining to the Bylaws. The committee shall study proposed amendments to the Bylaws referred by the Council, and make its recommendations to the Association through the Council. If deemed necessary, this committee shall revise or develop new Bylaws for submission or approval in turn by the Council and the Association subject to proper publication, notification, and approval by a two-thirds vote of members attending the Annual Business Meeting as set forth in Article XVI.

G. Communications Committee: This committee shall oversee the communications program of the Association including brochures, books, and electronic media. The Communications Committee, at the request of the President or Council, prepares, reviews, and publishes publications sponsored by the Association other than the journal. The Committee may propose other projects related to communications that must be approved by Council.

H. Corporate and Sustaining Membership Committee: This committee shall be responsible for initiating programs and activities whose purposes and objectives are to increase and represent the interests of the corporate and sustaining members. This committee shall assist the Executive Director and the Executive Committee in reviewing the applications for corporate and sustaining membership referred to it, secure all available information concerning such applicants, and submit its recommendations to the Executive Committee through the Executive Director.

I. Education and Training Committee: This committee shall promote international aerospace medicine and allied disciplines through excellence in education and training conducted or cosponsored by the Association and consistent with the Association's objectives. It shall establish procedures to ensure the dissemination of educational and training related information and materials to the membership; coordinate the Association's education and training needs with the Scientific Program Committee; and coordinate the Association's Continuing Medical Education (CME) role.

J. Finance Committee: this committee shall update and review the Association's financial balance sheets on an ongoing basis, provide an overview of the Association's financial position to the Council at its regular meetings, and bring forward or review potential new courses of financial action. The committee is comprised of a Chair and four regular members. The Chair will appoint the regular members of the committee. The President-Elect of the Association is an *ex officio* member of the Finance Committee.

K. Global Liaison and Outreach Committee: This committee shall be responsible for initiation, coordination, and promotion of the Association's global perspectives, namely: 1) to promote coordination, cooperation, and harmonization of efforts associated with global aerospace medicine and human performance challenges, 2) to promote the importance of and opportunities in aerospace medicine and human performance in each country or region, 3) to identify and promote global best practices in aerospace medicine and human performance research and applications, and 4) to strengthen the connection between AsMA and its global membership, its global constituents and affiliated organizations.

L. History and Archives Committee: This committee shall be responsible for acquiring, preserving, and maintaining those items of historical significance that represent and depict the achievements of the Association and its members. This responsibility shall be exercised through historical research, commemorative presentations, and fostering the preservation of library, archival, and museum collections.

M. Membership Committee: This committee shall be responsible for initiating programs and activities whose purposes and objectives are to increase membership in the Association and to promote public relations. This committee shall act in an advisory capacity to the Executive Committee and the Council in matters relating to the establishment of eligibility requirements for all classes of membership.

N. Nominating Committee: Elected officers and the elective members of the Council shall be nominated by a Nominating Committee made up of the five most recent living Past Presidents of the Association and a representative selected from each Constituent Organization of the Aerospace Medical Association. The immediate Past President shall serve as a member of the Nominating Committee for a one-year term, and shall become Chairperson of that committee in the subsequent year. A Chairperson or any Past President who is unable or unwilling to discharge their associated responsibilities shall be replaced by the President with another Past President. The Nominating Committee shall conduct its activities by electronic communication. Each individual nominated shall have been approved by at least a simple majority vote of the Nominating Committee members. The report of the Nominating Committee shall be made as stipulated in the Policies and Procedures Manual and orally at the opening ceremony of the Annual Scientific Meeting. Any member may offer additional nominations, including name of nominee and office for which nominated, from the floor at the Annual Business Meeting; however, the Executive Director must be provided written notice of the nomination no less than twenty-four hours before the Annual Business Meeting. Such nominations must be accompanied by a petition of at least 2% of the active members of the Association and must be accepted by a two-thirds majority vote of members attending the Annual Business Meeting, before the nominee can be a candidate in a vote for a named position.

O. Registration Committee: The Registration Committee assists with registration activities associated with the Annual Scientific Meeting. This includes distribution of registration materials and coordination of tickets for events.

P. Resolutions Committee: Resolutions may be proposed to the Resolutions Committee by individual members, standing and special committees, Constituent Organizations, the Executive Committee, and the Council. Proposed resolutions that have been reviewed and coordinated by the Resolutions Committee shall be submitted to Council. If disapproved by Council, the resolution will be returned to the Resolutions Committee for further review and coordination. If approved by Council, the resolution will be presented to the Association membership. Proposed resolutions will be published on the Association's website for a period of at least 60 days to offer members the opportunity for review and comment. Members of the Association will be notified by electronic means when resolutions are posted on the website for review and when posted for a vote. Members may submit comments to the Resolutions Committee within the 60-day comment period. Comments received from members may be incorporated into the proposed resolution by the Resolutions Committee, after which the revised resolution shall be resubmitted to Council. After final review and approval by Council, the draft resolution will be posted on the Association's website for a vote by the membership. Association membership shall have final approval of resolutions. Voting on resolutions by the Association members can be performed remotely by electronic means or in person during Annual Business Meetings of the Association. Electronic voting on proposed resolutions will be open for a period of at least 30 days. A quorum of 100 Association members is necessary for a vote, and a majority of those voting members is required for final approval of a proposed resolution. Voting will not be terminated prematurely when a quorum is achieved but will remain available for the entire 30-day period. If a quorum is not met at the end of the 30-day period, the voting period may be extended up to an additional 30 days.

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Q. Science and Technology Committee: This committee is responsible for informing and educating the Association regarding interdisciplinary problems in the areas of systems analysis and technology utilization, as well as aeromedical, biomedical, and human factor requirements.

R. Scientific Program Committee: The Scientific Program Committee is responsible for the development and execution of the scientific program for each year's Annual Scientific Meeting. The Chair, with the help of committee members, arranges for abstract submission and review, scheduling of scientific sessions, and presentation of the scientific program.

SECTION 4. Special Committees.

The Council or the President may create special committees as may be deemed necessary with such membership and for such a period of time as may be considered appropriate. The Council or the President shall establish and define the functions of such committees.

ARTICLE XIII. MEETINGS

SECTION 1. Required Meetings.

Required meetings may be conducted in one of the following formats (1) in-person only, (2) combined in-person and virtually, or (3) virtual only.

A. The Association shall conduct at least one Annual Business Meeting which shall be open to the general membership and devoted to the reception of annual reports, the nomination and election of officers, consideration of amendments to the Bylaws, consideration of resolutions, and any other such business as decided by the Council.

B. The Association shall conduct at least one scientific meeting each year.

SECTION 2. Time and Place of Meetings.

The Annual Scientific Meeting shall be conducted at a time and place, and in a format selected by the Executive Committee. Meetings shall be held as provided for in these Bylaws. In cases of emergency, the Council shall have the authority to cancel, postpone, or change the site or format of an annual meeting, or a special Association meeting may be authorized or called by the Council.

SECTION 3. Quorum.

The Annual Business Meeting shall require a minimum of one hundred (100) active members to constitute a quorum.

SECTION 4. Parliamentary Authority.

The current edition of Robert's Rules of Order Newly Revised shall cover the procedure at all meetings unless otherwise provided by these Bylaws. Unless provided otherwise by Robert's Rules of Order Newly Revised or by these Bylaws, all elections and questions shall be decided by a majority of votes cast.

SECTION 5. Parliamentarian.

The duties of the Parliamentarian will be as specified in the Parliamentary Authority, with the intent to help ensure the orderly progress of meetings and the fair and equitable treatment of all participants.

ARTICLE XIV. DUES AND SUBSCRIPTIONS

SECTION 1. Annual Dues.

A. Annual dues for all classes of membership shall be set by the Council with the proposed change becoming effective no sooner than 60 days following advance notice published in the journal of the Association, during which time members may register their comments with the Executive Director of the Association and such comments shall be given due consideration by the Council.

B. Membership dues are payable on the last day of the month in which the applicant is selected for membership and annually thereafter.

C. Annual dues shall include subscriptions to the official scientific journal of the Association and to such other records, reports, proceedings, and publications as authorized by the Council except where otherwise provided.

D. The Executive Committee may authorize suspension of dues or subscriptions on the part of any member.

SECTION 2. Exemption from Dues.

A. Honorary Member: Honorary Members shall be exempt from the payment of dues.

B. Life Member: Following payment of the appropriate fee, the Life Member shall thereafter be exempted from the payment of annual dues.

SECTION 3. Active Member.

An active member (a member in good standing) is one who is qualified for membership and is current in the payment of dues. Active members are entitled to all the rights and privileges of membership including voting and holding office.

SECTION 4. Delinquency.

A member is delinquent if Association dues are not paid within 60 days of the due date. If dues are not paid within 30 days after notification of delinquency, the member shall be removed from the active membership role of the Association for nonpayment of dues.

SECTION 5. Reinstatement.

Any member dropped for nonpayment of dues may be reinstated to member-in-good-standing status on payment of dues for the current year in advance.

ARTICLE XV. FUNDING AND FINANCES

SECTION 1. Funding.

Funds may be raised (a) by dues; (b) by assessments on active members on recommendation of the Council and after approval by the membership; (c) from the publications of the Association at a rate established by the Council; and (d) in any other manner approved by the Council. Funds may be appropriated by the Council to defray the expenses of the Association.

SECTION 2. Finances.

A. Fiscal Year: The fiscal year shall begin on January 1 and end on December 31 each year.

B. Insurance: The Executive Director shall procure Directors' and Officers' Liability Insurance in an amount determined by the Council, the cost to be paid by the Association. The Executive Director, Treasurer, and other persons approved by Council may sign checks.

C. Budget: The Council, at its fall meeting, shall adopt an income and expense budget covering all activities for the next fiscal year. No officer may make or authorize any unbudgeted expenditure without approval of the Executive Committee or the Executive Director. The Executive Director shall not make or authorize any unbudgeted expenditure exceeding the amount stipulated by the Policy and Procedures Manual without approval of the Executive Committee.

D. Audit: An audit shall be made by a certified public accountant at a frequency and time described in the Policy and Procedures Manual. The audit shall be submitted to the Executive Committee at its meeting prior to the Annual Scientific Meeting of the Association. The report of the audit shall be made available to the membership at the Annual Business Meeting of the Association.

ARTICLE XVI. AMENDMENTS.

The Bylaws of the Association may be amended at any Annual Business Meeting of the Association by two-thirds vote of active members present at such meeting. Association Bylaws amendment proposals may be submitted by any member of Council or a petition of at least 2% of the active membership of the Association. Proposed amendments must be communicated to the Association Headquarters by the end of December and approved by two-thirds vote of the Council members for consideration at the Annual Business Meeting. The membership must be notified of the proposed amendments no less than 60 days prior to the Annual Business Meeting. The Policy and Procedures Manual will describe the process for review, modification, and presentation of amendment proposals for the membership vote on each amendment at the annual meeting.

ARTICLE XVII. DISTRIBUTION OF ASSETS UPON DISSOLUTION.

In the event that the Association shall be dissolved, its assets at the time of dissolution shall be distributed to one or more organizations exempt from Federal Income Tax in accordance with Section 501(c)(3) of the Internal Revenue Code of 1954 or subsequent provisions to be used for purposes identical or similar to those of the Association.

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Silberman Installed as AsMA President; Wagstaff Is President-Elect

Warren Silberman, D.O., MPH, was installed as President of AsMA during the Annual Business Meeting, held June 3, 2025, at the Hyatt Regency Atlanta, Atlanta, GA, United States. He is currently performing aviation medical examinations and consultations. He spent 2 years as the Manager of the Occupational Health Clinic at the FAA's Civil Aerospace Medical Institute. Prior to that he was working in retirement for 5 years as an AME and Consultant. From June 1997 until January 2012, he was the Manager of Aerospace Medical Certification for the FAA. During the same time, he was the Oklahoma State Air Surgeon responsible for the Air National Guard healthcare. He is a past president of the Aerospace Medicine Division of the American Osteopathic College of Occupational and Preventive Medicine and the past Chair of the Fellows Group of the Aerospace Medical Association (AsMA) and a past Vice President of Education and Research. He is a Fellow of AsMA. His awards and honors include the U.S. Army Order of Aeromedical Merit; CAMI Employee of the Year; the Audie and Bernice Davis Award presented by CAMI; the Theodore Lyster, Boothby-Edwards, and Tamisiea Awards from AsMA; Office of Aerospace Medicine Flight Surgeon of the Year (twice); President's Commendation from CAMI for outstanding medical certification of airline pilots; and the Legion of Merit, awarded by U.S. Army Surgeon General Ronald Blanck for service at Raymond W. Bliss Army Community Hospital. A more comprehensive biography can be found in the August 2024 issue of *Aerospace Medicine and Human Performance* [AMHP 2024; 94(8):646] or in the August 2024 newsletter.



Anthony Wagstaff, M.B.Ch.B., D.Av.Med., was chosen as President-Elect of AsMA during the Annual Business Meeting on June 3, 2025. He will be installed as President next year. He has worked in aerospace medicine since 1991. He started his career in 1985 when he earned LRCPI, LRCSI, M.B.Ch.B., and a BAO from the Royal College of Surgeons in Ireland. He was awarded a Diploma in Aviation Medicine from the Royal College of Physicians, London, United Kingdom, in 1997 and then graduated from the University of Oslo in 2001 with a Dr. Med. (Ph.D.). In 2005, he earned an Executive Master of Business Administration from ESCP/EAP, Paris, France. During this time, from 1985–1992, he was an Occupational Health Physician at the government ministries in Oslo, Norway, and then a Ph.D. student and physician at the Institute of Aviation Medicine in Oslo until 1996. Following that, he took a position as Assistant Director at the Institute of Aviation Medicine until 2005, when he became a Physician for the National Institute for Occupational Health, also in Oslo. A year later, he became the Director of the Institute of Aviation Medicine. In 2019, he took his current position as Principal Advisor of Aerospace Medicine for the Norwegian Armed Forces.



Additionally, from 2013–2018, Dr. Wagstaff was an Associate Professor at the Institute of Health and Science at the University of Oslo. He was promoted to Adjunct Professor in Occupational and Aviation Medicine in 2018 and still holds that position. He is a Fellow and Executive Committee member of the Aerospace Medical Association, was a Board member of the Norwegian Society of Aviation Medicine, a Past President of the European Society of Aerospace Medicine, Director and Chancellor of the International Academy of Aviation and Space Medicine, was Chair of the Norwegian Board of Specialist Training in Occupational Medicine, and is a Board member of the Aerospace Medical Association Foundation. He was Patterson Trust lecturer at the 2017 Australasian Conference of Aerospace Medicine and received the U.S. Army award for best article in helicopter aviation medicine as a co-author.

Dr. Wagstaff has primarily supported the Norwegian Air Force but has also been active as a civilian AME in Norway and for EASA. He has a wide range of research activities spanning noise and vibration, hypoxia, ergonomics and preventive medicine to human factors and fatigue. He enjoys interdisciplinary work, as cross-learning between specialists often lead to new understanding. His major contributions in Norwegian Aerospace Medicine have been: 1) integration of occupational health principles with Aviation medicine and human performance activities, using research as the reference point along the way; and 2) trying to create a better trust relationship between pilot/aircrew and AME ("pilot-in-the loop") and emphasizing risk assessment in order to better use the pilot´s own perceptions and evaluations regarding his/her health in relation to flying. He has been active in aerospace medicine organizations both within Europe and internationally for many years, and has actively participated in collaborations between the different organizations.

Other elected officials are: **Vice Presidents** Eilis Boudreau, M.D., Ph.D., and Ian Mollan, M.B.Ch.B., M.Sc., **Secretary:** Amanda Lippert, MS, MSEd, and **Members-at-Large** Jaime Harvey, BS, MS, Roger Hesselbrock, M.D., W. Brent Klein, M.D., MPH&TM, and Winton Laslie, M.D., MPH.

The Need For SPEED
Farther, faster, together.

The AsMA Foundation is working to empower the next generation of Aerospace Medicine scientists. To achieve this objective, they have set a goal in "The Need for Speed" campaign of $5 million by AsMA's 100th Anniversary! Donations can be made through the AsMAFoundation.org website.

Support the Foundation!

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AEROSPACE MEDICAL ASSOCIATION HONORS NIGHT AWARDS
Hyatt Regency Atlanta, Atlanta, GA, June 5, 2025

Dr. Robert Orford, President of the Aerospace Medical Association, presented 20 awards to outstanding members during the Honors Night ceremonies at the 95th Annual AsMA Scientific Meeting, June 5, 2025, at the Hyatt Regency Atlanta, Atlanta, GA. Eric Olins, M.D., Chair of the Awards Committee, read the citations. The names of the awards' sponsors and representatives, when present, are printed in parentheses.

The Stapp award was not presented this year. The Goldenrath, Hastings, and Tuttle Awards were presented, but the honorees were unable to be there. The Longacre Award was presented posthumously; however, the family was also unable to attend.



Robert Orford, 2024–2025 AsMA President

All photos by Pamela C. Day. A photo gallery is available at: https://aeromed.smugmug.com/Meetings/.



2025 Louis H. Bauer Founder's Award
George K. Anderson, M.D., MPH
(Jan Stepanek, Mayo Clinic)



2025 John C. Adams Award
William B. Klein, M.D., MPH&TM, MBA
(Daniel Monlux, Society of U.S. Naval Flight Surgeons)



2025 Boothby-Edwards Award
Clayton Cowl, M.D., MS
(Mike Berry, Harvey Watt & Co.)



2025 David M. Clark Award
KBR
(Daren Chauvin accepting for KBR)

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2025 John Ernsting Award
Robin Griffiths, M.B.Ch.B.(Hons.), FFOM, FACOEM
(Bob Laurent, ETC)



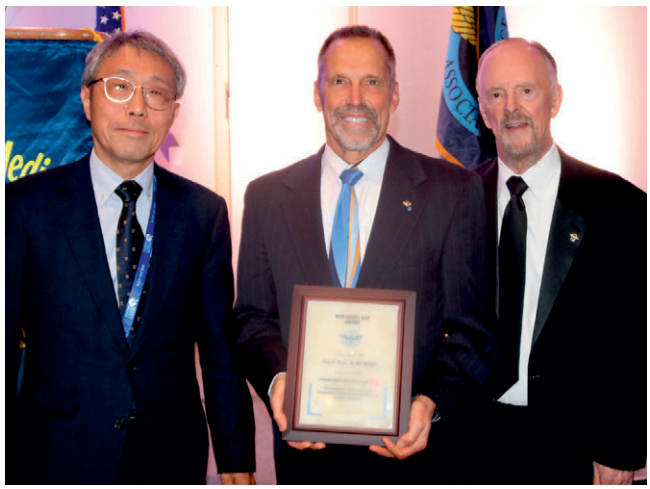
2025 Kent K. Gillingham Award
Torin K. Clark, Ph.D.
(Erich Roedig, AMST)



2025 Walter & Sylvia Goldenrath Award
Peter Hancock, Ph.D., D.Sc., FAsMA
(Dwight Holland accepting; Mark Campbell, AsMA Foundation)



2025 John D. Hastings Award
Herminio Cuervo-Delgado, M.D.
(Greg Pinnell, Civil Aviation Medical Association)



2025 Won Chuel Kay Award
Quay Snyder, M.D., MSPH
(JoungSoon Jang, Korean Aerospace Medical Association)



2025 Joe Kerwin Award
Joseph P. Dervay, M.D., MPH, MMS
(Casey Pruett, KBR)

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2025 Marey T. Klinker Award
David Picken, M.D., MPH, & Robert Mulcahy, M.D., MPH



2025 Sidney D. Leverett, Jr. Environmental Science Award
Nicholas D. C. Green, OBE, MBBS, Ph.D.
(Alper Kus, ETC)



2025 Eric Liljencrantz Award
Joan Saary, M.D., Ph.D.
(Brian Pinkston & Cheryl Lowry, Kinetic Group)



2025 Raymond F. Longacre Award
Charles Chesanow, D.O. (Posthumously)
(Harriet Lester accepting & representing the Aerospace Human Factors Association)



2025 Theodore C. Lyster Award
Amy Kreykes, M.D., MPH, FAsMA
(Eric Johnson, Society of U.S. Army Flight Surgeons)



2025 Marie Marvingt Award
George Pantalos, BSAAE, MSBE, Ph.D., FAIMBE
(Olivier Manen, La Société Francophone de Médecine Aérospatiale)

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2025 Harry G. Moseley Award
Stephen C. Merriman, BS, MS, AsTFBoeing
(Chris Backus, International Association of Military Flight Surgeon Pilots)



2025 John A. Tamisiea Award
Robert J. Gordon, D.O.
(Greg Pinnell, Civil Aviation Medical Association)



2025 Thomas J. & Margaret D. Tredici Award
Tyson J. Brunstetter, MBA, OD, Ph.D., CAsP
(Douglas Ivan, Thomas J. & Margaret D. Tredici Endowed Fund)



2025 Arnold D. Tuttle Award
Ross Pollock, MSc, Ph.D., & Thomas Smith, CF, MBBS
(Joseph Britton accepting; Daren Chauvin, KBR)



2025 Julian E. Ward Award
Samantha King, M.D., MS
(Tracy Bozung, Society of U.S. Air Force Flight Surgeons)



2025 President's Citation 1: Marian Sides received a citation from Dr. Robert Orford, 2024-2025 AsMA President.

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President's Citation 2: Kris Belland also recieved a citation from Dr. Robert Orford, 2024-2025 AsMA President.



Passing the Gavel: Outgoing President Dr. Robert Orford passes the gavel to incoming President Dr. Warren Silberman.



Past President's Pin: Mrs. Orford pins her spouse with the Past President's pin.



Past President's Gift: Incoming President Dr. Warren Silberman presents outgoing President Dr. Robert Orford with a captain's clock as a token of appreciation.



2025 Fellows: Those of the new Fellows who were present at Honors Night are pictured here with Fellows Chair Dr. Dan VanSyoc (far right) anJd 2024-2025 AsMA President Dr. Robert Orford. The names of the new Fellows are: John Allen; Samir Alvi; Serena Auñón-Chancellor; Tamara Averett-Brauer; Matthew Brakora; Tracy Bozung; Michael Gallagher; Norbert Guettler; Roy Hoffman; Karen Klingenberger; Robert Krause; Nathan Maertens; Casey Pruett; Michael Reddix; Robert Sanders; Michael Schmidt; Erin Smith; and Jeffrey Woolford.

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Annual Lectures



Bauer Lecture: Dr. Orford presents Jeffrey R. Davis, the Louis H. Bauer lecturer, with a token of appreciation. The lecure was on "Open Innovation at NASA: Good Ideas Can Come from Anywhere".

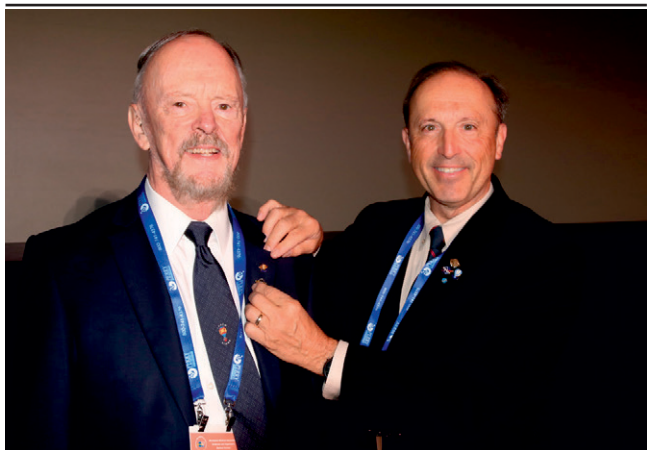


Reinartz Lecture: Dr. Orford presents Mark Sirangelo with a token of appreciation. Dr. Sirangelo gave a presentation on "Commercial Space, Human Spaceflight, the ISS, and the U.S. Return to the Moon".





Armstrong Lecture: This year, the Armstrong lecture was combined with UHMS's Hart lecture and was a panel made up of Joe Dervay, Jon Clark, Mitch Garber, Michael Gernhardt, and Richard Moon. In the bottom photo, they pose with Dr. Orford, AsMA President (right), and Bob Laurent (left), representing the sponsor, ETC. The panel was on "Pressure Perils from Undersea to Outer Space".



50-Year Pin: Dr. Robert Orford, past President, receives a 50-Year pin from Dr. Joe Dervay. Ulf Balldin and David Toth also earned 50-Year pins, but were unable to attend the meeting.

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Scholarship Winners



Mantri Scholarship: Lydia Varghese receives the Anita Mantri, Ph.D., Memorial Scholarship from Dr. Orford. On the left and right are Mrs. and Mr. Mantri.



Scarpa Scholarship: Catherine Mandigma receives the Philip J. Scarpa, M.D., Aerospace Medicine Endowed Scholarship from Dr. Orford and Dr. Scarpa.



AsMA International Scholarship: Lucas King receives the AsMA International Aerospace Medicine Scholarship from Dr. Orford.







Sunday Welcome Reception



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International Reception





Corporate Forum





President's Reception









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RAM Bowl

The RAM Bowl was held Wednesday, June 4.

To the right, Walt Dalitsch, one of the referees; in the photo below, the referees prepare to assist during the RAM Bowl. Below, Al Parmet and Becky Blue get ready; participants gather on the stage; and the winning team, UTMB.

The top scoring participant from each school were: Andrew Lam, UTMB (top scoring resident overall); Michael Emerson, U.S. Army; Will Roy, U.S. Navy; David Tingle, U.S. Air Force; Wiaam Elkhatib, Mayo Clinic; and Adrian Carpenter, UHMS.

More photos can be found at: https://aeromed.smugmug.com/Meetings/2025-AsMA-UHMS-Meeting-in-Atlanta.

All photos by Pam Day.













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Exhibitors

The exhibit hall was open for the Welcome Reception and during the day on Monday, Tuesday, and Wednesday, June 2–4, 2025. Pictured here are, from below top to bottom: Aeroclenz, Environics, and ETC; to the left, top to bottom: Go2Altitude, KBR, MDOnboard, and UTMB.

More photos are available on AsMA's SmugMug page at: https://aeromed.smugmug.com/Meetings/2025-AsMA-UHMS-Meeting-in-Atlanta.

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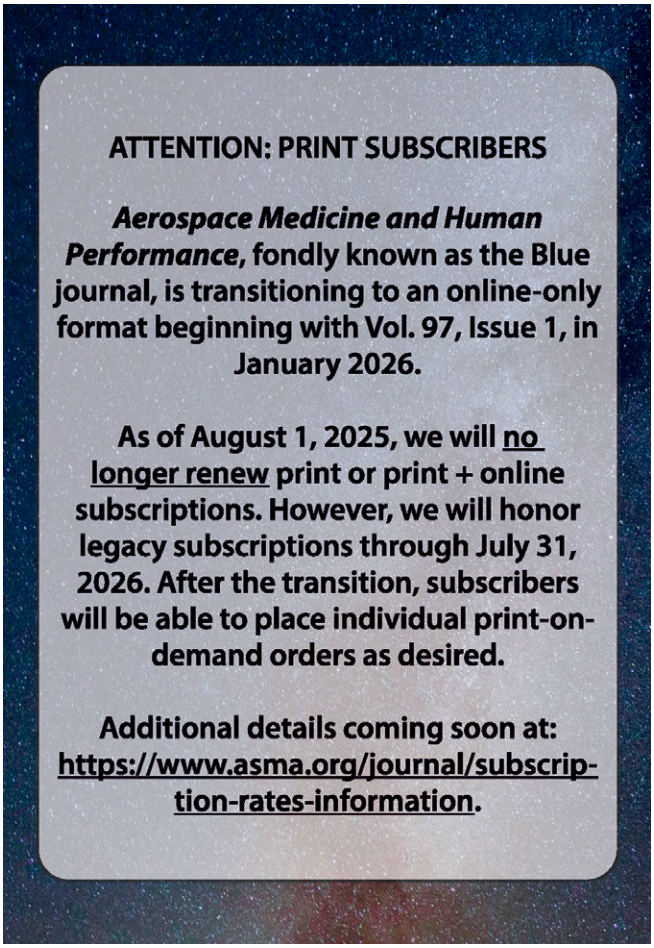








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Aerospace Medicine and Human Performance
INFORMATION FOR AUTHORS
http: //editorialmanager.com/AMHP

August 2025

These notes are provided for the convenience of authors considering preparation of a manuscript. Definitive information appears in the **Instructions For Authors** as published on the journal's website. Submissions that do not substantially conform to those instructions will be returned without review. We conform to the International Committee of Medical Journal Editors (ICMJE) Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals.

JOURNAL MISSION AND SCOPE

Aerospace Medicine and Human Performance is published monthly by the Aerospace Medical Association. The journal publishes original articles that are subject to formal peer review as well as teaching materials for health care professionals. The editor will not ordinarily review for publication work that is under consideration or has been accepted or published by another journal except as an abstract or a brief preprint.

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Case Reports and ***Case Series*** describe interesting or unusual clinical cases or aeromedical events. They should include a short Background to provide perspective, the Presentation of the Case, and Discussion that includes reference to pertinent literature and/or review of similar cases. Such manuscripts should not exceed 3000 words with approximately 12 references.

Short Communications and ***Technical Notes*** describe new techniques or devices or interesting findings that are not suitable for statistical analysis. They should contain the same sections as a Research Article but should not exceed 3000 words with approximately 12 references.

Commentaries are brief essays that set forth opinion or perspective on relevant topics. Such manuscripts may not exceed 1000 words with approximately 10 references without tables or figures.

We also accept ***Historical Notes*** and ***Aerospace Medicine Clinic*** (formerly **You're the Flight Surgeon**) articles.

RULES FOR DETERMINING AUTHORSHIP

Each person designated as an author should have made substantial intellectual contributions as specified in the Instructions for Authors.

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The journal's AI policy can be found at https://www.asma.org/asma/media/AsMA/pdf-journal/AmHP-AI-Journal-Policy.pdf.

ETHICAL USE OF HUMAN SUBJECTS AND ANIMALS

The Aerospace Medical Association requires that authors adhere to specific standards for protection of human subjects and humane care and use of animals. The methods section of a manuscript must explicitly state how these standards were implemented. Details appear as specified in the Instructions for Authors.

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Tables and figures should be used strictly to advance the argument of the paper and to assess its support. Authors should plan their tables and figures to fit either one journal column (8.5 cm), 1.5 columns (12.5 cm), or the full width of the printed page (18 cm). Tables should be assigned consecutive Roman numerals in the order of their first citation in the text. Tables should not ordinarily occupy more than 20% of the space in a journal article. Figures (graphs, photographs and drawings) should be assigned consecutive Arabic numerals in the order of their first citation in the text. Line drawings of equipment are preferable to photographs. All graphics should be black & white: 1200 dpi for line art; 300 dpi for photos; 600 dpi for combination art. They must be sent electronically, preferably as high resolution TIFF or EPS files. See Documents to Download online for further instructions.

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When the paper is ready for publication, the printer places on its web site a PDF file depicting the typeset manuscript. The Corresponding Author will be notified by e-mail and is responsible for correcting any errors and for responding to any "Author Queries" (AQs).

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