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

(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.

[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.*

[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

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.

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

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*

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.

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

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

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.

[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

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

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

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]
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(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

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]
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(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.

[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

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.

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

[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]
[1]*U.S. Air Force Aeromedical Research Lab, 711th Human Performance Wing, Wright-Patterson AFB, OH, United States;* [2]*KBR, Beavercreek, OH, United States*

(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

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*

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]

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(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.

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.

[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.

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

(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.

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
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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.

[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]
[1]*Aegis Aerospace, Houston, TX, United States;* [2]*Leidos, Houston, TX, United States;* [3]*NASA, Houston, TX, United States;* [4]*Jacobs Technology, Houston, TX, United States;* [5]*NASA and KBR, Houston, TX, United States*

(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

(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]
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(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

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(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,

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]
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(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]
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