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

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

Chair: Peter Mapes

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

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

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

[16] AEROSPACE EPIDEMIOLOGY & STATISTICAL ANALYSIS

Peter Mapes
Retired, Oscoda, MI, United States

(Education - Program / Process Review)

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

Learning Objectives
1. Individuals completing this course will be able to: understand the language of epidemiology and how it applied to aviation mishap

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

MONDAY, JUNE 02, 2025

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

[S-4] PANEL: CARDIOVASCULAR SCREENING FOR AIRCREW

Chair: Norbert Guettler
Co-Chair: David Holdsworth

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

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

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

(Education - Tutorial / Review)

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

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

Learning Objectives

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

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

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

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

(Education - Program / Process Review)

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

investigation, including aircrew data on the sensitivity, specificity, and positive and negative predictive values of various modalities of screening for coronary artery disease, will be presented. Although data is limited, mounting evidence can likely change how the world screens for heart disease in aircrew. An international, NATO-supported occupational cardiology working group has recently been established to provide international consensus on screening processes for aircrew.

Learning Objectives

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

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

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

[1]Hôpital de La Tour and Swiss Air Force, Meyrin/Geneva, Switzerland; [2]Oxford University Hospital, Oxford, United Kingdom; [3]French Air Force, Paris, France; [4]Swiss Air Force, Dübendorf, Switzerland; [5]Dutch Air Force, Utrecht, Netherlands; [6]U.S. Air Force, Dayton, OH, United States; [7]Canadian Air Force, Toronto, Canada; [8]German Air Force, Cologne, Germany

(Education - Tutorial / Review)

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

Learning Objectives

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

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

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

[1]Aeromedical Centre Swiss Air Force, Duebendorf, Switzerland; [2]German Air Force, Cologne, Germany; [3]Academic Centre of Military Medicine, Birmingham, United Kingdom; [4]Central Military Hospital, Utrecht, Netherlands; [5]French Military Health Service Academy - Percy Aeromedical Centre, Clamart, France; [6]Calian Contractor//Medical Consultant, CFEME/ Medical Services, Ottawa, Canada; [7]USAFSAM, Wright-Patterson AFB, OH, United States

(Original Research)

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

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

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

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

[1]British Army, Birmingham, West Midlands, United Kingdom; [2]Swiss Air Force, Luzerne, Switzerland; [3]University Medical Centre Utrecht, Netherlands; [4]Percy Army Training Hospital, Clamart, France; [5]Fliegerärztliches Institut der Armee, Zurich, Switzerland; [6]Royal Canadian Air Force, Toronto, Canada; [7]U.S. Air Force, Dayton, OH, United States; [8]German Air Force Centre of Aerospace Medicine, Cologne, Germany

(Education - Tutorial / Review)

INTRODUCTION: Cardiovascular conditions can lead to sudden incapacitation of aircrew, with potentially fatal consequences. There is a variety of approaches to applicant screening across different jurisdictions globally. Within the NATO screening panel this presentation will review the prognostic and diagnostic potential of clinical exercise testing for aircrew. **TOPIC:** The use of exercise ECG as an initial test to rule in/rule out flow-limiting

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

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

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

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

Chair: Leonard Temme

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

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

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

Leonard Temme

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

(Education - Tutorial / Review)

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

Learning Objectives

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

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

Erica Poole[1], Jeff Rabin[2]

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

(Original Research)

INTRODUCTION: Over the past two decades, intrinsically photosensitive retinal ganglion cells (ipRGCs) have been identified as the fifth type of human photoreceptor. Although not yet fully understood, ipRGCs are

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

Learning Objectives

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

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

Toan Trinh

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

(Original Research)

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

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

Learning Objectives

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

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

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

(Original Research)

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

Learning Objectives

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

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

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

(Education - Tutorial / Review)

INTRODUCTION: Properly regulated wake/sleep cycles, governed by intrinsic and extrinsic processes, are imperative for homeostasis. Intrinsically, the retinohypothalamic tract (RHT), connecting intrinsically

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

Learning Objectives

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

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

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

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

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

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

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

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

(Education - Program / Process Review)

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

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

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

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

(Education - Program / Process Review)

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

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

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

Craig Nowadly[1], Khaled Shennara[1], Lyle Babcock[1], Dennis Lovett[1], Hayley Brawley[1], Phyllis Friello[2], Justin Yang[3], Moriah Thompson[4], Rahul Suresh[4], Tina Bayuse[5], Sincy Mathew[6]
[1]U.S. Air Force, San Antonio, TX, United States; [2]Leidos, Houston, TX, United States; [3]Aegis Aerospace, Houston, TX, United States; [4]NASA, Houston, TX, United States; [5]KBR, Houston, TX, United States; [6]JES Tech, Houston, TX, United States

(Original Research)

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

Learning Objectives

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

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

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

[1]NASA, Houston, TX, United States; [2]Universities Space Research Association, Cleveland, OH, United States; [3]Aegis Aerospace, Houston, TX, United States; [4]NASA, Cleveland, OH, United States; [5]Voyager Space, Middleburg, OH, United States

(Education - Tutorial / Review)

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

Learning Objectives

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

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

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

[1]Universities Space Research Association, Cleveland, OH, United States; [2]ZIN Technologies, Cleveland, OH, United States; [3]NASA, Cleveland, OH, United States

(Original Research)

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

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

Learning Objectives

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

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

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

Chair: Douglas Boyd
Co-Chair: Frederick Bonato

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

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

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

(Education - Tutorial / Review)

INTRODUCTION: In an academic setting, published research represents one of the benchmarks commonly used for peer recognition and career advancement. However, bringing a research project to fruition (i.e. a published manuscript) represents a complex multi-step process. While researchers schooled in this sphere receive training in this respect, this is less

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

Learning Objectives

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

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

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

(Education - Tutorial / Review)

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

Learning Objectives

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

[34] AEROSPACE MEDICINE STATISTICS

Frederick Bonato
Manhattan University, Bronx, NY, United States

(Education - Tutorial / Review)

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

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

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

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

Frederick Bonato
Manhattan University, Bronx, NY, United States

(Education - Tutorial / Review)

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

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

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

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

(Education - Tutorial / Review)

INTRODUCTION: In academia, peer-reviewed published papers represent one of the benchmarks used for peer recognition/career advancement. After submission, a research manuscript is subjected to at least one round of reviews by subject matter experts/reviewers/referees and rarely accepted "as is." **TOPIC:** In this presentation, the author, (a reviewer for over 30 journals in as many years), will discuss the various elements that reviewers scan for and how best to deal with referee critiques. **APPLICATION:** A manuscript

Introduction should be concise, state the gap in knowledge and the research question posed. Too often, Introductions read like a graduate thesis and/or contain irrelevant material (red herrings). In the Results, how consistent are the data with each other? For example, if data from 200 and 230 subjects were presented in two separate tables/graphs, the discrepancy warrants explanation. In the Discussion, were the conclusions drawn by the author(s) supported by the data? Did this section represent a regurgitation of the Results - suggesting a poorly read author out of touch with the literature? Also in the Discussion, did the author address how the new research fits in with the bigger picture and importantly other work? Were the limitations of the research clearly stated? Commonly, authors are invited to revise/resubmit a manuscript after addressing a reviewer's concerns. Shortcomings highlighted by the referee should be addressed via new data acquisition/analysis/ experiments. Finally, responding to the reviewer in a non-confrontational manner will improve one's chances of final acceptance.

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

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

[S-8] SLIDE : AEROSPACE MEDICINE POTPOURRI

Chair: Warren Silberman
Co-Chair: Roy Allen Hoffman

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

Turan Kayagil
NTSB, Washington, DC, United States

(Education - Case Study)

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

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

Learning Objectives

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

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

Michael Rizzo

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

(Education - Case Study)

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

Learning Objectives

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

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

Geir Ingvar Berg

Norwegian Armed Forces, Oslo, Norway

(Education - Case Study)

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

Learning Objectives

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

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

Samantha King[1], Ethan Stephens[1], Rebecca Mendelsohn[1], David Alexander[2]

[1]UTMB, Galveston, TX, United States; [2]NASA, Houston, TX, United States

(Original Research)

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

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

Learning Objectives

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

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

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

[1]KBR Inc, Houston, TX, United States; [2]University of Texas Southwestern Medical Center, Dallas, TX, United States; [3]Penn State University, University Park, PA, United States; [4]University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, United States; [5]NASA, Houston, TX, United States; [6]GeoControl Systems, Houston, TX, United States

(Original Research)

INTRODUCTION: Carbon dioxide (CO_2) is a metabolic byproduct produced by humans that must be scrubbed from the atmosphere by environmental control and life support systems in space vehicles and spacesuits to prevent buildup. Current nominal CO_2 limits are set by NASA Standard 3001; however, limits during contingency situations are not specified. The purpose of this study was to characterize and quantify the physiological, cognitive, and self-assessed symptom and performance metrics as a function of inspired CO_2 ($PICO_2$) during a simulated 1-hour contingency lunar EVA scenario in virtual reality (VR). **METHODS:** Fifteen healthy subjects completed seven simulated EVA scenarios walking on a passive treadmill for one hour, breathing dry, ambient air mixed with added CO_2 in a blind, counterbalanced manner ($PICO_2$: 0, 5, 10, 15, 20, 25, 30 mmHg), simulating a 2.0 km contingency EVA walkback to a habitat on the lunar surface in the event of a CO_2 scrubber malfunction. Subjects were immersed in a Lunar VR environment and asked to maintain their walking speed between 2.1 km/h and an upper limit individually calibrated to a fixed metabolic workload of 1.3 L/min of O_2 consumption and performed periodic cognitive tasks and continuous cardiopulmonary measurements. Self-assessments of symptoms and task performance were measured via verbal Likert-scale survey at the onset of the walkback and at 10-minute intervals thereafter. Mixed models were employed to detect effects of CO_2. **RESULTS:** The time course of cardiopulmonary, cognitive, and self-reported responses at each level of $PICO_2$ will be presented. All 15 subjects were able to complete the 1-hr walkback task at all CO_2 levels. Physiological responses were rapid, typically within 1 to 5 min. No effects of time were detected for cognitive measures. Symptomatic ratings of headache, shortness of breath, and fatigue demonstrated a time-course development, reaching asymptote after 40 min of CO_2 exposure. **DISCUSSION:** These findings will inform the posture of risk associated with CO_2 exposure on human health and performance during microgravity and planetary surface operations, which will—in turn—help inform decisions related to space suit and environmental life support hardware requirements and EVA operational limits for contingency extravehicular activity (EVA) scenarios.

Learning Objectives

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

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

Alexander Lee[1], Richard Whittle[2]

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

(Original Research)

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

Learning Objectives

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

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

[S-9] SLIDE : BIOMECHANICS AND PHYSIOLOGY

Chair: Peter Hodkinson
Co-Chair: Robert Slater

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

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

(Original Research)

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

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

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

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

(Original Research)

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

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

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

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

(Original Research)

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

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

Learning Objectives

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

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

Tyler Rooks, Haley French Krahn

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

(Original Research)

INTRODUCTION: Military free-fall (MFF) and tandem tethered bundle (MTTB) operations are used to insert Service Members into combat. There is limited research investigating the biomechanics and health hazard effects of MFF and MTTB operations. Previous research focused on recreational skydiving and military static line injury incidence and associated injuries. The objective of the present study was to quantify the health hazard effects of MTTB operations associated with parachute opening shock exposure. **METHODS:** The study was conducted with experienced free-fall jumpers during prescheduled events. Volunteers completed multiple jump types (solo, tandem-passenger, tandem-equipment, and tandem-bundle) under high-altitude low opening (HALO) and high opening (HAHO) profiles. Prior to each jump, participants were instrumented with seven inertial measurement units (IMUs) to record jump severity and opening kinematics. At the start of the event, volunteers completed a survey and baseline physiological assessments, including neck range of motion (ROM), shoulder ROM, and neck strength. Assessments were repeated at the end of each day. **RESULTS:** Data were collected from 26 subjects conducting a total of 176 instrumented jumps. Subjects jumped an average of 6.7 (±4.4) times with a range of 1 to 17 jumps per subject. Jump types included tandem-bundle (n=115), tandem-equipment (n=8), tandem-passenger (n=31), and solo (n=22) jumps. Canopy types included standard military free-fall (n=8), military tandem parachutes (n=50), and next-generation tandem parachutes (n=118). Jump profiles included HALO (n=137) and HAHO (n=39) jumps. Significant reductions were also found in neck strength

and neck ROM from baseline to the end of the event period (approximately one week). Significant reductions in neck strength and neck ROM were observed on days with high jump severity (i.e., hard openings). High jump severity was defined as the upper 75th percentile of all openings as measured by the IMUs (peak acceleration) or self-reported opening shock severity. **DISCUSSION:** Data collected in the present study are a first step toward understanding the effects of parachute opening shock during MTTB operations. While reduced neck strength or neck ROM may not necessarily be associated with injury, repeated exposures without recovery time may develop into chronic damage or injury.

Learning Objectives

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

[47] PROGRESSIVE LENS USE IN HIGH PERFORMANCE AIRCRAFT

Bonnie Posselt, Guy Hunter, Malcolm Woodcock, Alaistair Bushby, Scott McClellan, Nicholas Green

RAF Centre of Aerospace Medicine, Henlow, United Kingdom

(Education - Program / Process Review)

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

Learning Objectives

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

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

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

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

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

(Original Research)

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

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

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

[S-10] SLIDE : AEROMEDICAL CAPABILITY AND PERFORMANCE

Chair: Carol Ramsey
Co-Chair: Leanne Baggott

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

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

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

(Education - Program / Process Review)

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

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

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

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

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

(Original Research)

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

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

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

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

Audrey Savini[1], Jose Eliezio Rodrigues de Aguiar[1], Vania Elizabeth Ramos Melhado[1], Augusto Duro Froner Dalazen[2], Helton Rubem Campos Dourado[4], Anna Clara Cybele Heliodora Coelho Cunha[1], Leonardo Eduardo Martins Santos[1]
[1]Azul Linhas Aéreas Brasileiras, São Paulo, Brazil; [2]Azul Linhas Aéreas Brasileiras, Porto Alegre, Brazil; [4]Azul Linhas Aéreas Brasileiras, Recife, Brazil

(Education - Program / Process Review)

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

Additionally, while established peer support program models serve as a foundation, they must be adapted to reflect local cultural nuances.

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

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

Jemma Austin[1], Camille Bilger[2], Erica Jackson[3], Bonnie Posselt[3], Peter Hodkinson[1]
[1]King's College London Department of Aerospace Medicine, London, United Kingdom; [2]Martin-Baker Aircraft LTD, Upper Denham, United Kingdom; [3]RAF Centre of Aviation Medicine, Henlow, United Kingdom

(Original Research)

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

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

[53] EMBRACING DIVERSITY FOR THE FUTURE OF HUMAN SPACEFLIGHT

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

(Education - Tutorial / Review)

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

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

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

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

(Education - Program / Process Review)

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

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

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

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

Chair: Willliam Hoffman
Co-Chair: Roger Hesselbrock

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

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

Roger Hesselbrock

FAA, Dayton, OH, United States

(Education - Program / Process Review)

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

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

[56] PARKINSONS DISEASE AND AEROMEDICAL NEUROLOGICAL CONSIDERATIONS

William Hoffman

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

(Education - Program / Process Review)

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

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

[57] AEROMEDICAL EVALUATION OF UNPROVOKED SEIZURES AND EPILEPSY

Eilis Boudreau

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

(Education - Program / Process Review)

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

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

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

Christopher Skinner[1], Joseph Connolly[2]

[1]Ottawa, Canada; [2]No institution, Beavercreek, OH, United States

(Education - Program / Process Review)

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

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

Learning Objectives

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

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

Ronan Murphy
FAA, Oklahoma City, OK, United States

(Education - Program / Process Review)

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

Learning Objectives

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

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

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

Chair: Forest Pavel

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

[60] A BRIEF HISTORY OF AVIATION PSYCHOLOGY

Raymond King
ESi, Dayton, OH, United States

(Education - Program / Process Review)

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

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

Learning Objectives

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

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

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

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

(Education - Program / Process Review)

BACKGROUND: Aviation and aerospace psychology in Europe can trace its roots to the establishment of EAAP in the Netherlands in 1956; the Association will mark it's 70th year anniversary in 2026 (in the Hague, NL). The Association provides a forum for professionals working in the various domains of aviation psychology, human factors and flight safety. It now has more than 600 members from within Europe as well as many others worldwide and is recognised as a leading professional association furthering all branches of psychology, human factors and human performance, in pursuit of improving flight safety. **OVERVIEW:** The objective of EAAP is to promote the study of psychology and the scientific pursuit of applied psychology in the field of aviation. EAAP aims to achieve this objective by: (a) Providing a network for professionals working in aviation psychology; (b) Organising conferences and workshops; (c) Facilitating education and training, and approving suitable courses, and professional recognition in aviation psychology; (d) Publishing a leading peer-reviewed journal with a distinguished international panel of editors, 'Aviation Psychology and Applied Human Factors', and periodical newsletters and information news flashes; (e) Making recommendations for scientific research and for the practical application of aviation psychology; (f) Co-operating and consulting with institutions active in related fields; (g) Giving guidance and support to national and international aviation regulators, bodies, associations and authorities; and (h) being open and receptive to new directions of research and professional endeavour. **DISCUSSION:** EAAP is an example of a professional aviation association which can reflect and promote common themes and interests within aviation psychology, doing

so across international boundaries. The Association considers variances in psychology and human factors registrations between states, and developed a comprehensive list of competencies against which members and prospective members can benchmark their professional development and 'calibrate' their membership grade. Recently, EAAP has been at the forefront of developing practice and standards for mental health professionals working within aviation psychology. We attribute some of the vibrancy and success of EAAP to it representing all relevant branches of psychology, human factors and flight safety, as well as promoting specialist sub-groups within our membership.

Learning Objectives

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

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

Ryan Green

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

(Education - Program / Process Review)

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

Learning Objectives

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

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

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

(Education - Program / Process Review)

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

Learning Objectives

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

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

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

(Education - Program / Process Review)

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

Learning Objectives

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

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

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

(Education - Program / Process Review)

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

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

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

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

[S-13] SLIDE : TOOLED FOR SPACE MEDICINE

Chair: Kris Lehnhardt
Co-Chair: Zach Campbell

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

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

(Original Research)

INTRODUCTION: This project outlines the enhancement of 3D printed surgical tools tailored for operations in the demanding conditions of space environments. Utilizing Finite Element Analysis (FEA) and opti-

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

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

[67] PROCESSING SURGICAL FLUIDS IN REDUCED GRAVITY

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

(Original Research)

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

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

Learning Objectives

1. Understand that in exploration spaceflight, conserving supplies and materials can include the recovery and processing of surgical waste fluids that can be processed into useful fluids rather than discarded with other waste material.

2. Taking advantage of the observation that surface tension is a dominant force for fluids in reduced and microgravity, fluid and air can be separated from each other using an array of flowstream vanes to maximize the effect of surface tension to attach fluid to the vanes separating it from air.

3. Physical selective porous filtering can be used to remove debris from recovered surgical waste fluids and resin adsorbent filtering can be used to remove undesired biochemicals from recovered surgical waste fluids to be sent to the Water Recovery System to produce potable water for crew use.

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

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

(Original Research)

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

Learning Objectives

1. The participant will better understand the challenges of telemedicine triage and remote diagnosis in remote, austere, bandwidth-constrained aerospace environments.

2. The participant will gain familiarity with a proposed video compression algorithm designed to improve bandwidth efficiency in support of telemedicine for remote and austere environments including space.

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

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

(Original Research)

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

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

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

Shankar Subramanian

Indian Air Force, Shillong, India

(Original Research)

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

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

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

David Rubin[1], Travis Houser[1], Neal Zapp[2]

[1]KBR, Houston, TX, United States; [2]NASA, Houston, TX, United States

(Education - Program / Process Review)

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

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

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

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

Chair: Philippe Stewart

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

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

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

(Education - Program / Process Review)

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

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

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

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

(Education - Program / Process Review)

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

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

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[74] WITHDRAWN

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

Philippe Stewart
RCAF, Ottawa, Ontario, Canada

(Education - Program / Process Review)

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

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

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[76] WITHDRAWN

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

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

Chair: Alejandro Garbino
Co-Chair: Ian Curry

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

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

(Original Research)

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

Learning Objectives

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

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

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(Original Research)

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

Learning Objectives

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

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

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

(Education - Case Study)

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

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

Learning Objectives

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

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

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

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(Original Research)

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

Learning Objectives

1. Understand the strengths and weaknesses of various screening modalities for coronary artery disease in aircrew.

2. Appreciate the differences in how 7 different countries screen for coronary artery disease.
3. Learn a path forward for an international, evidence based, approach to screening for coronary artery disease in asymptomatic aircrew.

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

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

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

(Original Research)

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

Learning Objectives

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

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

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

[1]International Social Security Association, Hamburg, Germany; [2]German Social Accident Insurance Institution for Commercial Transport, Postal Logistics and Telecommunication (BG Verkehr), Hamburg, Germany

(Original Research)

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

Learning Objectives

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

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

[S-16] SLIDE : G- FACTORS

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

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

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(Original Research)

INTRODUCTION: The Anti-G Straining Maneuver (AGSM) is crucial for fighter aircrew to prevent G-induced loss of consciousness. While foot pedal force measurement has been traditionally used to assess AGSM during centrifuge training, it may not accurately reflect all muscle groups involved. Surface electromyography (EMG) offers a potential alternative, but no studies have compared EMG to foot pedal force during routine centrifuge training. This study aimed to evaluate EMG as an alternative to foot pedal force measurement for assessing AGSM. **METHODS:** A retrospective observational study was conducted on 19 male aircrew trainees undergoing centrifuge training in April-May 2021. Subjects completed four training sessions over 4-5 weeks. EMG activity was recorded from four muscle groups: left medial gastrocnemius (MG), left biceps femoris (BF), right vastus medialis (VM), and right rectus abdominis (RA). Foot pedal force

was also measured. Five gradual onset runs (GOR, 0.1 +Gz/s) and four rapid onset runs (ROR, 6 +Gz/s) were analyzed. Pearson correlation and ANOVA were used for statistical analysis. The study was exempted from review by the DSO-SAF Institutional Review Board. **RESULTS:** In the GOR profile at peak Gz with AGSM and anti-G suit, positive correlations were found between left pedal force and VM (r=0.557, P=0.013), and between right pedal force and MG (r=0.54, P=0.017). RA tensing duration was significantly shorter than right pedal tensing (28.98±17.27s vs 46.36±17.92s, P=0.043). ROR profiles consistently showed positive correlation between right pedal force and VM (r=0.463, P=0.046). RA activity was significantly lower than other muscle groups before (P<0.005) and during (P=0.017) Gz acceleration in the ROR +8Gz profile. **DISCUSSION:** EMG provides more detailed information on individual muscle activity during AGSM compared to foot pedal force measurement. The lower RA activity observed suggests potential areas for improvement in AGSM technique. EMG appears to be a viable alternative to foot pedal force measurement in routine centrifuge training, offering real-time and post-session analysis of multiple muscle groups to better achieve the objective of improving G tolerance and endurance.

Learning Objectives

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

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

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

(Original Research)

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

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

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

[85] WITHDRAWN

[86] WITHDRAWN

[87] WITHDRAWN

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

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

(Original Research)

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

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

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

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

Chair: Floyd Manley

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

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

Rachael Martinez
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(Original Research)

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

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

Learning Objectives

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

[90] BURNOUT PROFILES AMONG INTELLIGENCE PERSONNEL

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

(Original Research)

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

Learning Objectives

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

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

Kinsey Bryant-Lees
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(Original Research)

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

Learning Objectives

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

[92] MORAL INJURY

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

(Original Research)

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

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
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(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
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