

### [364] PSYCHOLOGICAL COUNTERMEASURES FOR SPACE TOURISM: TOWARDS COMMERCIAL SPACE TRAVEL TRANSLATION

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#### (EDUCATION - PROCESS)

**PROBLEM STATEMENT:** Commercial space flight is in the initial stages of development and marketing to the general public. Guidance and research on commercial space flight is evolving, but at present, the FAA requires that "An operator must inform each space flight participant in writing about the risk of the launch and reentry, including the safety record of the launch or reentry vehicle type" (FAA 14 CFR Part 460, Subpart B. § 460.45). From centrifuge research studies simulating spaceflight, "Space doctors are finding that the most significant barrier to flying ordinary people may not be their physical ailments but something that is much less understood: anxiety." This spaceflight-associated anxiety could be mitigated by mid-level providers trained in operational risks associated with commercial spaceflight. **TOPIC:** An appropriate expectation of space tourism will be risk assessment and individualized mitigation of anticipated psychological/physiological events during their space travel. A space travel case management team would be comprised of registered nurses, a mid-level medical provider (Advance Practice Nurse/Physician Assistant) knowledgeable in the traveler's medical/psychological condition. The scope of care: 1. Review medical records and perform initial assessments; 2. Coordinate evaluations; 3. Provide coaching for the evaluation experience (example: centrifuge) and flight experience; 4. Monitor for changes in medical/psychological status prior to flight; and 5. Follow up post-flight. Success of space tourism will depend on travelers' positive reports of the experience; the likelihood of a positive subjective experience can be improved with care from providers specially trained to coach spaceflight participants through the psychological challenges of spaceflight. Mid-level providers are ideal for this role because of their training's emphasis on interviewing, counseling, and education as well as facilitating the individual patient's experience.

**APPLICATIONS:** Propose that a Commercial Space Travel Medical Certification be developed and offered at AsMA Annual Scientific Meeting to train registered nurses and mid-level providers to the appropriate level of operational knowledge based on the exposures and risks of commercial space operations and travel. **RESOURCE:** Literature review of NASA Data Base and Center of Excellence Commercial Space Travel (COE CST).

#### Learning Objectives:

1. Develop an understanding of current medical/psychological standards for CST.
2. Know what current psychological/physiological screening tools for CST are ready for translation from NASA and analog space research.
3. Understand the current research on CST for the general public.

**Wednesday, May 09**

**4:00 PM**

**Chantilly East**

### S-075: PANEL: THE 10TH ANNUAL RAM BOWL

*Sponsored by American Society of Aerospace Medicine Specialists*

**Chair: Rebecca Blue**  
Fayetteville, NY

**Chair: A. Parmet**  
Kansas City, MO

**Chair: Jan Stepanek**  
Scottsdale, AZ

**PANEL OVERVIEW:** The 10th Annual RAM Bowl features residents and teams competing for the Louis H. Bauer Trophy.

### [365] THE 10TH ANNUAL RAM BOWL

A.J. Parmet<sup>4</sup>, J. Stepanek<sup>3</sup>, R. Johnson<sup>2</sup>, R.S. Blue<sup>5</sup>, G.K. Anderson<sup>8</sup>, W.S. Silberman<sup>1</sup>, B. Pinkston<sup>6</sup> and C. Lowry<sup>7</sup>

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#### (EDUCATION - PROCESS)

The 10th Annual RAM Bowl features residents and teams competing for the Louis H. Bauer Trophy. International residents will be able to participate. Aerospace Medicine Residents are required to demonstrate multiple competencies to satisfy the requirements of ACGME and ABPM and serve as specialists in the field. Multiple tools are available for developing appropriate didactic knowledge in aerospace medicine, public health, epidemiology, biostatistics and health care management. Teams complete in a college bowl format that tests aerospace medicine competencies, recall speed, teamwork and individual knowledge. Topics include the specialty aerospace medicine competencies including the flight environment (atmosphere, radiation, vibration, acceleration, and microgravity), clinical aerospace medicine, aircraft and space vehicle systems/operations, accident investigation, historical events, aerospace physiology, human factors, ergonomics, medical standards, federal aviation regulations, passenger transport, restraint and escape, cockpit resource management and Aeromedical transportation. Questions are divided into toss-up questions and bonus questions. Multiple rounds of competition will lead to the selection of this year's victor and awarding of the Louis H. Bauer Trophy, sponsored by the American Society of Aerospace Medicine Specialists.

#### Learning Objectives:

1. Preparation of Residents in Aerospace Medicine for the American Board of Preventive Medicine examination.
2. Review of Aerospace Medicine for attendees seeking maintenance of certification by the American Board of Preventive Medicine.

**THURSDAY, MAY 10, 2018**

**Thursday, May 10**

**8:15 AM**

**Chantilly East**

### 53<sup>rd</sup> ANNUAL HARRY G. ARMSTRONG LECTURE

*John Charles, Ph.D.*

**"From Here to Mares: How the Twins Study and the Year-Long ISS Mission Have Moved Us Closer to the Red Planet"**

**Thursday, May 10**

**10:00 AM**

**Wedgewood**

### S-076: SLIDE: LONG-DURATION SPACEFLIGHT COUNTERMEASURES AND REHABILITATION

**Chair: Mark Campbell**  
Paris, TX

**Chair: Patrick McGinnis**  
Friendswood, TX

**10:00 AM**

### [366] BIOPHOTONICS AS COUNTERMEASURE - FROM PREVENTING ASTRONAUT HEALTH DETERIORATION TO RESOLVING TERRESTRIAL DISEASES

P.A. Souvestre<sup>1</sup>, D.L. Pederson<sup>3</sup> and M. A. dos Santos<sup>2</sup>

<sup>1</sup>NeuroKinetics Health Services, Inc., Vancouver, BC, Canada; <sup>2</sup>Microgravity Centre, PUCRS, Porto Alegre, Brazil; <sup>3</sup>Dragonfly MedTech, Vancouver, BC, Canada

## (EDUCATION - PROCESS)

**MOTIVATION:** Space agencies seek novel ways to ensure astronauts safety, health, wellness, and performance, especially in long-duration spaceflights. 2017 Bellagio Summit identified Space-to-Earth translations of biomedical advances achieved in key healthcare areas. Review of NASA research on biomedical use of biophotonics in Space reports cell growth and physiological mechanisms reflecting homeostasis and tissue regeneration require precise calibration to Earth gravity to optimally perform, such as to achieve injury healing. Their discalibration induces significant astronaut health risks. NASA LED-technology initially engineered to study vegetal development in Space was also found to deliver photobiomodulation within animal and human tissues to restore healing mechanisms. **OVERVIEW:** Biomedical countermeasures in extreme environments can be identified, besides pharmacology and therapeutic equipment, from advances in other modalities also shown worth considering. During spaceflights, astronauts report intractable treatment-resistant minor injuries and wounds healing disorders. Using LEDs as an effective medical therapy have been researched further on Earth by NASA sponsored organizations and others, particularly on cornea, skin, other tissues, cancer, and brain disorders. Mitochondrial function enhancement is a key intracellular resulting mechanism of LED photobiomodulation, which reacts with cytochromes which when activated stimulate tissue growth and regeneration. Mitochondria are generic anatomical constituents of all cells, hence therapeutic effects can be expected anywhere in the body. **SIGNIFICANCE:** Biophotonics are under-used therapeutics to explore. NASA development of early biophotonic LED technology used in Space was positively translated to terrestrial medical therapeutic applications. Capability to treat tissue with LED light raises very promising prospects and multiple applications such as ambulatory care provided in challenging environments where logistics may not accommodate pharmacological nor manual therapies. Foreseeable benefits to NASA, military operations, and civilian populations include faster lower-cost resolution of extended serious burns, crush injuries, non-healing fractures, intractable inflammation, traumatic ischemic wounds, radiation tissue damage, compromised skin grafts, and tissue degeneration. Safe, non-invasive, portable, lightweight, LED technologies rely on a significant fast-paced growing foundational research.

**Learning Objectives:**

1. Attendees will refine their understanding and become able to appraise the rationale underlying indications and contraindications for biophotonic treatment and the options for its use during Spaceflight.
2. Attendees will learn how to identify, mitigate, and monitor adverse environmental interferences shown to present significant risks for astronauts' physiological deconditioning and subsequent health deterioration, using biophotonics/human factors relationship models.
3. Attendees will learn to analyse and appraise the option and steps to investigate and anticipate on the challenges linked to intervening, controlling, and reversing a deteriorating trauma-induced plateaued biomedical physical condition.

**10:15 AM****[367] INSPIRATORY IMPEDANCE AS A COUNTERMEASURE TO SPACEFLIGHT-ASSOCIATED NEURO-OCULAR SYNDROME**

A.E. Sargsyan<sup>2</sup>, B. Macias<sup>2</sup>, K. Garcia<sup>2</sup>, D.T. Kemp<sup>4</sup>, M.B. Stenger<sup>5</sup>, A. Hargens<sup>3</sup>, S.L. Johnston<sup>5</sup>, R. Danielson<sup>1</sup> and D. Ebert<sup>2</sup>

<sup>1</sup>Department of Otolaryngology, Baylor College of Medicine, Houston, TX; <sup>2</sup>KBRwyle, Houston, TX; <sup>3</sup>UCSD Medical Center, San Diego, CA; <sup>4</sup>UCL Ear Institute, London, United Kingdom; <sup>5</sup>NASA Lyndon B. Johnson Space Center, Houston, TX

## (ORIGINAL RESEARCH)

**INTRODUCTION:** Spaceflight Associated Neuro-ocular Syndrome (SANS) is a human spaceflight risk with no proven mitigation strategy. Evidence suggests that saturated filling of the cranio-cervical venous space may alter venous hemodynamics and drainage of the cranio-cervical basin. However, the fact and the degree of such causation for SANS has not been established. In prior spaceflight studies, Mueller maneuver reduced the filling of the internal jugular vein (IJV), especially in combination with thigh cuffs (J Appl Physiol 112: 454–462, 2012). As shown by others, inspiratory resistance also reduces intracranial pressure (ICP), another proposed factor

in SANS development. This study investigated the effects of an impedance threshold device (ITD) (7 cm H<sub>2</sub>O inspiratory resistance) on physiological variables relevant to SANS. **METHODS:** Fifteen test subjects underwent two identical testing sequences: with ITD and with sham ITD (resistive valve removed) in randomized order. Data were acquired in four positions - seated, supine, 6° head-down tilt (HDT), and 15° HDT, and included IJV imaging; pulsed Doppler of several vessels including IJV, carotid artery, middle cerebral artery, and vessels in the orbit; echocardiography, estimated IJV pressure; optic nerve sheath diameter; optical coherence tomography; noninvasive ICP correlates (cochlear and cerebral fluid pressure data and otoacoustic emissions); intraocular pressure; facial soft tissue thickness; and transcutaneous pCO<sub>2</sub>. An electronic questionnaire was used to record tolerability and perceptions of cephalad fluid shift. **RESULTS AND DISCUSSION:** ITD was well tolerated with no test interruptions. Data from the multi-modality testing protocol are presented to confirm the intended effects of ITD compared to placebo, including reduction of the time-integrated exposure to cranio-cervical venous filling in HDT. Analysis of four subjects in 15° HDT with ITD shows 44% average reduction in IJV cross sectional area during inspiration and 19% reduction at end-expiration when compared to respective baselines with sham ITD. We conclude that inspiratory resistance as a countermeasure for the cephalad fluid shift of spaceflight appears promising. A device of this type can readily be tested in flight. Further work on optimization and individualized titration of the intervention is warranted, along with attention to the synergistic effects with other potential countermeasures such as lower body negative pressure and thigh cuffs.

**Learning Objectives:**

1. Understand the supporting evidence and rationale for application of an impedance threshold device (ITD) as a countermeasure for cephalad fluid shift.

**10:30 AM****[368] EXTENDED HUMAN ADAPTATION TO THE CORIOLIS CROSS-COUPLED ILLUSION FOR ARTIFICIAL GRAVITY**

K. Bretl, S. Metcalf and T.K. Clark

University of Colorado at Boulder, Boulder, CO

## (ORIGINAL RESEARCH)

**INTRODUCTION:** Despite advancements in spaceflight technologies, optimized artificial gravity (AG) designs remain incomplete. Short-radius, intermittent centrifugation may reduce the cost associated with full-vehicle AG and provide a more feasible design, but a higher spin rate is required for desired loading. This can elicit the vestibular cross-coupled (CC) illusion, leading to motion sickness. To improve feasibility of future AG systems, we aim to help astronauts become more tolerant of CC illusions. **METHODS:** Previous research evaluated the efficacy of a *personalized training protocol* to acclimate individuals to higher spin rates. Here, spin rate was incrementally modulated such that the CC illusion was always near each subject's threshold. Subjects performed head tilts at given spin rates and reported the presence or absence of the CC illusion. If no illusion was reported, the spin rate was increased by 1 rpm; otherwise it was maintained. This continued for 25-min sessions once per day for 10 days. **RESULTS:** All subjects showed an increase in their CC illusion threshold over time, and this trend of adaptation (quantified by CC illusion threshold) appeared linear. The mean beginning threshold (i.e., spin rate at which no CC illusion was experienced at the beginning of the first session) was 1.75 rpm (range: 1-3 rpm) and the mean ending threshold on the tenth day was 17.8 rpm (range: 4-30 rpm). There was no apparent plateau reached, suggesting that adaptation may continue beyond 10 days. The individual variability seen in adaptation is of particular interest, as it is important to understand if those who adapt slower can achieve higher thresholds given the opportunity to adapt over a longer duration. **DISCUSSION:** The ongoing extended investigation builds on these findings and past protocols, however, current testing has two novel stopping conditions: 1) completing 50 days of training, or 2) reaching a beginning threshold of 25 rpm (sufficiently high for most AG centrifuge designs). We will identify if the adaptation continues linearly or if a threshold plateau is reached, while determining the proportion of subjects capable of adapting to a relatively high spin rate. The acclimation to CC illusions associated with high spin rates will be critical for the feasibility of short-radius centrifugation for future artificial gravity applications, and we aim to further quantify adaptation capabilities with this extended study.

**Learning Objectives:**

1. The attendee will be able to gain further understanding of the capability of humans to adapt to the vestibular cross-coupled illusion associated with the high spin rates required for short-radius, intermittent artificial gravity.

**10:45 AM****[369] A SYSTEMS BASED APPROACH TO DESIGN THE LUNAR EVA EMERGENCY PRESSURISATION (LEEP) SHELTER**R.S. Whittle<sup>1</sup>, P.D. Hodkinson<sup>2</sup> and D. Cullen<sup>1</sup><sup>1</sup>Cranfield University, Cranfield, United Kingdom; <sup>2</sup>RAF Centre of Aviation Medicine, Hitchin, United Kingdom**(ORIGINAL RESEARCH)**

**INTRODUCTION:** The European Space Agency has a vision for a collaborative multi-national village to establish a long-term human settlement on the Moon, building on the legacy established by ISS operations. Medical planning and life support considerations for the Moon Village need to address routine operations, special scenarios (e.g., higher risk activities) and emergencies. Within this planning life support systems will be designed with in-built redundancy and back-up options and, typically, also a safety net of a separate emergency system. The aim of this study was to assess the medical requirements and engineering considerations and to design a potential solution for one such emergency life support system; that required for emergency pressurization in the event of spacesuit failure during Extra-Vehicular Activity (EVA) on the Lunar surface. **METHODS:** The system was designed using a Model-Based Systems Engineering approach. Beginning with the business justification, formal requirements engineering, and an architecture trade-off, behavioral and structural models are created using the systems modelling language, SysML. Each major subsystem was then considered including physiological requirements, environmental control, thermal control, power supply, and structures and mechanisms. The subsystems were then combined into a comprehensive system, and some consideration for recovery methods. **RESULTS:** The proposed Lunar EVA Emergency Pressurization (LEEP) shelter design has mass of 63 kg (weight ~10.5 kg on lunar surface). It would be capable of deployment and pressurization in 60 seconds creating a 5 m<sup>3</sup> volume, sufficient for two astronauts in EVA suits. It would be pressurized to 29.8 kPa with 100% oxygen from compressed gas cylinder (2800 L STP capacity) with subsequent atmospheric recycling at 6 ft<sup>3</sup>/min using rapid cycle amine technology to remove CO<sub>2</sub>. Internal temperature would be controlled between 283-316K using convection heating and/or vapor sublimation. Power is from a 730 Wh battery to support 28W operation for up to 26 hours. Further consideration has been given to system implications for likely medical complications and potential recovery methods. **CONCLUSIONS:** The study as a whole is not intended to be a complete design, merely a concept exploration highlighting many areas for further research and study that would need to be considered before the LEEP could be manufactured and implemented, however it provides a solid baseline for future research.

**Learning Objectives:**

1. The approach to this project highlights the benefits of interdisciplinary working between aerospace medical professionals and engineers to provide operationally focussed solutions. In this case it highlights the potential limitations of one such solution, the associated constraints on what medical management may be possible in such a scenario and, therefore, potential impact on mission planning considerations.

**11:00 AM****[370] REHABILITATION RATES POST LONG-DURATION SPACE-FLIGHT ON THE ISS**M. Foster<sup>2</sup> and K.R. Lehnhardt<sup>1</sup><sup>1</sup>Department of Emergency Medicine, George Washington University, Washington, DC; <sup>2</sup>Department of Physical Medicine and Rehabilitation, McMaster University, Hamilton, ON, Canada**(EDUCATION - PROCESS)**

**MOTIVATION:** Rehabilitation after microgravity exposure will be crucial for future long-duration, long-distance space missions. This review

provides a synthesis of the successes and challenges in post long-duration spaceflight rehabilitation, in particular, the time necessary to regain preflight functional ability. **OVERVIEW:** Multiple academic journal databases were reviewed, along with NASA reports, examining astronaut rehabilitation topics such as aerobic fitness, anaerobic fitness, bone health, neurovestibular health, orthostatic intolerance, and overall function. These sources were evaluated from a preflight, in-flight, and post-flight perspective in order to identify potential high yield areas of future investigation. **SIGNIFICANCE:** Aerobic fitness overall can be maintained with existing on-orbit countermeasures and anaerobic fitness has improved with resistance exercise. Trabecular bone losses however do not fully recover after flight and cortical bone appears to increase in order to compensate. fMRI demonstrates central nervous system changes that occur after microgravity exposure, and adaptive mechanisms and accommodative strategies play a role in neurovestibular rehabilitation. Neurovestibular deficits appear to be most severe immediately after flight, though limited studies have been done during this timeframe. Vestibular dysfunction negatively impacts factors such as blood pressure control, visual tracking, and postural stability, and functional performance was worse for tasks requiring dynamic postural control compared to static postural control. In general, for overall function, baseline status was regained between 10-15 days post-landing with aggressive rehabilitation. However, ongoing deficits up to and beyond 30 days post-landing related to aerobic and anaerobic fitness may indicate that the functional reserve of astronauts is not fully restored. Though the sample size of these studies is small, the increasing number of astronauts on long-duration missions will enable improved analysis, which is an important step in developing improved guidelines/programs for astronaut rehabilitation.

**Learning Objectives:**

1. Identify the time required to regain preflight functional ability after long-duration spaceflight on the ISS.
2. Compare the timeframes required for rehabilitation for separate physiologic systems after long-duration spaceflight on the ISS.

**11:15 AM****[371] SELECTION OF BREATHING GASES FOR EXTRATERRESTRIAL VESSELS AND HABITATS**

J.T. Webb

SARC, LLC, Bandera, TX

**(ORIGINAL RESEARCH)**

**INTRODUCTION:** A two-gas, oxygen:helium atmosphere was extensively studied as a Manned Orbiting Laboratory (MOL) cabin atmosphere in the 1960s. This paper focuses on potential for a 33% oxygen, 33% nitrogen, 33% helium tri-mix atmosphere for extraterrestrial habitats/cabins. **METHODS:** Review of the MOL data indicated breathing high concentrations of helium (55% at 18,000 ft with 44% oxygen) yielded no significant problems, however, the level of oxygen was an atmosphere of increased burning rate according to the newer National Fire Protection Agency (NFPA) directives. Extensive advances in control of breathing gas mixtures over the past half century have allowed consideration of a three-gas breathing mixture not tested in the 1960s. Using data from published decompression sickness literature and use of alveolar gas equations, evaluation of the tri-mix feasibility was accomplished. **RESULTS:** The tri-mix suggested here would not be an atmosphere of increased burning rate (NFPA). The helium concentration, as diluted with nitrogen, would be less than used during the MOL research and unlikely to produce vocalization or thermal conductivity issues detected, but not considered significant at that time. One issue with transportation of large quantities of breathing gases is their physical weight, giving a definite advantage to incorporation of helium at 1/7 the mass of nitrogen. Alveolar gas equations indicate that a cabin/habitat atmosphere corresponding to 18,000 ft on Earth, with 33% oxygen would be equivalent to breathing air at lower than 6,500 ft. **CONCLUSION:** Altitude research chamber data could determine if the tri-mix of oxygen, helium, and nitrogen is feasible as an environmental breathing atmosphere in extraterrestrial environments.

**Learning Objectives:**

1. Understand the need for inclusion of nitrogen, helium, and adequate oxygen in the atmosphere of an extraterrestrial cabin or habitat.



**Thursday, May 10**  
**Senators**

**10:00 AM**

## **S-077: PANEL: HOW TO CONDUCT RESEARCH FOR THE AEROSPACE MEDICINE PRACTITIONER**

*Sponsored by Education Committee*

**Chair: Alex Garbino**  
*Houston, TX*

**Chair: Derek Nusbaum**  
*Houston, TX*

**PANEL OVERVIEW:** Because of the novel environments in which aerospace medicine practitioners operate, questions inevitably arise regarding how best to provide medical care in these environments, as well as how best to manage new physiologic processes that are inevitably discovered as a part of working in these atypical environments. Thus, sound research is necessary in order to inform best practices for providing medical care in these situations. However, these environments can also create unique challenges for the investigator attempting to conduct aerospace medicine research. A thorough understanding of sound research practices is therefore needed in order to carry out aerospace medicine investigations meant to serve as the foundation for evidence-based aerospace medicine practices. This panel is designed to educate those with minimal or no research experience on sound research methodology, in order to empower them to conduct rigorous research into unanswered aerospace medicine questions. This panel consists of a series of lectures discussing how to formulate sound clinical and operational research questions, how to establish a useful research infrastructure, what tools to use to carry out sound scientific methodologies, and how to establish a network of collaborators to ensure a project's success. This panel is meant to empower aerospace medicine practitioners to conduct research in order to enhance the aerospace medicine knowledge base and to ensure sound, data-driven clinical practices for the aerospace medicine community to use.

## **[372] AN OVERVIEW ON HOW TO ORGANIZE A CLINICAL RESEARCH PROJECT**

A. Garbino

*Emergency Medicine, Baylor College of Medicine, Houston, TX*

*(EDUCATION - TUTORIAL)*

**PROBLEM STATEMENT:** Developing and implementing a clinical research project can be a daunting task for the inexperienced researcher. This presentation will provide an overview of the various methods used and resources available for developing and successfully carrying out a clinical research project. **TOPIC:** There are many resources available at most academic institutions that are available to help early career research investigators organize research projects so that they are optimized for success. Most institutions will have a biostatistics department that can help investigators determine what statistical methods would be best used for answering the desired research question. This department can also be engaged early on in the study development process to help shape the Investigator's research question into one that is answerable with a research study. Many academic institutions will have a grants office that can help with the organization of and paperwork associated with submitting a grant proposal, if there is a desire to secure funding by the study team to carry out the project. In addition to helping with funding sources, grant preparation can help with organizing a research project, including working out the details for all of the various logistical challenges that come along with executing the project. Working with other clinician scientists within one's institution can also provide lessons learned on how to organize a research project, as well as how to handle the logistics of its execution. Finally, working with an institution's various ethics boards can help to make sure that an investigator's study design is structured in a sound and ethical way. This includes the Institutional Review Board for issues related to human clinical research and the Animal Care and Use Committee for research utilizing animal data. These boards are often very helpful early on in the process with questions on how to ensure that a study is designed ethically, even before an investigator

plans to submit a protocol for board approval. **APPLICATIONS:** Organizing a clinical question or problem into a research question that can be investigated with a designed study can be a difficult task, especially for the investigator who is new to research. There are, however, many resources available at most academic institutions, as described above, that can assist investigators when attempting to develop and implement a research question.

### **Learning Objectives:**

1. Identify resources available at academic institutions that can help early investigators with the organization and implementation of clinical research projects.

## **[373] WHAT SOFTWARE PACKAGES ARE USEFUL WHEN DOING RESEARCH**

W. Fraser

*Silatyuk Research, Toronto, ON, Canada*

*(EDUCATION - TUTORIAL)*

**PROBLEM STATEMENT:** An investigator has a plethora of software options that can aid in the research process, especially for the analysis and display of data. Choosing which statistical software tool to use can be problematic. This presentation will address some of the features, advantages, and disadvantages of the web based, commercial, and open-source software that is available. **TOPIC:** A number of factors will influence the choice of software including the statistical expertise of the user, financial resources, organizational policies and standards, programming skills, the quantity and complexity of the data and metadata, audit and reproducibility requirements, data security, and educational/ research/career goals. When working with small data sets and/or statistical models involving only a few predictor variables, the growing number of web-based applications provide readily accessible analytical tools. In terms of market share, the commercial SAS product dominates the advanced analytics industry, and is extensively used in large scale clinical trials, especially those involving the evaluation of pharmaceuticals, as it provides specific tools and resources to meet the regulatory requirements of various agencies. The open-source R software environment, with its over 11,000 add-on packages, provides the most comprehensive data analysis and statistical toolset, with both program/script and GUI based interfaces, robust version control, and audit trail capabilities. Calls to specific R analytical routines can be made from Python and other programming code, as well as from commercial software such as SAS. To provide a comprehensive audit trail, R, SAS, and Python commands developed for the analysis process and the generation of graphical and tabular summaries can be embedded within the technical reports and research papers, ensuring the reproducibility of the analysis. **APPLICATIONS:** The choice of software will be dependent on the needs of the investigator and the research environment. The online applications and the R tools are the obvious choices if cost is a significant factor. An expertise in SAS, R, and Python, and how they can be integrated, will provide the greatest flexibility in the research environment, as well as offer more extensive employment options.

### **Learning Objectives:**

1. Identify the criteria to access the appropriateness of on-line, open-source, and commercial software for data analysis.

## **[374] HOW TO AVOID IRB TURBULANCE: A MAP FOR NAVIGATION VFR DIRECT THROUGH HUMAN RESEARCH PROTECTION PROCESSES**

J. Candia, K. London, and R. Allen

*Air Force Research Laboratory, Wright-Patterson AFB, OH*

*(EDUCATION - TUTORIAL)*

**PROBLEM STATEMENT:** Complex regulatory and ethical requirements apply to human research supported by the U.S. Federal government and the U.S. Department of Defense (DoD). This talk will summarize the requirements and provide strategies to allow participants to anticipate and address related issues to avoid delays. **TOPIC:** Common requirements apply to human research supported by most U.S. Federal departments. Additional requirements may apply to human research supported by the DoD or DoD Components (e.g., Army, Navy, or Air Force). All DoD-supported, non-DoD conducted human research requires

a DoD ethics review. The DoD ethics review ensures compliance with all applicable Federal, DoD, and DoD Component (e.g., Army, Navy, or Air Force) human research protections requirements. Completion of this review is required prior to provision of DoD support to human research. Common compliance issues often delay completion of DoD ethics reviews. Researchers who address these issues in their proposals may avoid these delays. Institutional Review Board (IRB) submissions must include: risk/benefit assessments, recruitment and consent plans, plans to protect special populations (e.g., children and international subjects), as well as other regulatory requirements referenced in the Resources below. In addition, this talk will identify DoD and DoD Component-unique requirements, e.g., requirements for specific IRB documentation, local command authorization, avoidance of undue influence, and disclosure of risks to service members' duty status. This talk will address special considerations for trauma patients common to DoD-supported aeromedical evacuation research, to include: surrogate consent and the requirement for direct benefit to subjects. Participants will receive a handout summarizing these common issues and strategies to address them. This handout will be a valuable tool for successful development of research plans, selection of collaborators, and choice of funding source, particularly if the research involves the DoD. **APPLICATIONS:** The requirements addressed in this talk are applicable to U.S. Federally funded research involving live human subjects, their identifiable private information, or biological specimens. Additional requirements apply in international research settings. **RESOURCES:** 32 CFR 108, 219; 10 USC 980; DoDI 3216.02

#### Learning Objectives:

1. Participants will understand regulatory requirements to include in the design and development of human research.
2. Participants will learn the strategies for efficient completion of DoD ethics review.

### [375] TECHNICAL WRITING FOR SCIENTIFIC JOURNALS AND THE PATHWAY TO PUBLICATION

F. Bonato

Montclair State University, NJ, Montclair, NJ

#### (EDUCATION - TUTORIAL)

**PROBLEM STATEMENT:** Publication in a scientific journal (such as *Aerospace Medicine and Human Performance*) is a worthwhile pursuit given its potential benefits to one's career and the valuable addition it could provide to one's field. However, for some, the set of processes leading towards possible publication can be daunting and sometimes disappointing, especially when manuscripts are rejected. How does one maximize the chances of getting successfully published? How can requests for revised manuscripts best be handled? **TOPIC:** This talk will cover the following: 1) Is a given body of research ready to be published and is it worthy of publication? 2) What journal should the work be submitted to? 3) Writing and formatting the submission (following the author guidelines), 4) Acceptable ways to present statistical and graphical results, 5) Proper referencing, 6) The peer-review process, 7) Responding to reviews, 8) Cover letters and revised manuscripts, 9) Corresponding with the journal office/editor. **APPLICATIONS:** The need for preparation before submitting a manuscript for publication consideration is essential. Following simple steps in preparing, submitting, and revising manuscripts can help maximize the probability of a manuscript being accepted and published in a timely manner. These guidelines are broadly applicable to many scientific journals.

#### Learning Objectives:

1. Provide authors with a systematic approach to preparing and submitting a manuscript for publication.
2. Familiarize authors with the peer review and editorial processes.

### [376] STRATEGIES FOR OBTAINING RESEARCH FUNDING IN THE U.S. DEPARTMENT OF DEFENSE

B.S. Shender

Human Systems, NAVAIR, Patuxent River, MD

#### (EDUCATION - TUTORIAL)

**PROBLEM STATEMENT:** This abstract discusses strategies to lay the foundations for research programs and DoD funding opportunities

to seek. **TOPIC:** Funding opportunities are not as plentiful as they once were, particularly for basic and applied research. Sponsors require a clear pathway to transition research into new technologies or knowledge. This often requires demonstration of successfully maturing research Technology Readiness Levels (1) from basic principles to demonstration in relevant / operational environments. To achieve this, it is useful to develop a roadmap outlining the steps required and discuss that plan with your customer and funding sponsor. Seek out and meet potential funding sponsors (many have open houses) to understand their requirements. Since funding is scarce and conducting studies involving humans or animals is complicated and costly, seeking collaborations is a useful strategy. Working in parallel can achieve research goals more quickly at less cost to individual sponsors.

**APPLICATIONS:** There are multiple DoD sponsors, including the Office of the Secretary of Defense (OSD), Office of Naval Research (ONR), and internal laboratories. Projects are selected and managed using unique processes specific to the funding agency. Each source of funding will have a different TRL at the start and completion of the project. Calls for information and funding are often posted on <https://www.fbo.gov/>. Broad Agency Announcements (BAA) are found in the websites of most government agencies (military and civilian). Small businesses and universities can compete for Small Business Innovation Research and Small Business Technology Transfer Research funding. TRL1-6 projects are sponsored by ONR and through the Defense Advanced Research Projects Agency (OSD). The University Research Initiatives is a coalition of five programs to develop Naval-relevant fundamental knowledge and maintain the health of the defense scientist and engineer workforce. International collaborations can be funded by Foreign Competitive Testing (TRL3-6) and Coalition Warfare Program (TRL6-9). U.S. Navy labs fund internal research through the Section 219 Naval Innovative Science and Engineering program (TRL1-5). Support for maturing technology can be obtained from the Rapid Prototyping, Experimentation, and Demo (RPED), Joint Concept Technology Demo (JCTD), and Rapid Innovation Fund (TRL6-8) programs. **RESOURCE:** (1) [https://en.wikipedia.org/wiki/Technology\\_readiness\\_level](https://en.wikipedia.org/wiki/Technology_readiness_level).

#### Learning Objectives:

1. Learn strategies and opportunities to obtain research funding.

Thursday, May 10

10:00 AM

Topaz

### S-078: SLIDE: OPTIMIZING PERFORMANCE IN COMPLEX AEROSPACE ENVIRONMENTS

Chair: John Allen

Huntingtown, MD

Chair: Annette Sobel

Lubbock, TX

10:00 AM

### [377] OPERATIONAL HEALTH UNITS IN AIR FORCE INTELLIGENCE: OVERVIEW OF A NEW CAPABILITY ENHANCING HUMAN PERFORMANCE

M. Cunningham<sup>1</sup> and C. Young<sup>2</sup>

<sup>1</sup>548th Intelligence, Surveillance and Reconnaissance Group, Beale Air Force Base, CA, Beale Air Force Base, CA; <sup>2</sup>25th Air Force, Joint Base San Antonio, TX

#### (EDUCATION - PROCESS)

**MOTIVATION:** Optimizing human performance is a basic tenet of aerospace medicine. In the U.S. Air Force (AF), intelligence operators (IOs) are exposed to stresses and performance issues similar to personnel in aviation-related fields, including shiftwork, task saturation, and tedium followed by immediate action. This presentation will discuss an initiative to provide expedient clinical care in a new format to IOs. It will also present discussion and solicit metrics to show potential benefits gained from this initiative. **OVERVIEW:** The Operational Medical Element (OME) consists of physical and mental health personnel; combined with a religious support team, they form the

Airman Resiliency Team (ART). There have been many iterations of OME- and ART-type constructs across various AF units. Currently, the 480th Intelligence, Surveillance and Reconnaissance (ISR) Wing employs ARTs in six geographically dispersed units to address the wellbeing of its deployed-in-placed airmen executing missions vital to national security. A recent development has been the addition of Operational Health Units (OHUs) at several sites; the OME at the 548th ISR Group was the first to implement an OHU, which began operations in March 2017. This OHU allows the OME's physician and medical technician to provide limited-scope medical care within the ISR workplace, with the goal of quickly assessing and treating airmen to ensure faster return to the mission. In the first six months, a total of 151 patients received medical evaluations in the OHU, saving an estimated 226.5 hours away from the mission compared to using the remotely located base medical clinic. Common issues included allergic rhinitis, upper respiratory infections, gastroenteritis, various musculoskeletal complaints, rashes, and insomnia. **SIGNIFICANCE:** The OHU has expanded the ability of OMEs to care for ISR airmen. Initial surveys reveal benefits from OHUs that include more expedient access to medical examinations and other limited scope services. These include mental health education and coaching, leadership consultation, medical liaison services, and others. Overall response from both airmen and leadership has been very positive. As the OHU concept expands with placement within other units of the 480th ISR Wing, efforts will continue toward establishing best practices for tracking outcomes, especially in the realm of human performance, from the addition of this service to the already established OME/ART construct.

#### Learning Objectives:

1. Recognize how Operational Health Units are addressing human performance in Air Force intelligence units.

#### 10:15 AM

### [378] MATCHING DESIGN TO USE: HOW SYNERGY BETWEEN HUMAN PERFORMANCE, AVIATION, AND MEDICINE CAN CREATE BETTER CHECKLISTS

A.L. Clebone<sup>2</sup> and B. Burian<sup>1</sup>

<sup>1</sup>Human Systems Integration Division, NASA Ames Research Center, Moffett Field, CA; <sup>2</sup>University of Chicago School of Medicine, Chicago, IL

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Critical events in both aviation and medicine demand time sensitive, cause-specific, often complex responses. Both involve system failures. In aviation, however, a checklist is almost always used from the beginning of the event, whereas in medicine, typically steps are taken to stabilize a patient before a checklist is accessed. (1) Although cognitive aids can improve clinician performance in medicine, these aids are not always used during actual critical events, possibly because their design does not match clinician needs well. We applied multidisciplinary problem solving, using the science of human performance, as well as lessons learned in both medicine and aviation, to develop checklists that would fit the perioperative domain. Although many cognitive aids are organized as a linear sequence of tasks or treatments, during a critical event clinicians may seek only specific information from a cognitive aid, a behavior we termed 'sampling'. We hypothesized that cognitive aids designed to support sampling behavior would improve the ability of clinicians to extract information from a critical event cognitive aid. (1) **METHODS:** Using well-established findings from human factors and cognitive science research, we created two novel cognitive aid designs to support two types of sampling: hunting for information when the type of information is known a priori (e.g., drug dosage), and surveying for information that is not known a priori (e.g., additional treatments). Using eye-tracking technology, we tested the ability of clinicians to sample adverse event cognitive aids. **RESULTS:** In this part-task simulation study, we found that our design principles—grouping related content by topic, color-coding and labeling the topic, organizing topics and actions in the order in which they are accomplished during event response, consistently locating topics on the aids, and minimizing distractors (2)—significantly improved participants' ability to rapidly obtain relevant information from cognitive aids. **DISCUSSION:** Our novel cognitive aid designs supported sampling behavior more

effectively than cognitive aids organized in a linear fashion. More research is needed to evaluate whether implementation improves overall management of adverse events. **REFERENCES:** (1) Burian, et al. *A&A*. 2017, *In Press*. (2) Wickens C. *Engineering Psychology and Human Performance*. Prentice Hall, 2000.

#### Learning Objectives:

1. To learn about how synergy between the human factors, medical, and aviation domains, and looking at the unique aspects of the medical domain, can be used to develop better medical checklists.
2. To learn about how human factors design principles—grouping related content by topic, color-coding and labeling the topic, organizing topics and actions in the order in which they are accomplished during event response, consistently locating topics on the aids, and minimizing distractors—significantly improved participants' ability to rapidly obtain relevant information from medical cognitive aids during a part-task usability study.
3. To explore usability testing as we uniquely applied it to the medical domain to create better medical checklists.

#### 10:30 AM

### [379] DESIGN FACTORS AFFECTING PERIOPERATIVE CRITICAL EVENT COGNITIVE AID USABILITY

B. Burian<sup>1</sup> and A.L. Clebone<sup>2</sup>

<sup>1</sup>Human Systems Integration Division, NASA Ames Research Center, Moffett Field, CA; <sup>2</sup>University of Chicago School of Medicine, Chicago, IL

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Managing perioperative critical events is an essential skill for anesthesiologists and cognitive aids can support effective event response.<sup>1</sup> Although there is agreement that aid design is important<sup>2</sup>, there is little detailed design guidance available for medical checklist developers. **METHODS:** Using multidisciplinary human factors and cognitive science research findings, we conducted a part-task study to evaluate the effectiveness of different critical event cognitive aid designs to support clinicians "sampling" them for needed information (e.g., a medication dose, additional treatment ideas) associated with three different critical events. Unlike aviation, clinicians often reference or sample critical event checklists for specific information rather than use them for step-by-step guidance for event response. **RESULTS:** We observed the effects design features had on clinician speed in locating the specified information in each event scenario and obtained ratings and feedback on the usability of the design features and of the aids in various clinical situations. Narrative responses were subjected to a thematic analysis<sup>3,4</sup> which revealed six major themes: 1) Accessibility, 2) Reason for Aid's Use, 3) Content, 4) Layout, Organization, Design, 5) Ease of Use/Simplicity, and 6) Guiding Treatment/Clinician Response, and two sub-themes: Clinical Needs and Overall Usability. Cohen's kappa analyses of response coding revealed a high degree of inter-rater reliability (e.g.,  $k = .80$ , (95% confidence interval [CI], .69 to .92),  $p < .001$ ). **DISCUSSION:** The strong bi-directional relationship found between two themes—4) Layout, Organization, Design and 5) Ease of Use/Simplicity—confirms the importance of aid design for its ultimate usability and consequently, its effectiveness. However, determination of aid content receives most of the attention in the literature. Although content is critical, so is aid design. Specific design features assessed in this study and clinician's judgments of the checklists' utility and usability will be discussed. **REFERENCES:** (1) Burian, et al. *A&A*. 2017, *In Press*. (2) Merry, et al. *British Medical Journal Quality Safety* 2016;25(10):733-5. (3) Fereday, et al. *International Journal of Qualitative Methods* 2006;5(1):1-11. (4) Stemler et al Available at: <http://pareonline.net/getvn.asp?v=7&n=17> Downloaded on: May 2017.

#### Learning Objectives:

1. The participants will be able to identify at least three design features essential to ensuring usability of perioperative critical event cognitive aids.
2. The participants will be able to explain the relationships among perioperative critical event cognitive aid 1) content development, 2) layout, organization, and design, and 3) aid usability and utility.



**10:45 AM****[380] ASSESSING PILOTS' FAMILIARITY AND ABILITY TO INTERPRET METAR, WINDS ALOFT, SATELLITE, AND PROGNOSTIC CHART PRODUCTS**J.M. King, B. Blickensderfer, Y. Ortiz, T. Guinn, R. Thomas and N. Defilippis*Embry-Riddle Aeronautical University, Daytona Beach, FL***(ORIGINAL RESEARCH)**

**INTRODUCTION:** In the last two decades, General Aviation (GA) flights have accounted for the majority of weather related accidents. Previous studies have identified poor preflight weather planning and a lack of aviation weather knowledge as possible contributing factors to the stagnant GA weather accident rate. During the preflight process, pilots depend on weather products to understand how weather will develop along their route. Research suggests that pilots use weather products they believe contain pertinent information. Although pilots may collect preferred useful weather products during the preflight process, it is unclear how well pilots are able to interpret this information. The purpose of this paper is to understand pilots' familiarity and pilots' ability to interpret weather products. **METHODS:** Three hundred and nineteen pilots (ranging from Private, Instrument, Commercial with Instrument, CFI/CFII, to ATP) were recruited and separated into two groups. Group 1 ( $n=151$ ) completed a weather product familiarity survey and weather product interpretation assessment for METAR and Winds Aloft products. Group 2 ( $n=168$ ) participants the same measures for Prognostic Chart and Satellite products. The weather product familiarity survey assessed familiarity with specific weather products. The weather product interpretation quiz measured ability to interpret aviation weather products. This study will assess and compare pilots' familiarity and ability to interpret Satellite Image/Prognostic Chart and METAR/Winds Aloft products. **RESULTS:** Six Spearman's Rho correlations were run to investigate the relationship between product familiarity and product interpretation score on METAR/ Winds Aloft composite cores, Prognostic / Satellite composite scores, METAR, Winds Aloft, Prognostic Chart, and Satellite. No significant relationships were found. Four 2 x 5 Mixed ANOVAs were performed to compare the effect of test topic and certificate rating on weather product familiarity and product interpretation scores. **DISCUSSION:** Results suggest that although pilots may be familiar with certain weather products, pilots could still have difficulty interpreting weather information. Further research should investigate factors hindering pilots from effective weather product interpretation.

**Learning Objectives:**

1. The audience will gain insight on how pilots rate aviation weather product familiarity and their ability to interpret aviation weather products.
2. The audience will understand the relationship between pilots' product familiarity and their ability to interpret aviation weather products.

**11:00 AM****[381] THIGH AND BUTTOCK PAIN IN PUMA HC2 AIRCREW**K. Cooper<sup>2</sup>, M. Smyth<sup>2</sup>, M. Trudgill<sup>1</sup> and P.D. Hodkinson<sup>1</sup><sup>1</sup>RAF Centre of Aviation Medicine, Hitchin, United Kingdom; <sup>2</sup>Royal Air Force, Ballymoney, United Kingdom**(ORIGINAL RESEARCH)**

**INTRODUCTION:** Following the introduction of a new armored seat there have been numerous Defence Aviation Safety Occurrence Reports (DASORs) of Puma HC2 front crew experiencing thigh and buttock discomfort. 16 DASORs were submitted from operational theatres between Jan 16 – Jan 17 with varying degrees of perceived flight safety risk. The aim of this trial was to investigate the etiology and suggest improvements to alleviate symptoms. **METHODS:** This trial was conducted by the RAF Centre of Aviation Medicine Aircrew Equipment Integration Group. Seat pressures were mapped and recorded for 12 non-aircrew volunteers in 3 Puma seat types (HC1 Armoured, HC2 Armoured and HC2 Standard), with and without Body Armour Load Carriage System (BALCS). Volunteers wore two-piece aircrew flying clothing with long johns for all configurations. They were instructed how to adopt a standard body position to best mimic a normal Puma HC2 operator. Xsensor pressure monitoring equipment with the Xsensor X3

Pro V7 software was used for data collection. Anthropometric data were recorded for all subjects. Methodology complied with locally approved procedures and MOD Research Ethics Committee approval was not required in accordance with JSP 536. Data were analyzed using repeated measures ANOVA. **RESULTS:** Both peak and mean seat pressures were significantly higher when wearing BALCS compared with No BALCS. Seat type did not have a significant effect on peak or mean seat pressures and there were no interactions between seat type and BALCS. The pressure area was greater in both the HC2 Standard and Armoured seats compared with the HC1 Armoured seat. There was no difference in pressure area when comparing HC2 Armoured and standard seats. **DISCUSSION:** These data show that wearing BALCS causes high seat pressures. The peak pressures were experienced at the Ischial Tuberosities and in the upper thigh region, in keeping with other literature and distribution of reported symptoms. Pressure mapping showed no evidence to suggest that the design of the HC2 Armoured seat caused an increase in seat pressures. Therefore, these findings suggest BALCS, rather than seat design, is the major cause of buttock and thigh discomfort in Puma HC2 front crew.

**Learning Objectives:**

1. The participant will be able to understand the impact of seat design and the wearing of torso mounted armour on Puma HC2 aircrew comfort.

**Thursday, May 10****Sapphire****10:00 AM****S-079: PANEL: PREPPERS COMPREHENSIVE MEDICAL READINESS PROGRAM FOR FLIGHT SURGEONS****Chair: Charles Clinton***Xenia, OH***Chair: Douglas Files***Fairborn, OH***Chair: Jameson Voss***Wright-Patterson, AFB, OH*

**PANEL OVERVIEW:** Aerospace medicine professionals need to be preppers who are ready for a wide range of contingencies. Whether it is a physiologic event response, an aviation mishap with mass casualties, or an aeromedical evacuation, flight medicine professionals need to think correctly when they are moving fast. The panel will engage participants with a hands-on interactive experience addressing a single mishap sequence that begins with a pilot experiencing a hypoxia physiologic event leading to a mishap involving mass casualties and hazardous materials. After scene safety is addressed, some casualties will require medical clearance for aeromedical evacuation. Finally, a briefing will be simulated addressing human factors related to the mishap to a flight safety audience. The session format will include some updated didactic material addressing each step in the sequence, but all attendees will engage directly in the mishap by splitting into groups (as appropriate) and working through each of the four sections using table top icons and a moderator. In order to enhance realism, participants who fail to ensure scene safety will be lost to their team and will have to work the remainder of the sequence using a paper based case. At the conclusion, attendees will have enhanced preparedness for medical contingencies.

**[382] PREPPERS AEROMEDICAL EVACUATION**J.D. Voss and D.S. Files*USAFSAM, Wright-Patterson, AFB, OH***(EDUCATION - PROCESS)**

**MOTIVATION:** Aeromedical professionals are sometimes required to certify a patient is medically cleared for transportation through the aeromedical evacuation system. This interactive scenario will engage professionals with simulated evacuation clearance cases to help maintain comprehensive medical readiness skills. **OVERVIEW:** Following a

mass-casualty event, some casualties will require medical evacuation while others will have compromising injuries, trapped air pockets (ocular, intracranial, etc.), or other contraindications for flight. In addition to considering the medical judgment required for complex clearance decisions, the casualty tracking system (e.g., TRAC2ES in a military contingency environment) is also important for casualty management throughout the system. **SIGNIFICANCE:** Although medical clearance is an important function, it is not a daily task outside the deployed environment. Thus, U. S. Air Force flight surgeons need regular training to rehearse these skills for comprehensive medical readiness. The training is applicable beyond the Air Force to all aeromedical evacuation including the Tri-service interface with the American inter-theater military casualty evacuation system.

#### Learning Objectives:

1. Aeromedical professionals are sometimes required to certify a patient is medically cleared for transportation through the aeromedical evacuation system. This interactive scenario will engage professionals with simulated evacuation clearance cases to help maintain comprehensive medical readiness skills.

### [383] PREPPERS MASS CASUALTY RESPONSE

A. Gammill and D.S. Files  
USAFSAM, Wright-Patterson AFB, OH

#### (EDUCATION - PROCESS)

**MOTIVATION:** Mishap response is an important role for aerospace medicine professionals who may respond to mass casualty scenarios involving aircraft mishaps, which often involve hazardous materials. This session will involve a simulated mass casualty event with seriously injured spectators and aircrew following an aircraft mishap. **OVERVIEW:** Medical first responders require a range of skills including advanced trauma life support, triage, and procedural skills. Aerospace medicine professionals often have to manage the situation at an even higher level requiring specific knowledge of their local mishap response plan and working knowledge of how they fit within the national incident management system. To make matters more complicated, many aircraft carry hazardous materials, making the assessment of scene safety particularly salient. **SIGNIFICANCE:** Despite the complexity and importance of mishap response, aerospace medicine professionals rarely work in these emergency situations and may lose currency in how to manage them. Although the National Incident Management System is only required in the United States, attendees from all countries will benefit from considering integration of the disaster response capabilities in a realistic scenario.

#### Learning Objectives:

1. Mishap response is an important role for aerospace medicine professionals who may respond to mass casualty scenarios involving aircraft mishaps, which often involve hazardous materials. This session will involve a simulated mass casualty event with seriously injured spectators and aircrew following an aircraft mishap. Participants will renew their skills in performing this key function.

### [384] PREPPERS IN-FLIGHT PHYSIOLOGIC EMERGENCY RESPONSE

C.D. Clinton, J.D. Voss and D.S. Files  
USAFSAM, Wright Patterson, AFB, OH

#### (EDUCATION - PROCESS)

**MOTIVATION:** Acute physiologic emergencies such as hypoxia, decompression sickness, and spatial disorientation can have life threatening consequences. Although rare, these causes of aircraft mishaps are preventable offering an exciting opportunity for multidisciplinary efforts to improve flight safety. **OVERVIEW:** Whenever a physiologic event occurs, it requires a thorough medical evaluation to determine the contributing cause(s) (environmental conditions, flight equipment, underlying predisposition), how it could be prevented, and the aeromedical disposition. Some physiologic events require a medical work-up for diagnosis of an underlying condition or to rule out serious sequelae. Students will focus on how to care for aircrew with hypoxia from high cabin altitude. **SIGNIFICANCE:** Fortunately, these incidents are rare, but that means many aerospace medicine professionals get out of

practice, showing the value in case-based rehearsal. Those attending this session will consider a particular incident that leads to a mishap sequence in order to demonstrate the potentially fatal consequences of these events. Following the training, professional will have enhanced comprehensive medical readiness skills.

#### Learning Objectives:

1. Those attending this session will consider a particular incident that leads to a mishap sequence in order to demonstrate the potentially fatal consequences of hypoxia and other physiologic events. Following the training, professional will have enhanced comprehensive medical readiness skills.

### [385] PREPPERS HUMAN FACTORS BRIEFINGS

D.S. Files, J.D. Voss and A. Gammill  
USAFSAM, Wright-Patterson, AFB, OH

#### (EDUCATION - PROCESS)

**MOTIVATION:** Human factors briefings are a mechanism for aerospace medicine professionals to educate the aviation community about the impact of human factors on flight safety. **OVERVIEW:** Human factors briefings have a role in circumstances varying from a regularly scheduled unit flying safety briefing, a formal course utilizing special equipment (such as night vision goggles) or a analyzing on-board data recorders following a particular aircraft mishap. In this case, participants will consider the circumstances of the mishap and the resulting mass casualty, then identify how to brief the relevant human factors. **SIGNIFICANCE:** Aerospace medicine professionals communicate human factors in a manner that can be understood by aircrew while also understanding technical details that identify the causal human factors involved in mishap prevention, investigation, and response. By addressing briefing techniques, participants will gain confidence in their ability to communicate the impact of human factors on flight safety.

#### Learning Objectives:

1. Aerospace medicine professionals communicate human factors in a manner that can be understood by aircrew while also understanding technical details that identify the causal human factors involved in mishap prevention, investigation, and response. By addressing briefing techniques, participants will gain confidence in their ability to communicate the impact of human factors on flight safety.

Thursday, May 10  
Chantilly East

10:00 AM

### S-080: SLIDE: SICKNESS & DECISION MAKING

Chair: Robert Orford  
Scottsdale, AZ

Chair: Warren Silberman  
Oklahoma City, OK

10:00 AM

### [386] GENDER AND NATIONALITY DIFFERENCES IN SELF REPORTS OF AIRSICKNESS IN COMMERCIAL FLIGHTS

S. Rice  
Human Factors, ERAU, Viera, FL

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Several studies have shown that females are more susceptible to air-sickness than males. Primarily, they focused on examining the physiological differences experienced with air-sickness between genders. A few studies have looked at Asian-Caucasian comparisons; however, to date, no study that we know of has compared participants from India and America. The purpose of this study was to examine how both nationality and gender may play a role in air-sickness. **METHODS:** 200 participants from an online community in the United States and India were asked to self-report the following: 1) How likely they were to experience airsickness on commercial flights; 2) How likely they were to take an anti-airsickness medication if needed; 3) How severe



the symptoms usually were; and 4) How long the symptoms lasted. The first three scales were scored 1-10, while the last one was scored in minutes. **RESULTS:** In general, Indians ( $M = 6.25$ ) reported a much higher rate of airsickness compared to Americans ( $M = 3.92$ ). American males reported the lowest rates compared to the other three groups. Indians ( $M = 6.76$ ) were also much more likely to take anti-airsick medications compared to Americans ( $M = 4.96$ ). Both Indian and American males reported lower rates compared to their female counterparts. Indians ( $M = 6.38$ ) reported much more severe symptoms compared to their American counterparts ( $M = 3.96$ ), with males reporting fewer symptoms compared to females for both Indians and Americans. Lastly, the amount of time feeling airsick was similar between Indians ( $M = 24.66$ ) and Americans ( $M = 25.97$ ). American females ( $M = 35.74$ ) reported longer times compared to the other three groups. **DISCUSSION:** Self-reports of airsickness clearly differ as a function of nationality and gender. In general, Indians report that they are more likely to get airsick, have worse symptoms, and are more likely to take anti-airsickness medications compared to their American counterparts. In general, females were more likely to take anti-airsickness medications, and reported worse symptoms compared to their male counterparts. In two significant interactions, American females reported that they were more likely to get airsick compared to their American male counterparts, and that their airsickness lasted longer than any of the other groups. Indian females, in contrast, did not differ from Indian males in these two conditions.

#### Learning Objectives:

1. The participant will be able to analyze gender and nationality differences in self reports of airsickness.

#### 10:15 AM

### [387] SAFETY IMPLICATIONS OF SIX-MONTH VS. ONE-YEAR FIRST-CLASS AEROMEDICAL CERTIFICATE DURATION FOR OLDER PILOTS

W.D. Mills and C.A. DeJohn

Medical Research Division, FAA Civil Aerospace Medical Institute, Oklahoma City, OK

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** This study explores the safety risk due to delayed detection of hazardous health conditions that would result from increasing the duration of U.S. first-class aeromedical certificates from 6 months to 12 months for pilots aged from 40 through 60 years old. **METHODS:** All pilots who submitted a U.S. first-class medical application in 2014 with no electrocardiogram and with the previous exams 4.5 to 7.5 months prior were selected from the FAA airman medical database. Proportions of FAA denial pathology codes and Aviation Medical Examiner (AME) deferrals were compared for these exams within and between age groups from 40 through 75 years old as our measure of risk. The relative incidence of these proportions was compared graphically and the absolute incidence was compared using the "1% rule." **RESULTS:** The relative risk between age groups for delayed identification of disqualifying medical conditions showed that the 56–60 year-old group would be at about twice the risk as the 40–45 year-old group, but that the absolute risk of the 56–60 year-old group would just meet the 1% rule criteria. **DISCUSSION:** The conclusion as to whether these results support a 12-month duration for first-class aeromedical certificates in the 40-year-old to less than 60-year-old age group should be based on the importance of the increased absolute versus relative risk for the specific situation.

#### Learning Objectives:

1. Understand the challenges inherent in predicting the safety impact of modifying the frequency of aeromedical examinations - and one approach to examining this question.

#### 10:30 AM

### [388] PRIMARY HYPERPARATHYROIDISM DISGUISED AS CHEST PAIN: A CASE REPORT

S. Ilmer

Flight Medicine, Tinker AFB, Oklahoma City, OK

#### (EDUCATION - CASE STUDY CLINICAL)

**PROBLEM STATEMENT:** This case report describes a military AWACS Airborne Communication Systems Operator (ACO) who

experienced chest pain during his fitness testing. **BACKGROUND / LITERATURE REVIEW:** Hyperparathyroidism is an endocrine disorder of the parathyroid gland which leads to oversecretion of the parathyroid hormone (PTH). It is characterized by a range of clinical symptoms which can be remembered by the mnemonic "bones, abdominal moans, stones, psychiatric groans." **CASE PRESENTATION:** The subject is a 23 y/o Male ACO, who initially presented to the flight medicine clinic with angina, which started while he was performing the run portion of the fitness test. The patient had a history of viral pericarditis 1.5 years prior to the onset of his current symptoms following an upper respiratory infection. Assuming this may have been a recurrence of his pericarditis, he underwent cardiology work-up, which was normal. As patient continued to endure worsening chest pain, which started to occur even during rest, further labs were drawn. He was found to have severe hypovitaminosis D, hypercalcemia of 11.1 mg/dL and hyperparathyroidism of 86 pg/mL. After correcting vitamin D levels with calcium and vitamin D supplementation, he continued to have worsening chest pain, hypercalcemia and hyperparathyroidism. A review of his records revealed mildly elevated calcium levels in 2015 of 10.6 mg/dL, and a repeat of 10.9 mg/dL, but no additional work-up was performed at that time. Further work-up revealed a parathyroid adenoma in the right lower parathyroid gland. Parathyroidectomy with intraoperative PTH monitoring was then performed – two of his glands were fully excised, with Right inferior parathyroid gland being confirmed to have parathyroid adenoma on pathology. Post procedure, his chest pain had fully resolved, his calcium and PTH level normalized and he is now training for his fitness test, which he plans to take in 6 months. Thus, his initial presentation with chest pain was likely bone pain secondary to primary hyperparathyroidism. **OPERATIONAL / CLINICAL RELEVANCE:** This case illustrates the importance of further investigation of hypercalcemia in asymptomatic patients. Subjects may eventually present with a range of clinical symptoms which makes diagnosis more difficult and require extensive work-up. Hyperparathyroidism is rare in young individuals and further investigation is warranted in patients who present with asymptomatic hypercalcemia on routine work-up.

#### Learning Objectives:

1. Learn the diagnostic approach in a patient presenting with hypercalcemia.
2. Identify patients with primary hyperparathyroidism.
3. Understand treatment options in patients with primary hyperparathyroidism.

#### 10:45 AM

### [389] COAGULOPATHY AND VASCULOPATHY – WOULD YOU LET THIS AIRLINE PILOT FLY?

P. Masrani<sup>1</sup>, V. Masrani<sup>1</sup> and P. Navathe<sup>2</sup>

<sup>1</sup>V M Medical Centre, Mumbai, India; <sup>2</sup>The Maitland Hospital, Maitland, Australia

#### (EDUCATION - CASE STUDY CLINICAL)

**PROBLEM STATEMENT:** An experienced airline diagnosed with hypercoagulopathy and vasculopathy with no underlying cause except smoking and a strong family history was declared medically unfit due to challenges of monitoring him on Warfarin and the aeromedical concerns of the underlying condition. **BACKGROUND/ LITERATURE REVIEW:** Hypercoagulopathy along with vasculopathy requiring long term warfarin has not been commonly reported in pilots. Warfarin is approved by most regulatory authorities for pilots with stabilized INR levels provided the underlying condition is adequately controlled. Pilots on anti-platelet agents and DOACs are easier to treat and have lesser side effects compared to those on Warfarin – however in this case, anti-platelets or DOACs were not considered adequate. **CASE PRESENTATION:** This case study is about an experienced airline pilot, who was diagnosed with claudication secondary to stenosis at bifurcation of abdominal aorta. Angioplasty failed and restenosis was treated by aorto-iliac bypass. He was placed on warfarin. INR levels in this pilot were maintained within target range with Warfarin but his tendency to hypercoagulate and dependence on Warfarin were assessed as posing a significant risk to flight safety (even in a multicrew environment), and certification was refused. Discontinuation of Warfarin and switching to antiplatelet medication after 18 months (to attempt to get his medical certification) led to recurrence of symptoms. **OPERATIONAL/ CLINICAL RELEVANCE:** Risks include future involvement of coronaries and cerebral vessels and complications thereof. Other risks are

the medication, requiring dietary control along with risks due to the condition itself which are not sufficiently mitigated. Monitoring compliance with Warfarin and maintaining a safe range of anticoagulation are crucial. Global approaches to such cases are presented, and a protocol for evaluation of such cases is proposed.

#### Learning Objectives:

1. To study the atypical presentation of an airline pilot whose coagulopathy was controlled only with Warfarin.
2. To appreciate the global approaches in evaluation of such cases.
3. To discuss the challenges of monitoring warfarin compliance and maintaining safe ranges in a commercial aviation environment in a case which is highly dependent on Warfarin.

**11:00 AM**

### [390] CONCERNS OVER ROTARY WING FLIGHT SAFETY UNDER CONDITIONS OF A DEGRADED VISUAL ENVIRONMENT (DVE)

M.R. Lattimore

USAARL, Ozark, AL

#### (EDUCATION - PROCESS)

**MOTIVATION:** The Army aviation vision standard is NOT adequate to meet DVE challenges. DVE, characterized by dimly lit and/or washed-out viewing conditions, isn't currently visually assessed. There's no recognition of the visual demands occurring under DVE-related flight conditions. A conservative analysis indicated half of all Army aviators aren't currently visually qualified for DVE flight. Since the April 2002 Surgeon General approval of refractive surgery, Army surgeons have performed hundreds of excimer laser procedures on Army aviators. Coincidentally, a review article later appeared in *Survey of Ophthalmology* documenting night vision disturbances associated with laser refractive surgery. Our research concerns those initially in the bottom half of the DVE visual performance distribution. If those at-risk aviators also received refractive surgery, they now have two visual performance challenges weighing against them. Placing those individuals under DVE conditions may exceed their flight reliability limitations. None can be identified without detailed record reviews and the institution of modernized vision testing standards. **OVERVIEW:** This is a proposed risk assessment involving Army rotary wing aviators flying under DVE conditions. Characterization of specific risk profiles associated with unique mission sets has been identified as an Aviation gap. Additionally, the Aviation PEO has identified DVE-associated mishaps as his primary concern; a decision influenced by a U.S. Army Combat Readiness Center assessment of DVE-based events, which accounted for almost half (46%) of all fatalities over the deployment assessment period of 2002 – 2013. Without the adoption of mitigating or corrective actions, this issue will continue to be defined by its dominance over other performance gaps. **SIGNIFICANCE:** Improved aviation safety will be achieved by implementing vision testing standards capable of quantifying both resolution and contrast sensitivity. Human performance will be advanced by identifying those under the greatest risk of mishap, enabling a redirection of their flight profiles avoiding DVE-related conditions. These rotary-wing risk factors represent a universal public health risk, equally applying to all Uniformed and Federal Services utilizing rotary-wing aircraft. Recommended vision standards have been developed; evidence-based decision-making studies to determine the actual risk facing our aviators have been submitted for funding consideration.

#### Learning Objectives:

1. The current AR 40-501 vision testing standard for aviators is NOT adequate to meet the challenges posed by DVE flight conditions.
2. DVE-based events accounted for almost half (46%) of all fatalities over the deployment assessment period of 2002 – 2013.
3. Recommended vision standards have been developed; evidence-based decision-making studies to determine the actual risk facing our aviators have been submitted for funding consideration.

**11:15 AM**

### [391] COGNITIVE EMOTIONAL CONTROL IN DECISION MAKING FOR HIGH-RISK CAREERS: CONCEPTS FOR THE DEVELOPMENT OF TARGETED MENTORSHIP

W. Thompson<sup>1</sup> and W. Chappelle<sup>2</sup>

<sup>1</sup>Neurostat Analytical Solutions, LLC, Alexandria, VA; <sup>2</sup>Aeromedical Operational Psychology, USAFSAM, Wright-Patterson AFB, OH

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Critical decision making in leadership, training, and combat is a function of cognitive processing and emotional affect. Emotional states can positively or negatively impact cognitive functioning, while cognitive understanding can impact emotional processes resulting in successful decision making. Understanding this process in high-risk, high-demand careers is critical to ensuring safe and effective operations, particularly in those career fields where emotional processes influence speed and accuracy of processing information as well as attending, encoding, retrieving, and prioritizing information. The purpose of this study is to develop a theoretical model of cognitive and emotional traits of functioning relevant to critical decision making and evaluate how accurately the model identifies individuals with the capacity to effectively adapt to the unique rigors of high-risk, high-demand career fields. **METHODS:** Pretraining cognitive and personality-based psychological testing data from remotely piloted aircraft Predator/Reaper training candidates were collected over three years. A model for critical decision making and adaptation was developed integrating measures of cognitive and emotional functioning. **RESULTS:** Findings suggest a holistic approach integrating measures of cognitive and emotional functioning will result in greater success in critical decision making both in training and operations. Predictive analysis was applied to all career fields for a proposed model for training operators in a high-risk, high-stress environment on how to manage their cognition and emotion and succeed where effective, critical decision making skills are essential to mission success and safety. **DISCUSSION:** The results of the study provide data on the integrative relationship between cognitive and emotional processes among those who are able to develop critical decision making skills within unique, high-risk, high-demand remotely piloted aircraft career fields. The results may be used to develop and improve upon training and crew resource management programs and personnel selection processes. Additionally, the results reveal pretraining psychological testing provides the capability to understand aspects of an individual's cognitive and emotional states of functioning that may provide useful information for developing mentorship and interventions that promote optimal performance and improve decision making.

#### Learning Objectives:

1. The participant will be able to identify the cognitive and emotional processes among those who are able to develop critical decision making skills within remotely piloted aircraft career fields.

**Thursday, May 10**

**Chantilly Foyer**

**9:30 AM**

### S-081: POSTER: TROUBLE WITH TRAVEL

**Chair: Nona Mapes**

Rockville, MD

**Chair: Casey Pruett**

Cologne, NRW, Germany

### [392] HUMAN PAPILLOMA VIRUS (HPV) VACCINATION COMPLIANCE IN A MILITARY AVIATION TRAINING COMMUNITY (PART 1)

I.M. Porter<sup>1</sup>, G. Stoker<sup>1</sup>, S. Seals<sup>2</sup>, S. Drollinger<sup>1</sup>, H. Schutte<sup>1</sup> and G. Rice<sup>1</sup>

<sup>1</sup>NAMI, Pensacola, FL; <sup>2</sup>University of West Florida, Pensacola, FL

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** To our knowledge there are no studies evaluating HPV vaccination compliance in an aviation training environment. Current HPV vaccination adherence within the aviation training environment is unknown. This study identifies baseline and follow-up HPV vaccination rates among officers and enlisted personnel assigned to a local aviation training command. **METHODS:** We identified baseline and follow-up (3 months

post-intervention) HPV vaccination compliance rates of active duty officer and enlisted aviation personnel stationed at Naval Aviation Schools Command (NASC) in Naval Air Station Pensacola Branch Medical Clinic by reviewing electronic immunization records. An intervention: educational brief, survey, and informational handout about the HPV vaccine were distributed to consenting participants. HPV vaccination compliance rates were then re-examined after 3 months for both the intervention and control arm of this study to assess the impact of the intervention.

**RESULTS:** 548/594 participants included for data. 46 were excluded for missing data. 205/548 or 37.4% had at least started the vaccine series. 130/548 or 23.7% completed the vaccine series. 10/343 or 2.92% received the vaccine after intervention. 282/548 or 51.5% were enlisted service members, 3/282 or 1% ever had vaccine, and 1/282 or 0.35% completed the 3 shot series. 0/282 or zero percent of enlisted personnel went to obtain the vaccine after intervention. All of the post intervention vaccine recipients were officers. **DISCUSSION:** There is a significant disparity among officer and enlisted training aviation personnel in terms of HPV vaccination compliance (75% vs. 1% respectively). A vaccination incidence was noted at 2.92% per three months for the intervention group. The post intervention vaccinated personnel were all officers. The findings in the enlisted aviation community are congruent to findings in previous U.S. Navy HPV vaccination studies. Part 2 of this study addresses the behavioral aspects gleaned from the survey and apparent reporting discrepancies of being HPV vaccinated in comparison to the poor vaccination rates found upon records review.

#### Learning Objectives:

1. To educate the aviation community about current baseline rates in active duty aviation training personnel.
2. To communicate the descriptive findings of this HPV vaccination compliance research.
3. To further HPV vaccination research and awareness by utilizing non-invasive techniques for intervention.

### [393] HUMAN PAPILLOMA VIRUS (HPV) VACCINATION COMPLIANCE IN A MILITARY AVIATION TRAINING COMMUNITY (PART II): SELF-REPORTED BARRIERS

G. Stoker<sup>1</sup>, I.M. Porter<sup>1</sup>, G. Rice<sup>1</sup>, S. Seals<sup>2</sup> and H. Schutte<sup>1</sup>

<sup>1</sup>NAMI, Pensacola, FL; <sup>2</sup>University of West Florida, Pensacola, FL

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** To date, there is a dearth of knowledge regarding barriers to HPV vaccine compliance among active duty personnel. This study was proposed to understand current HPV vaccination completion rates, identify barriers to vaccination completion, and identify gaps in HPV knowledge among military aviation personnel. **METHODS:** Using a brief survey, enlisted and officer aviation personnel presenting for training to Naval Air Station, Pensacola, were asked to report prior HPV vaccine experience and barriers to completion of vaccine series, if not completed. Awareness of HPV infection as the most common STI, the link between persistent HPV infection and certain types of cancer, and presence of an effective HPV vaccine was assessed. For those who reported no prior vaccine experience, participants were asked if a targeted HPV education brief improved their opinion about HPV vaccine compliance. **RESULTS:** After fifteen weeks, 925 surveys have been received (363 enlisted, 562 officers). Among surveyed personnel, 26.4% of enlisted reported HPV vaccine completion as compared to 49.5% of officers. Lack of awareness of available vaccine was the most commonly reported barrier to series completion. After targeted education brief, 83.8% of enlisted and 61.8% of officers who had not started the vaccine felt the education brief improved their opinion of the vaccine. Among enlisted, 70.5% were unaware HPV is most common STI, 55.4% were unaware of HPV-associated diseases, and 60.8% reported lack of awareness of a vaccine for HPV. **DISCUSSION:** Less than half of active duty personnel surveyed reported having completed HPV vaccination series. A notable disparity between self-reported rates by enlisted as compared to officers (26.4% vs 49.5%) echoes the disparity in documented HPV vaccine compliance as evidenced by immunization

records reported in Part 1 of this study. Gaps in knowledge regarding HPV and its adverse health implications appear to exist among our active duty members, with lack of awareness of the HPV vaccine listed as the most common barrier to obtaining the vaccine. Interestingly, self-reported rates of HPV vaccine completion do not coincide with documented HPV vaccine compliance as noted within electronic immunization records (unpublished data from Part 1). Understanding barriers to vaccine completion and providing tools to overcome barriers will ensure a healthy and ready force now, and into the future.

#### Learning Objectives:

1. Identify current HPV vaccine compliance, and barriers to compliance as reported by military aviation personnel.
2. Assess gaps in knowledge regarding HPV virus infection, association with anogenital and oropharyngeal cancer, and presence of effective vaccine against HPV.
3. Assess if a HPV education brief can improve opinion of HPV vaccine among personnel who have not yet obtained the vaccine.

### [394] ANALYSIS OF AIRCRAFT CABIN AIR QUALITY AND ENVIRONMENT IN CHINA

B. Qiu<sup>1</sup>, J. Fan<sup>1</sup>, T. Liu<sup>1</sup> and G. Bai<sup>2</sup>

<sup>1</sup>Public Health Research Division, Civil Aviation Medical Center of CAAC, Beijing, China; <sup>2</sup>China CDC, Beijing, China

WITHDRAWN

### [395] FROM PATIENT TO PASSENGER: UK ANESTHESIOLOGISTS' KNOWLEDGE OF FITNESS TO FLY GUIDANCE

M.A. Stubbs<sup>1</sup> and B. Posselt<sup>2</sup>

<sup>1</sup>Department of Anaesthesia, Portsmouth Hospitals NHS Trust, Portsmouth, United Kingdom; <sup>2</sup>Royal Air Force, Bedfordshire, United Kingdom

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Anesthesiologists are often asked to provide fitness to fly information/decisions for passenger travel after surgery or anesthesia. Guidance resources for practitioners are available, however, these are not widely published in the UK healthcare system. Additionally, aerospace medicine is not taught on university medical degree programs. This survey aimed to assess the aerospace medical knowledge of anesthesiologists and their awareness of guidance resources. **METHODS:** An electronic survey was circulated, over a one month period, to all anesthesiologists in two large UK teaching hospitals. Participants were asked to estimate the length of time until patients could safely fly as passengers, following 9 commonly performed elective surgical procedures and 3 common anesthetics, and how frequently they were asked to give such advice. Responses were compared with advice published by multiple international aviation related organizations (CAA, IATA, AsMA, and the UK MoD). If participants knew of any guidance sources, they were asked to list them and detail any formal aerospace medical training that they had received. **RESULTS:** 162 surveys were distributed and 82 responses were received (51% response rate). The median frequency that aerospace medical advice was issued by anesthesiologists was every 3-6 months (range: every month-less than once per year). 6 participants (7.3%) were aware of at



least one source of guidance and 3 (3.6%) had received formal aerospace medical training. In general, answers given were more cautious than the most restrictive guidance. There were however some notable exceptions: safe time to fly after intra-ocular gas injection (median answer: 4 wks; CAA suggest minimum 6 wks), and following spinal anesthesia (median answer: 48hrs; AsMA cites severe complications precipitated by air travel 7 days after spinal). **DISCUSSION:** The House of Lords Science and Technology Report (2000) states that non-aerospace medicine specialists should have awareness of and access to fitness to fly guidance. However, this survey demonstrated that although anesthesiologists' are frequently asked for fitness to fly opinions, few are aware of any guidance resources or have received formal training. Efforts should be made to improve anesthesiologists' awareness of aerospace medicine and access to appropriate guidance material. This could be introduced as part of the hospital induction package.

#### Learning Objectives:

1. State the available sources of guidance for practitioners who provide fitness to fly advice to patients undergoing surgery and anesthesia.
2. Summarize the fitness to fly guidance for uncomplicated patients undergoing common surgical procedures and anesthetics.

#### [396] THE LIMITS OF AGE LIMITS: NOVEL APPROACHES TO ASSESSING RISK OF INTERNATIONAL COMMERCIAL PILOTS

M.K. Cairns

Kings College Hospital NHS Foundation Trust, London, United Kingdom

#### (EDUCATION - PROCESS)

**MOTIVATION:** Recent analysis shows global requirements for international commercial aviators will increase substantially over the forthcoming decades. Concurrently, experienced pilots are not permitted under ICAO rules to fly international single handed operations over age 60 or multi-crew operations over age 65. This combination of shortfall in supply and increased demand has led some to consider broader strategies to assess risk of sudden incapacitation - the key limiting factor in certifying fitness to fly. This poster aims to assess several novel approaches which may help mitigate the age-associated loss in the pilot workforce. **OVERVIEW:** 'Genome Analysis': There is a clear divergence in the susceptibility for ill health across a population at a given age. No group shows uniform risk. Most risk analyses have overlooked genetic propensity for all but monogenic hereditary disease. The recent democratisation of genome analysis has however made it feasible to analyse individuals decades before they develop disease and mitigate against this. Although medico-ethically contentious, pilot recruitment could include this as a means of lengthening healthy life years. 'Real-time Biomedical Monitoring': Recent advances in technology have allowed real time detection of both normal and abnormal health parameters as seen by the explosion of fitness tracking devices and applications. Assessment of aviators prior to and during flight could allow non-intrusive early detection of pulse irregularities, blood glucose monitoring, fatigue measurement and even psychological problems. 'Physiological Age Measurements': A growing body of data suggests rates of ageing and physiological functioning are very individualistic. A combined panel of biochemical and physiological markers including everything from cognitive assessment to baseline activity levels and VO2 max measurement is perhaps a more useful aggregate of risk. **SIGNIFICANCE:** A heavier focus on evidence-based individualistic data intensive assessments which were previously not possible could increase the lifespan of the global pilot workforce and help prevent the growing problem of workforce shortfall. This work is of broader interest to regulatory bodies, airlines and AMEs.

#### Learning Objectives:

1. To consider the difficulties of workforce planning to ensure adequate supply of suitably qualified commercial aviators.
2. To increase understanding of how recent advances in genome analysis may help early identification of individuals at increased risk of cardiovascular disease and other causes of sudden incapacitation.
3. To further understanding of how noninvasive biomonitoring may play a role in real time assessment of pilots' health.

#### [397] WHY PHYSICIANS DON'T PARTICIPATE IN INFLIGHT MEDICAL CARE? BASED ON AN ONLINE-RESEARCH IN SOUTH KOREA

S. Lim<sup>2</sup>, S. Park<sup>2</sup>, Y. Jeon<sup>2</sup>, H. Cho<sup>2</sup> and J. LIM<sup>2,1</sup>

<sup>1</sup>International Healthcare Center, Seoul National University Hospital, Seoul, Republic of Korea; <sup>2</sup>College of Medicine, Seoul National University, Seoul, Republic of Korea

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** In the previous study we conducted regarding in-flight doctor calls in South Korea, it was revealed that Korean physicians have low willingness to participate (61.6%) in comparison to their actual participation rate (76.0%). The aim of this study is to understand why such phenomenon happens by comparing related laws of various countries. **METHODS:** Subjects were members of the Korean Academy of Family Medicine and Korea Aerospace Medical Association. The online survey was conducted from July 26<sup>th</sup> 2016 to August 5<sup>th</sup> 2016. The questionnaire consisted of 18 items on recognition of physicians' experiences, laws, medical services, etc. We re-evaluated these items, then compared them with current situation of other countries, mainly Japan, Germany and the United States. **RESULTS:** Total 445 respondents completed this online questionnaire. Amongst them, 23.4% (104/445) left comments freely regarding in-flight doctor calls in South Korea. As for the related laws, Korea amended the law in 2011 that protects physicians involved in medical emergencies from civil and criminal liabilities unless there has been deliberate intent to harm or gross negligence, and also granted commutation, not full exemption, of criminal charges in case the patient dies. However, it is still possible to file a civil lawsuit. In this case, the physician must demonstrate that there has been no intentional and grave error in judgement. Japan has a similar law. Japanese Civil Code Section 698 states that "when managing to avoid the imminent danger of property or health of other person, he or she shall not be held responsible for damages incurred unless there is major or gross negligence". In Germany, Good Samaritan law applies to inflight medical emergencies as well. However, it encourages medical professionals to help people in need by providing protection from legal liability concerns and simultaneously obligates them to give proper care as the law condemns those who fail to give help. **DISCUSSION:** The results have revealed that the fear of legal ramifications was a major reason for physicians to hesitate providing care for fellow passengers in inflight medical emergencies. Furthermore, the current law regarding inflight medical emergencies is perceived as discouragement rather than protection among physicians. Though countries vary in their legal stances related to physician's involvement in inflight medical emergencies, need for more appropriate Good Samaritan laws seem to be ubiquitous.

#### Learning Objectives:

1. Understand how many physicians actually participated in inflight medical care?
2. Understand why physicians will not participate in inflight medical care?
3. Understand impact of the fear of legal issues and current law on the participation.

#### [398] AN INNOVATIVE INNER-EAR-SENSOR TO MEASURE OXYGEN SATURATION DURING MILITARY FLIGHTS INCREASING SAFETY

A. Werner<sup>1</sup>, H. Ortlepp<sup>2</sup>, O. Brodersen<sup>2</sup>, A. Steinke<sup>2</sup>, C. Wittmann<sup>3</sup>, F. Fischer<sup>4</sup> and C. Jühran<sup>5</sup>

<sup>1</sup>Aviation Physiology Training Centre, German Air Force - Centre of Aerospace Medicine, Königsbrück, Germany; <sup>2</sup>Fachbereich optische Sensorik, CiS Forschungsinstitut für Mikrosensorik GmbH, Erfurt, Germany; <sup>3</sup>Koralewski Industrie-Elektronik oHG, Hambühren, Germany; <sup>4</sup>SpaceBit GmbH, Eberswalde, Germany; <sup>5</sup>Section II 3 c, German Air Force - Centre of Aerospace Medicine, Fürstenfeldbruck, Germany

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Every time full tissue oxygenation is a requirement to avoid cognitive and perceptual deficits. In high-performance jets oxygen (O<sub>2</sub>) increasingly is given to ~100% and pressurized over a mask. Nevertheless, hypoxic-like symptoms are

reported in high-altitude aviation until today. In other aircrafts,  $O_2$  is usually not applied, but deoxygenation could be similarly an issue. Due to well-educated personal deathtrap situations averted to date. However, it is of great interest finding a safe and straightforward technological solution to monitor continuously and in real time  $O_2$ -saturation inflight. **METHODS:** Investigations in a non-invasive, photo-plethysmography (PPG)  $O_2$ -sensor applicable in the extern acoustic meatus (inner-ear-sensor - IES) were done. An individually adjusted ear tip was assembled with this new developed LED-emitter/photo-detector silicon chip. Its advantage is the fast detection of oxygenation which could be averaged below 10sec. Two subjects were asked to test this design during education in a high-altitude-chamber (HAC). **RESULTS:** The ear tip was reported as comfortable and did not annoy under the helmet. Sensors' conduction was always excellent, and the plotted data gave a quick response of  $O_2$ -saturation in real-time. The velocity of tracing deoxygenation was faster compared to finger-clip. As a side product, pulse-wave and heart frequency were recorded. The hearing wasn't disturbed; liminal audiometry evidenced an auditive absorption of less than 5dB (>3kHz). **DISCUSSION:** The IES fulfilled the requirements by using it during HAC exercise. Compared to other devices (exhaled breath components, hypoxia biomarkers), this chip technology seems to be less fragile. Further tests are necessary as the comparison with other sensors (e.g., NONIN, NIRS) and the utilization during the real flight. The chip is supposed to generate additional physiological parameters (calculated blood pressure). Embedded in a physiological system with radio capability this innovation could help to increase flight safety by giving an immediate warning of threatening unconsciousness.

#### Learning Objectives:

1. Hypoxic-like symptoms are reported in high-altitude aviation until today, nevertheless, oxygen increasingly is given to ~100% and pressurized over a mask in high-performance jets.
2. It is of great interest finding a safe and straightforward technological solution to monitor continuously and in real time oxygen saturation inflight.
3. Investigations in a non-invasive, photo-plethysmography (PPG) oxygen sensor applicable in the extern acoustic meatus (inner-ear-sensor - IES) were done successfully.

### [399] MULTIMODAL NEUROIMAGING OF BRAIN RESPONSE TO POTENTIAL MECHANISMS UNDERLYING UNEXPLAINED PHYSIOLOGIC EVENTS

M.J. Decker<sup>1</sup>, E.G. Damato<sup>1</sup>, T.A. Flak<sup>2</sup>, S.B. Donnola<sup>1</sup>, A.M. Ziganti<sup>1</sup> and C.A. Flak<sup>1</sup>

<sup>1</sup>Case Western Reserve University, Cleveland, OH; <sup>2</sup>BioAutomatix LLC, Shaker Heights, OH

#### (EDUCATION - TUTORIAL)

**PROBLEM STATEMENT:** Unexplained physiologic events (UPE) have incapacitated even the most seasoned aircrew. An emergent need exists to enhance technologies measuring brain structure, function and performance and employ these technologies during experimental scenarios replicating cockpit environments existing before, during and after such events. **TOPIC:** Magnetic Resonance (MR) neuroimaging provides high resolution, high contrast images. Until recently, MR-derived classification of neural structure has been qualitative; tissue characteristics were constrained to categories of white matter, grey matter and cerebral spinal fluid. To provide quantitative measures of neural structure and function, newer MR techniques of Diffusion Tensor Imaging (DTI) and Arterial Spin Labeling (ASL) are implemented alone or in combination with semi-quantitative techniques such as functional MRI (fMRI), T1/T2 weighting and Fluid-attenuated inversion recovery (FLAIR). When coupled with high-density electroencephalography (HD-EEG), neuroimaging techniques may provide multiple, real time measures of the brain's response to any number of conditions proposed to induce unexplained physiologic events. Although technically feasible, it has been unclear whether HD-EEG can be integrated with multiple MR techniques into a single series of sequences measuring the brain's functional response during abrupt changes in arterial oxygen or carbon dioxide levels, two physiologic stressors frequently encountered

during flight. Therefore, we have developed and implemented the use of HD-EEG with multiple quantitative MR techniques. During development, we assessed cost-benefit ratio of higher vs lower resolution, and tissue slice thickness upon sequence duration. The final series of sequences provide real time measures of brain perfusion and EEG activity during exposure to differing levels of inspired oxygen. Co-registering functional responses with discrete neuroanatomical locations and white matter tracts provides insight into regions most impacted by abrupt changes in inspired oxygen. **APPLICATIONS:** Multimodal neuroimaging provides insight to neural functional responsiveness to abrupt changes of inspired oxygen concentration, one proposed mechanism of UPEs. The approach is applicable to other medical research questions as well as many clinical conditions, e.g. quantifying brain structure and function following therapeutic interventions for traumatic brain injury, stroke or neurodegenerative disease.

#### Learning Objectives:

1. Understand the strengths and weaknesses of magnetic resonance imaging techniques and their applicability for real-time measurements of brain structure and function.

### [400] ASSESSING PILOTS' KNOWLEDGE OF BASIC WEATHER PLANNING PRODUCTS

Y. Ortiz, B. Blickensderfer, J.M. King, T.A. Guinn, R. Thomas and N. Defilippis

Embry-Riddle Aeronautical University, Daytona Beach, FL

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Weather briefing is an integral component of safe flight operation planning. In general aviation (GA), absent or deficient weather briefings have been associated with weather-related accidents, such as visual flight rule operations into instrument meteorological conditions. The presence and quality of a weather briefing is derived from a pilot's knowledge and ability to obtain and interpret various types of weather hazard products, such as observation and forecast products. However, pilots may lack the appropriate knowledge to interpret even the simplest forms of weather data. Therefore, the purpose of this study was to investigate pilots' knowledge of interpreting the most commonly used flight planning weather products (METAR, TAF, Winds Aloft, PIREP). **METHOD:** A hundred and fifty-two pilots ( $M_{age} = 58.0 \pm 13.2$ ;  $Mdn_{flight\ hours} = 1025.0$ ) across the U.S. completed a 25-item assessment online. Pilot certifications ranged from private ( $n = 37$ ), private with instrument ( $n = 49$ ), commercial with instrument ( $n = 22$ ), certified flight instructor ( $n = 20$ ), to airline transport pilots ( $n = 24$ ). **RESULTS:** A 5x4 mixed analysis of variance was conducted to assess the impact of pilot certification (private, private with instrument, commercial with instrument, CFI/CFII, ATP) and product type (METAR, TAF, Winds Aloft, PIREP) on percent correct. There was no significant interaction between pilot certificate and product type, Wilks' Lambda = .92,  $F(12, 384) = 1.07$ ,  $p = .39$ ,  $\eta_p^2 = .03$ . A main effect of pilot rating occurred,  $F(4, 147) = 5.16$ ,  $p < .01$ ,  $\eta_p^2 = .12$ . Private ( $M = 62.40$ ) scored significantly lower than CFI/CFII ( $M = 73.26$ ) and ATP ( $M = 76.62$ ), while ATP scored significantly higher than private with instrument ( $M = 67.09$ ) and commercial with instrument ( $M = 65.64$ ). A main effect for weather planning product type occurred, Wilks' Lambda = .30,  $F(3, 145) = 113.28$ ,  $p < .01$ ,  $\eta_p^2 = .70$ . Pilots scored significantly lower on METARs ( $M = 55.95$ ) and TAFs ( $M = 56.85$ ) than on PIREPs ( $M = 77.66$ ) and Winds Aloft ( $M = 85.55$ ). Additional analyses indicate correlations may exist between METAR/TAF format usage (standard/decoded) and METAR/TAF scores. **DISCUSSION:** Low TAF knowledge scores indicate pilots may have difficulty in interpreting forecast data. Further assessments are needed to fully measure pilots' knowledge of forecast products; this includes assessing pilots' knowledge in interpreting area forecasts, G-AIRMETs, and low level significant weather charts.

#### Learning Objectives:

1. The audience will learn that pilots scored the lowest on METARs and TAFs, and the highest on PIREPs and Winds Aloft.
2. The audience will learn that ATP, CFI/CFII, and commercial with instrument scored similarly on basic weather planning products, while private pilots scored the lowest.

#### [401] U.S. ARMY PARACHUTE MISHAP FATALITIES: 2010-2015

E.S. Johnson<sup>1</sup>, S.J. Gaydos<sup>1</sup>, R.S. Kotwal<sup>2</sup>, J.J. Pavelites<sup>1</sup> and J.E. Houk<sup>3</sup>

<sup>1</sup>School of Army Aviation Medicine, Fort Rucker, AL; <sup>2</sup>Joint Trauma System, U.S. Army Institute of Surgical Research, San Antonio, TX;

<sup>3</sup>82nd Combat Aviation Brigade, 82nd Airborne Division, Fort Bragg, NC

##### (ORIGINAL RESEARCH)

**INTRODUCTION:** Military parachuting operations can be used to insert combat forces into strategic locations on the battlefield. Despite the large number of U.S. military members that conduct military parachuting operations, its operational importance, and the introduction of the new T-11 military parachute in 2010, very little has been published in the last decade on military parachute fatalities. **METHODS:** We conducted a descriptive study of all U.S. Army fatalities resulting from military parachuting operations between January 1, 2010 and December 31, 2015. Parachute fatality records from accident investigations maintained by the U.S. Army Combat Readiness Center were reviewed. De-identified data from each case were collected on demographics, environment, weather, mission, equipment, and aircraft. Incident causes and lethal injuries were also reviewed. **RESULTS:** Thirteen cases met study inclusion criteria. These were 92% male and 77% from enlisted ranks, with a median age of 27 years (IQR 11.5) and a mean BMI of 26.5 (SD 3.75). Of the fatalities, 27% occurred during static-line operations from altitudes between 1,000 and 1,250ft above ground level. In 92% egress was out of a side door. Six different aircraft types were used as jump platforms. In 46% of fatalities, a C-17 transport aircraft was used. The T-11 was the primary parachute used in 54% of cases. Accident investigators assigned 11 different causal codes across the 13 cases, with up to two codes used per case, totaling 18 codes. These included improper or abnormal exit (3/18), static-line injury (1/18), unstable or improper body position (3/18), entanglement (2/18), parachute malfunction (2/18), lost or stolen air (1/18), dragged on the drop zone (2/18), drop zone hazard (1/18), and other (3/18). In 69% of cases blunt force trauma was the cause of death. Neck injuries, electrocution, and asphyxiation accounted for the remainder of the lethal injuries.

**DISCUSSION:** The incident causes were heterogeneous and included human actions, equipment failure, and environmental factors. Death caused by blunt force trauma upon impact with the ground being the most frequent lethal injury was expected for parachute operations. This descriptive study provides awareness to military leaders of circumstances in which fatalities occur. Future investigation into parachute fatalities including data on the total number of jumps for each investigated factor would provide a more comprehensive and informative analysis.

##### Learning Objectives:

1. Describe the variety of factors that contribute to Army parachute fatalities.
2. Identify the leading factors correlated with parachute fatalities described in this study.
3. Discuss features of future investigations related to parachute fatalities that will better quantify risk associated with contributing factors.

#### [402] INADVERTENT IMC TRAINING AND FATAL HELICOPTER EMERGENCY MEDICAL SERVICE ACCIDENTS

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<sup>1</sup>Department of Aviation, Swinburne University, Melbourne, Australia;

<sup>2</sup>Aviation Medicine Unit, Monash University, Melbourne, Australia

##### (ORIGINAL RESEARCH)

**INTRODUCTION:** The United States Helicopter Emergency Medical Service (HEMS) industry, has suffered fatal accidents at night, predominantly from non-instrument proficient pilots becoming spatially disoriented in dark night conditions or after inadvertent entry into instrument meteorological conditions (IMC). Instrument rating proficiency can be replaced by a pilot competency check demonstrating safe recovery from inadvertent IMC entry. This study sought to determine whether non-instrument proficient pilots with inadvertent IMC training (IIT) had less risk of fatal outcomes from loss of control accidents compared to those without. **METHODS:** Night VFR HEMS fatal accident data from 1995-2013 were reviewed. Twenty-seven accidents occurred in

conditions associated with adverse weather. Twenty non-instrument proficient pilots were involved, only ten of which had conducted inadvertent IMC training. All loss of control outcomes used total number of fatalities from each flight. Both pilot groups (with and without IIT) and accident outcomes were analyzed in a 2x2 contingency table using Fishers Exact Test of independence. Odds ratios and relative risk were used to analyze risk. Times from IIT to accident were extracted for all pilots. **RESULTS:** Pilots with IIT demonstrated significant (FET 0.002) increased risk (RR 1.94 95% CI 1.24-3.028) and odds (OR 6.0 95% CI 1.92-18.74) for fatalities following loss of control, compared to pilots without training. For those pilots who had completed IIT, the accident occurred an average of 149 elapsed days (SD±105) later. **DISCUSSION:** Inadvertent IMC training showed no protective effect against fatalities from loss of control accidents, compared to pilots with no such training. The results of this study suggest that there is a degree of skill atrophy associated with IIT. While studies demonstrate improvements in pilot handling skills after IIT, how long these improvements last for and how often pilots should retrain are important questions remaining to be answered. The perishable nature of the skills associated with IIT requires further attention, particularly if pilots are to avoid type II (recognized) disorientation outcomes during HEMS operations. Understanding pilot performance under difficult operational conditions is vital to protect all those involved.

##### Learning Objectives:

1. Understand the relationship between inadvertent IMC training and fatal HEMS accidents.

#### [403] ASSESSING TRENDS IN CANNABINOID CONCENTRATIONS FOUND IN SPECIMENS OF AVIATION FATALITIES BETWEEN 2007 AND 2016

A. Norris, K. Cliburn, P. Kemp and V. Skaggs

Civil Aerospace Medical Institute, FAA, Oklahoma City, OK

##### (ORIGINAL RESEARCH)

**INTRODUCTION:** Tetrahydrocannabinol (THC) is the main psychoactive ingredient in marijuana and is used to evaluate impairment in aviation accidents. A previous study established a 2.7-fold increase in mean concentration of THC in specimens collected from aviation fatalities during 1997-2006. No study has examined this comparison since 2006. Aims of this study are to assess the association between exposures and cannabis-related aviation fatalities from 2007-2016 and to compare concentration of both THC and metabolite THCCOOH found in airmen's blood to previous studies. **METHODS:** Cannabinoid concentrations in blood evaluated in the toxicology lab of the Office of Aerospace Medicine (OAM) were compared over the 10-year time period. Results from 2007-2011 and 2012-2016 were combined to evaluate trends in cannabinoid concentrations. We conducted additional analyses to evaluate the association between potential exposures and marijuana-related fatalities in a case-control study among medically-certificated aviation pilots. Outcomes were fatal accidents where the pilot was positive for THC or THCCOOH. Exposures were mostly collected from the pilots' most recent medical certificate examination. Other exposures examined were presence of ethanol and impairing drugs at the time of fatality. **RESULTS:** Overall median THC concentration for the 10 years was 8.0 ng/ml (range=1.3-69.2), while the median THCCOOH concentration was 10.5 ng/ml (range=1.2-200.5). When we categorized quantities into 5-year time periods, median THC concentration for 2007-2011 was not statistically different from concentrations during 2012-2016 (p=0.1030). However, median THCCOOH concentration for 2007-2011 was 16.7 ng/ml (range=1.2-200.5), and was statistically higher than median THCCOOH concentration of 7.4 ng/ml (range=1.5-124.3) for 2012-2016 (p=0.0155). For the second analyses, 55 cases were identified with THC or THCCOOH, and 1,918 controls were identified who did not test positive for THC or THCCOOH. With the exception of age and presence of other impairing drugs, the distribution of cases and controls were similar across exposure categories. **DISCUSSION:** While we failed to find a significant increase in cannabinoid concentrations over the 10-year time period, overall median concentrations were higher than reported findings from the previous 10 years. The results indicate age and polydrug use may be more important risk factors of THC-positive fatalities than cannabinoid concentration.



**Learning Objectives:**

1. Examine blood cannabinoid concentrations detected in victims of aviation fatalities, and compare these cases with fatalities where no concentrations were present.

**Thursday, May 10**  
**Wedgewood**

**1:30 PM**

## **S-082: PANEL: CURRENT TOPICS IN EXPLORATION MEDICINE FOR DEEP SPACE**

**Chair: Eric Kerstman**  
Galveston, TX

**Chair: David Reyes**  
Galveston, TX

**PANEL OVERVIEW:** This panel presents the results of the past year of resident and medical student research to help NASA's Exploration Medical Capability answer questions that are important to define the medical capabilities and risk posture of future missions to the moon and Mars. The first topic describes the creation of a suite of standardized medical scenarios that were used by system engineers to define system requirements and spacecraft interfaces for an interplanetary medical system. The second, uses one of those standardized medical scenarios to estimate the maximum communication bandwidth required to support a serious medical event in spaceflight. Limitations on bandwidth can be used to help define the risk posture and the level of autonomous care needed on an exploration mission. The speed with which deep space is traversed can also affect risk by prolonging or decreasing the exposure time to radiation and other space hazards, as discussed in the third topic, where the medical outcomes from missions using different propulsion systems were modelled. Risk during deep space missions is also constrained by mass and volume, requiring new and old techniques to address medical needs of the trauma patient. Thus, the fourth presentation reviews percutaneous drainage techniques, and shows how they can be applied in the resource constrained environment of a deep space mission. And finally, the development of a "floating" blood bank is discussed, based on similar concepts used in austere, terrestrial environments. Transfusion from a "floating" blood bank represents the ultimate in space saving and sustainable medical care. Together, these topics comprise a snapshot of current topics in deep space exploration medicine, and showcase the work of future aerospace medicine practitioners.

### **[404] COMMUNICATION BANDWIDTH CONSIDERATIONS FOR EXPLORATION MEDICAL CARE**

M. Krihak<sup>2</sup>, C.K. Middour<sup>4</sup>, D. Reyes<sup>3</sup>, D. Nusbaum<sup>3</sup> and E. Antonsen<sup>1</sup>  
<sup>1</sup>Exploration Medical Capability, NASA JSC, Houston, TX; <sup>2</sup>Universities Space Research Association, Mountain View, CA; <sup>3</sup>Preventive Medicine and Community Health, UTMB, Galveston, TX; <sup>4</sup>Millennium Engineering and Integration, Mountain View, CA

#### **(ORIGINAL RESEARCH)**

**INTRODUCTION:** Travel to destinations beyond low Earth orbit, especially Mars, have several important constraints, including limited resupply, no possibility of medical evacuation, and delayed communication with ground support teams. Therefore, medical care is driven toward greater autonomy and necessitates a medical system that supports this paradigm. However, communication with ground support will still be used even when there is a one-way delay of up to 24 minutes. **METHODS:** The medical data transfer needs for an exploration mission at Mars were estimated by defining a medical scenario that would require a high rate of data communication between the vehicle and Earth. The medical scenario created involves a case of hydronephrosis that evolves into pyelonephritis, then urosepsis, due to obstruction by a renal stone. A data communication timeline was created following the medical care described in the scenario. From this timeline, total medical data transfers and burst

rates were estimated. **RESULTS:** The total amount of data transferred to the ground was estimated to be 94 gigabytes (GB), whereas the ground-to-vehicle data transfer was estimated to be 8 GB. The greatest amount of medical data communication occurred in the first 72 hours, when the average data rate from vehicle to Earth was 380 kilobytes per second (kB/s) and the average data rate from Earth to vehicle was 36 kB/s. The maximum data burst estimate was determined to be 7.7 megabytes per second (MB/s). The high data rates are primarily driven by the transfer of ultrasound images (~28 MB) and video recordings (~90 MB per minute of video). **DISCUSSION:** Although any crewed Mars mission should be capable of functioning autonomously, as long as the possibility of communication between Earth and Mars exists, Earth-based subject matter experts will be relied on to augment mission medical capability. Therefore, setting an upper boundary to medical communication rates can help factor medical system needs into vehicle communication requirements. Conversely, the recognition of bandwidth limitations can influence the allocation of resources to the treatment of anticipated medical conditions. Knowledge of medical data communication limitations can also be used to inform the medical risk profile for a given exploration mission.

#### **Learning Objectives:**

1. Realize medical data transmission needs and the potential impact on planned medical care for a long-duration, space exploration missions beyond Earth orbit.

### **[405] MEDICAL SIMULATION SCENARIOS FOR EXPLORATION MEDICINE**

D. Reyes<sup>1</sup>, R. Suresh<sup>1</sup>, J. Pavela<sup>1</sup>, M. Urbina<sup>2</sup>, J. Mindock<sup>4</sup> and E. Antonsen<sup>3</sup>

<sup>1</sup>Preventive Medicine and Community Health, UTMB, Galveston, TX;

<sup>2</sup>MEI Technologies, Houston, TX; <sup>3</sup>Exploration Medical Capability, NASA JSC, Houston, TX; <sup>4</sup>KBRwyle, Houston, TX

#### **(ORIGINAL RESEARCH)**

**INTRODUCTION:** Medical simulation is a useful tool that can be used to train personnel, develop medical processes, and assist cross-disciplinary communication. Medical simulations have been used in the past at NASA for these purposes, however they are usually created ad hoc. A stepwise approach to scenario development has not previously been used. The NASA Exploration Medical Capability (ExMC) Element created a medical scenario development tool for use in testing of medical procedures, technologies, concepts of operation, and in systems engineering (SE) processes. **METHODS:** UTMB Aerospace Medicine Residents were tasked with developing an algorithm for medical scenario development, under the guidance of NASA flight surgeons, ExMC system engineers, and other interested parties. A robust scenario tool was developed that captures the physician thought process used during medical encounters. This tool was then used to take 11 scenarios from the Mars Transit Medical Concept of Operations (ConOps) that demonstrate various system functions, and decompose them for training and testing purposes. **RESULTS:** A robust scenario development tool was created and then used to make a book of medical scenarios that show how a physician would approach treatment of the functional medical scenarios in the ConOps. This work was then used to inform human factors and SE activities for the definition of system medical requirements for the Gateway and Mars Transit vehicle systems. **DISCUSSION:** Medical scenarios are often used for training of medical personnel, but have broader utility. The ExMC medical algorithm and scenario book created an excellent communication tool that bridged the worlds of medicine and engineering. The stepwise algorithm helped engineers understand the medical thought process, and gave team physicians some insight into the needs of engineers. This tool will be used to refine and test aspects of the exploration medical system ConOps in analog environments, such as the Human Exploration Research Analog (HERA), the Integrated Power, Avionics and Software platform (IPAS), and eventually aboard the International Space Station.

#### **Learning Objectives:**

1. Learn how medical scenarios are used as a tool to bridge the worlds of medicine and engineering.

#### [406] A QUANTITATIVE COMPARISON OF CREW HEALTH RISKS FOR DIFFERENT INTERPLANETARY PROPULSION TECHNOLOGIES

M.S. Thompson<sup>1</sup>, W. Rodriguez-Jimenez<sup>1</sup>, D. Reyes<sup>1</sup>, E.L. Kerstman<sup>1</sup> and E. Antonsen<sup>2</sup>

<sup>1</sup>Preventive Medicine and Community Health, UTMB, Galveston, TX;

<sup>2</sup>Exploration Medical Capability, NASA JSC, Houston, TX

##### (ORIGINAL RESEARCH)

**INTRODUCTION:** Interplanetary missions carry increased crew health risk compared to low Earth orbit. The primary driver of health risk for travel to Mars is the round-trip transit time (RTT), which is dependent upon method of propulsion. Longer RTT increases exposure to microgravity, radiation, and overall health risk. This study uses NASA's Integrated Medical Model (IMM) to provide a quantitative comparison of the medical risk between various modes of propulsion. **METHODS:** The IMM version 3.0, a probabilistic risk assessment tool, was used to simulate one hundred thousand trials for each propulsion Design Reference Mission (DRM). RTT for fusion, VASIMR, nuclear thermal, solar electric, and nuclear electric propulsion were input, as well as the NASA Mars DRM-5 mission, which uses conventional propulsion. The crew profile was held constant across all DRMs and consisted of 3 female and 3 male crewmembers with pre-existing medical conditions consistent with historical crew data. Outcomes included total medical events (TMEs), crew health index (CHI, the inverse of quality adjusted time lost), probability of evacuation (pEVAC), and probability of loss of crew life (pLOCL). Extravehicular activity (EVA) and surface time were not included. **RESULTS:** The TMEs, pEVAC, and pLOCL increased in a nearly linear fashion with increasing transit times. TMEs ranged from 90.3 for fusion propulsion with the shortest RTT (150 days) to 540.0 for nuclear electric propulsion with the longest RTT (1,103 days). TMEs reported as "events per person-year" showed similar trends, aside from shorter DRMs which had a higher relative impact from space adaptation conditions. The pEVAC (probability) ranged from 0.042 for fusion propulsion to 0.190 for nuclear electric. The pLOCL ranged from 0.004 to 0.029. The CHI decreased with increasing RTT, ranging from 93.90% for fusion propulsion to 79.96% for nuclear electric. **DISCUSSION:** Crew health risk increased with increasing RTT, with implications for medical planning and propulsion selection. Technologies are in various stages of development and feasibility; payload mass, engineering constraints, and cost must also be considered. This study focused on RTT given its significant health impact. A comprehensive risk assessment will also consider launch and landing risk profiles, EVA, and length of surface stay.

##### Learning Objectives:

1. Understand the relationship between medical risk and round-trip transit times for varying modes of interplanetary propulsion.

#### [407] PERCUTANEOUS DRAINAGE CAPABILITY FOR DEEP SPACE EXPLORATION

A. Guehl<sup>3</sup>, E.L. Kerstman<sup>2</sup>, D. Reyes<sup>2</sup> and E. Antonsen<sup>1</sup>

<sup>1</sup>Exploration Medical Capability, NASA JSC, Houston, TX; <sup>2</sup>Preventive Medicine and Community Health, UTMB, Galveston, TX; <sup>3</sup>Aerospace Medicine, Wright State University, Dayton, OH

##### (ORIGINAL RESEARCH)

**INTRODUCTION:** Percutaneous drainage serves as a viable and often preferred minimally invasive surgical technique for several medical conditions that have been identified as a concern on long-duration spaceflight. Terrestrial use of this technique in resource-limited environments provides an appropriate analog to spaceflight. Percutaneous drainage also fits well within the constraints of mass, volume, communication, and autonomy that are required for deep-space exploration. **METHODS:** A literature review was performed searching for articles published after the year 2000. Key words searched included "percutaneous drainage", "remote surgical capabilities", "remote mission", "surgical emergency", and "medical treatment of surgical conditions", along with specific medical conditions such as "appendicitis" and "cholecystitis". A review of training recommendations and remote-setting utilization of percutaneous drainage was also included. Additional publications were collected from the references of articles

retrieved by the initial search. Subject matter expert interviews were also included in the review. **RESULTS:** Percutaneous drainage along with appropriate medical care was found to be successful in the treatment of several conditions such as pneumothorax, hemothorax, urinary retention, and abdominal compartment syndrome. Recent literature including meta-analyses reinforces the concept of percutaneous drainage as an appropriate treatment alternative to more invasive terrestrial surgical procedures including appendectomy and cholecystectomy. **DISCUSSION:** In the terrestrial environment successful use of percutaneous drainage to treat medical conditions serves as a viable analog for intervention of potentially life-threatening conditions that could be encountered on exploration-class space missions. Imaging is often an essential component of percutaneous drainage. Current crews use and rely on ultrasound imaging, which will likely be the only imaging available on future missions. The conditions that are amenable to percutaneous drainage continue to expand with the improved design of lightweight equipment, continued advancement of ultrasound technology, and improved computer-based training. Percutaneous drainage could significantly contribute to the medical capabilities of future exploration-class missions given the low mass, volume, and training requirements needed to use this continually evolving technology.

##### Learning Objectives:

1. Review current evidence based capabilities of percutaneous drainage and compare to medical conditions and constraints that may occur in exploration class space missions.

#### [408] "FLOATING" BLOOD BANK CAPABILITY FOR DEEP SPACE EXPLORATION

E.S. Nowak<sup>1</sup>, D. Reyes<sup>2</sup>, E.L. Kerstman<sup>2</sup> and E. Antonsen<sup>3</sup>

<sup>1</sup>Internal Medicine and Pediatrics, MetroHealth Medical Center, Lakewood, OH; <sup>2</sup>Preventive Medicine and Community Health, UTMB, Galveston, TX; <sup>3</sup>Exploration Medical Capability, NASA JSC, Houston, TX

##### (ORIGINAL RESEARCH)

**INTRODUCTION:** Astronauts on long duration space missions may be at risk for traumatic injury and life-threatening hemorrhage. Protocols for emergent volume resuscitation are limited by the medical resources available in the austere conditions of spaceflight. In low-resource terrestrial settings, "walking blood banks" provide a framework for direct, person-to-person blood transfusions. They are used by the military, disaster response teams and ships at sea to generate blood supplies without the need for transport or storage. Here we synthesize existing literature on walking blood banks and apply these concepts to the design of "floating" blood banks for future deep space exploration. **METHODS:** A literature review was performed using PubMed and Google Scholar and subject matter expert interviews. References were cross-checked for additional publications not identified using the initial search terms. **RESULTS:** There is potential for traumatic injury or medical conditions resulting in hypovolemia on long duration missions. At this time, volume resuscitation in zero gravity is limited to infusion with normal saline. Blood transfusion in zero gravity presents a challenge based on storage capacity, containment of liquids, and relative anemia and hypovolemia of crew members. Alternative solutions including deep frozen or lyophilized blood products have been suggested but are impractical based on their storage requirements. Studies of walking blood banks show that transfusion with fresh whole blood is effective but carries an increased risk of transmitted disease. There is no apparent increase in transfusion reactions. Pooled data from six studies show that overall mortality for walking blood bank transfusion recipients is not significantly increased compared to those who received typical component therapy. Individual protocols for walking blood banks include methods for prescreening donors, training and coordinating personnel, activating donors, confirming blood type, infection screening, and monitoring transfusion amount. **DISCUSSION:** In planning for deep space exploration, it is important to account for the possibility of hypovolemic shock or traumatic exsanguination. Floating blood banks could provide a source of blood that is not limited by storage space or shelf life. Successful models of walking blood banks have demonstrated fresh whole blood transfusion can be fast, efficient, and safe.

**Learning Objectives:**

1. Understand current methods and challenges in providing fluid resuscitation in microgravity.
2. Interpret the benefits and drawbacks of walking blood bank protocols in austere terrestrial settings and apply these methods to future deep space exploration missions.

**Thursday, May 10****1:30 PM****Senators****S-083: PANEL: RESIDENT RESEARCH AND QI/PI PRESENTATIONS – PART 1****Chair: Richard Allnutt**  
Beavercreek, OH**Chair: Mark Coakwell**  
Beavercreek, OH

**PANEL OVERVIEW:** This panel will consist of Aerospace Medicine residents presenting the findings from their scholarly activity. During their residency practicum years, residents develop and execute either a research project or a quality improvement/process improvement (QI/PI) project on a topic of aeromedical importance and prepare a presentation to report their results. Residents will here present the findings from their projects. Engaging in scholarly activity advances resident learning and produces information that contributes positively to the body of knowledge relevant to Aerospace and Operational Medicine.

**[409] TRAVEL WITH CHILDREN – AN UPDATED GUIDELINE FOR PARENTS**S. Pelligra

U.S. Air Force, Oakwood, OH

**(EDUCATION - PROCESS)**

**MOTIVATION:** Air travel is becoming ever more commonplace and, as aerospace medical professionals, we are regularly approached for guidance regarding the challenges of transiting through a relatively inhospitable environment as well as problems that can occur when visiting unaccustomed locations. This presentation will review the process of taking children on trips and returning them home safely. The information will be useful for parents as well as for preventative medicine specialists (without routine pediatric exposure in their practice) who are approached for recommendations. **OVERVIEW:** Evidence-based practice necessitates that clinicians remain current with scientific literature. The material presented will be used to update the Aerospace Medical Association's Fitness to Fly and Medical Clearance subdivision, "Travel with Children," which was published in 2003. Topics covered will include appropriate age to travel, age-related travel necessities, traveling while sick, as well as the immunization component and common disease prevention/treatment for international travel. Primary resources in developing a travel process are peer-reviewed journals and systematic reviews. The process and its development will be presented with special reference to promoting health, safety, and comfort, and how these can be improved for future travel.

**SIGNIFICANCE:** Families, both civilian and military, often take advantage of competitive fares to travel by air both domestically and internationally on vacation and, at times, for relocation. All are confronted with issues related to special travel considerations that the pediatric population requires. Patient safety and human performance, at any age, are impacted by utilizing current evidence-based practices in clinical decision making, and aerospace medicine specialists are in a distinctive position to offer guidelines that can support parents for an upcoming trip.

**Learning Objectives:**

1. Review the systematic process of taking children on trips and returning them home safely.

**[410] AIR TRAVEL GUIDELINES FOR MUSCULOSKELETAL INJURIES**E. Casstevens

USAFSAM, Wright-Patterson AFB, OH

**(EDUCATION - TUTORIAL)**

**PROBLEM STATEMENT:** Musculoskeletal injuries are a relatively common occurrence among virtually all age groups, yet there are few sources that commercial air travelers or their provider can consult for guidance about safely flying with these injuries. The Aerospace Medical Association is leading the effort to create a reference for commercial air travel that both medical professionals and the general public can access. This presentation will discuss commercial air travel guidelines for certain musculoskeletal injuries. **TOPIC:** The currently available literature on this topic is sparse; no comprehensive reference exists that addresses commercial air travel with a musculoskeletal injury. Few commercial airlines provide any general medical guidance for travelers or medical professionals, and only one airline specifically addresses orthopedic or musculoskeletal injuries. This commercial air travel guidance will be available to the public via the Aerospace Medical Association website and will include information about why flying with the injury is a potential issue, changes resulting from flying with the injury, management of other associated risks, a summary of the risks, and recommendations for actions to take before, during, and after the flight, as applicable. With the dearth of evidence-based information available, this resource will also integrate expert opinion from orthopedic surgeons, physical therapists, chiropractors, and other sports medicine specialists regarding their specific recommendations for patients with acute or chronic musculoskeletal injuries. **APPLICATIONS:** No comprehensive resource exists to provide guidance for air travelers with musculoskeletal injuries. Using what is known about the pathophysiology of the injuries, and knowledge of the flight environment, combined with expert opinion, these air travel guidelines will represent a novel resource for medical professionals and airline passengers alike.

**Learning Objectives:**

1. Understand how the flight environment affects musculoskeletal injuries.
2. Learn how to minimize the risks of air travel with a musculoskeletal injury.

**[411] MEDICAL CONSIDERATIONS FOR AIRLINE TRAVEL: EAR, NOSE, AND THROAT UPDATES**M. Frayser

USAFSAM, Wright-Patterson AFB, OH

**(EDUCATION - TUTORIAL)**

**PROBLEM STATEMENT:** Ear, nose, and throat (ENT) conditions are common among the general population, including those traveling by air. While the majority of these passengers are able to complete their journey without significant disturbance or discomfort, it is not uncommon for those with ENT-related pathology to experience symptoms such as pain, congestion, headache, dizziness, vertigo, or changes in hearing. **TOPIC:** Understanding how passengers can experience ENT-related difficulties while flying requires an understanding of the changes in atmosphere associated with commercial air travel. The majority of airlines currently pressurize their aircraft cabins to an equivalent altitude of approximately 2440 m (8000 ft). Therefore, unless the departure airport is above this altitude, it results in an atmosphere with lower barometric pressure, decreased partial pressure of oxygen, and lower humidity, often associated with increased cabin noise. It is the interaction of these atmospheric changes along with the location and severity of the ENT pathology that results in the various symptoms experienced. **APPLICATIONS:** Healthcare providers are frequently questioned regarding the safety and comfort of flying with certain ENT conditions. The intent of this presentation is to provide updated guidance for both patients and healthcare providers regarding how to minimize risk and maximize patient comfort while being subjected to the stresses of flight.

**Learning Objectives:**

1. Understand how the flight environment can adversely affect the most common ENT diseases.
2. Gain knowledge regarding how to minimize risk and maximize the comfort of commercial airline passengers with ENT disease in the flight environment.



#### [412] AEROSPACE MEDICAL ASSOCIATION AIR TRAVEL MEDICAL GUIDELINES: GASTROINTESTINAL DISEASES UPDATE

P.R. Newbold

USAFSAM, Wright-Patterson AFB, OH

##### (EDUCATION - TUTORIAL)

**PROBLEM STATEMENT:** Each year over one billion people travel by air. Since the prevalence of gastrointestinal (GI) disease is relatively common among the population at large, many air travelers with acute and/or chronic GI disease are subjected to the stresses of flight each day. Several studies have cited GI complaints as among the most common etiologies of all in-flight medical events. **TOPIC:** The flight environment has the potential to exacerbate several different underlying GI conditions. Additionally, some diagnoses that are secondary to chronic GI disease (i.e., anemia) and mild may become symptomatic at altitude. This presentation will briefly review the underlying pathophysiology of how the flight environment impacts common GI diseases and provide recommendations/mitigation strategies for both the air traveler and the primary care physician managing these conditions. **APPLICATIONS:** Patients frequently ask their healthcare providers whether or not it is safe to fly. The intent of this presentation is to focus on some of the potential issues facing air travelers with GI disease and offer guidance regarding how to minimize risk and maximize their comfort while being subjected to the stresses of flight.

##### Learning Objectives:

1. Understand how the stresses of flight can adversely affect the most common GI diseases as well as those conditions that may be present secondary to the GI disorder.
2. Gain knowledge regarding how to minimize risk and maximize the comfort of commercial airline passengers with GI disease in the flight environment.

#### [413] REVISION AND REFORMATTING OF THE THEATER PATIENT MOVEMENT REQUIREMENT CENTER VALIDATING FLIGHT SURGEON PRIMER

R. Woolley

USAFSAM, Wright-Patterson AFB, OH

##### (EDUCATION - TUTORIAL)

**OVERVIEW:** For a decade now, the Validating Flight Surgeon Primer (VFSP) has served as a valuable reference to providers working in the patient movement arena. Initially conceived as a guide for validation of patient movement from the Central Command area of responsibility, there has been increasing use of aeromedical evacuation (AE) for regulated patient movement of non-combat-related illness from a variety of geographic locations. The current VFSP is aging and lacks a consistent format for the presentation of the aeromedical considerations for many non-trauma conditions. **MOTIVATION:** The invention of portable medical equipment made the development of Critical Care Air Transport Teams possible, offering an unprecedented ability to provide long distance movement of critically ill individuals by air. With the success of the U.S.-led model, both civilian and military patient transport systems across the globe are moving greater numbers of moderately to critically ill patients from austere locations to higher levels of care or for repatriation. The expanding envelope of patients eligible for AE has created new challenges for the validating flight surgeons, whose role is to anticipate and prevent unique aeromedical complications. The U.S. Transportation Command Theater Patient Movement Requirement Center serves as the hub for validation of all U.S. military patient movement, and the Command Surgeon serves as the Department of Defense single manager for the development of policy and standardization of procedures and information support systems for global patient movement. Evolving insights into the impact of barometric pressure changes, relative hypoxia, vibration, noise, acceleration and deceleration, and wide swings in ambient air temperature on the ill and injured led to the development of the first VFSP by Col. (ret) Bill Butler. The VFSP is intended to serve as a well-organized, concise reference to address the pertinent validation concerns for patients with the most commonly encountered traumatic and non-traumatic conditions. **SIGNIFICANCE:** An updated, reformatted VFSP will significantly aid the Theater Patient Movement Requirement

Center and Theater Validating Flight Surgeons in providing the originating care providers with vital information related to patient preparation for and the profiling of aeromedical transport missions for a broad array of trauma and non-trauma-related conditions.

##### Learning Objectives:

1. The learner will be able to describe the role of the validating flight surgeon and at least one pertinent validation concern for the aeromedical evacuation of a patient suffering from a non-trauma related medical condition.

Thursday, May 10

Topaz

1:30 PM

#### S-084: PANEL: HIGH PERFORMANCE AT HIGH ALTITUDE: MEDICAL SUPPORT FOR THE EQUAL PLAYING FIELD SOCCER GAME NEAR THE SUMMIT OF MT. KILIMANJARO

Chair: Dana Levin

Galveston, TX

**PANEL OVERVIEW:** This panel presents the medical events, observational studies, and operational support for the highest altitude full length soccer game ever played. This past June the women's rights group Equal Playing Field sponsored 36 national and Olympic level female athletes and 20 support crew members from 22 different countries climbed Mount Kilimanjaro and played a full-length regulation soccer game in the crater at 18,795.93 feet above sea level. They did this to raise awareness for the inequalities surrounding women's athleticism and to promote athletic opportunities for women and girls world-wide. The first presentation details the preparations, medical kit design, evacuation plan, and the design for game medical support. The second presentation covered the incidence of medical events occurring during the expedition, and compares actual to expected incidence. The third details an observational study of the relationship between menstrual cycle and acute mountain sickness. The fourth panel details the use of non-pharmacological strategies for managing some conditions encountered on the expedition and potential future applications. The Final presentation describes the lessons learned and advice for future expeditions based on the experiences of the Equal Playing Field medical team.

#### [414] MEDICAL KIT, EVACUATION, AND SUPPORT PLANNING FOR A HIGH ALTITUDE ATHLETIC EVENT

D. Levin<sup>1</sup> and B. Easter<sup>2</sup>

<sup>1</sup>Aerospace Medicine, UTMB, Galveston, TX; <sup>2</sup>Emergency Medicine, University of Colorado Denver, Aurora, CO

##### (EDUCATION - PROCESS)

**INTRODUCTION:** This presentation describes the methods and resources used to build the operational medical plan for Equal Playing Field's expedition to set the record for highest altitude soccer game on Mount Kilimanjaro. **METHODS:** The planning was organized in 4 stages. Pre-expedition, trekking, game support, and evacuation. Stage 1 used a survey to gather information on participant medical history. Stage 2 combined stage 1 data with published expedition medical event incidence data to build predicted incidence of expected conditions. A 20% buffer of additional supplies was added and a likelihood of occurrence vs. severity of event matrix was used to estimate the amount of needed equipment. Stage 3 involved discussions with FIFA representatives, review of soccer game medical set ups, and published incidence of soccer game medical events. Stage 4 was based on discussions with rescue crews familiar with Kilimanjaro. **RESULTS:** 57 people (6 male, 51 female) responded to the stage 1 survey. Preexisting conditions included food intolerances, medication allergies, anemia, asthma, prior history of cancer, anxiety, depression, smoking history, sinus problems, hypo and hyperthyroidism, and history of acute mountain sickness. Stage 2 conditions/incidence included; airway <1%, HEENT 3%, Trauma 50% (2% severe), minor hiking injuries 100%, infections 11%, Altitude sickness

4.5% (<1% severe), pain management 50%, GI distress 30%, exposure injuries <1% requiring treatment. The stage 3 plan evaluated each player for symptoms prior to the game against a go/no-go criteria and used a pre-game 6 minute walk test. A medical tent equidistant from the team tents, three rapid response teams with O<sub>2</sub>, AEDs, and stretchers, and 7 oxygen stations were positioned around the field. Support, substitutions, rests, and emergency signals were planned to comply with FIFA regulations. For stage 4 evacuation on foot was deemed the most feasible and appropriate routes were chosen. **DISCUSSION:** The methods used proved effective in providing adequate supplies and staff for this expedition. They were easy to employ and provide a useful template for future expedition medical planners.

#### Learning Objectives:

1. Apply planning methodology to a large group expedition.

### [415] EXPECTED AND ACTUAL INCIDENCE OF MEDICAL PROBLEMS DURING A LARGE, HIGH ALTITUDE EXPEDITION UP MOUNT KILIMANJARO

D. Levin

*Aerospace Medicine, UTMB, Galveston, TX*

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Information on the incidence of medical events during wilderness expeditions is of value to expedition planners. The Equal Playing Field expedition of 54 female athletes and support crew to play a full-length soccer game near 19,000 feet on Mount Kilimanjaro provided a unique opportunity to report on the incidence of medical problems on this predominantly female expedition. **METHODS:** Records of medical care provided to expedition members were reviewed and organized into a database. This database was broken into categories and incidence for each category of event was reported. The medications/materials used and disposition for each case was also recorded and compared to the predicted incidence based on pre-expedition planning. **RESULTS:** The planning for this expedition yielded adequate medical supplies and care for all but one minor condition arising during this expedition. No severe events requiring complete evacuation occurred but two players did not meet criteria for participating in the soccer game and had to be accompanied back to a lower altitude camp to rest under their own power. **DISCUSSION:** The predicted incidence of medical issues in this expedition closely matched or exceeded the actual incidence. Use of these sources is helpful in planning expeditions. Medical gear carried on this expedition proved adequate for medical support and included a large reserve of unused supplies.

#### Learning Objectives:

1. What are the most common medical problems arising from high altitude expeditions.

### [416] THE EFFECT OF MENSTRUATION ON INCIDENCE OF ACUTE MOUNTAIN SICKNESS, AN OBSERVATIONAL STUDY

D. Levin<sup>2</sup> and M. Edmundson<sup>1</sup>

<sup>1</sup>OB/Gyn, Kern Medical Center, Bakersfield, CA; <sup>2</sup>Aerospace Medicine, UTMB, Galveston, TX

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** While it has been proposed that menstruation may increase susceptibility to the adverse health effects of high altitude climates, there is little evidence to support or refute this claim. The Equal Playing Field expedition, in which 54 female athletes and support crew trekked to 5729m and played a full-length soccer game on Mt. Kilimanjaro, provided a unique opportunity to study the effect of menstruation on (Acute Mountain Sickness) AMS. **METHODS:** Records from the expedition were reviewed to determine which women were menstruating and which developed symptoms of AMS. 48 women and 6 men, most of whom reside near sea level, climbed Mt. Kilimanjaro from Arusha at 1387m to Crater Camp at 5,729m over 8 days. Data from the game and subsequent summiting was excluded. The incidence of AMS reported among women who were actively menstruating during the expedition was compared to that among women who were not and a chi square analysis was performed. These rates, and the overall rate of AMS in women were compared to data from the men on the expedition.

**RESULTS:** Data was collected for 6 men and 48 women, 46 of whom were

premenopausal. The overall incidence of AMS was 25.9% with the incidence in men being 16.7% and in women being 27.1% ( $p=0.663$ ). Among the reproductive age women, 17 reported actively menstruating during the trip and 29 reported they were not. 35.3% of menstruating women and 27.6% of non-menstruating women reported symptoms of AMS ( $p=0.583$ ). 85% of the women, took Diamox and/or Decadron and 1 was partially acclimatized from her primary residence being at 2,250m. 2 women reported taking birth control. Both were included in the non-menstruating group, and neither developed AMS. **DISCUSSION:** Menstruation did not increase susceptibility to AMS in this study. Conclusions from these results are limited since this was an observational study, and data on menstrual cycle stage was not collected. Future studies should include a matched control arm, a larger male comparison arm, limited access to prophylactic medications, and detailed tracking of each woman's menstrual cycle more quantitatively to ensure an accurate observation of the possible relationship between menstruation and altitude related illness.

#### Learning Objectives:

1. Understand how menstruation affects symptoms of acute mountain sickness.

### [417] USE OF COMPLEMENTARY/ALTERNATIVE MEDICAL TECHNIQUES IN AN AUSTERE, HIGH ALTITUDE ENVIRONMENT

D. Levin<sup>2</sup> and E. Stratton<sup>1</sup>

<sup>1</sup>SUNY Upstate Medical University, Cicero, NY; <sup>2</sup>Aerospace Medicine, UTMB, Galveston, TX

#### (EDUCATION - CASE STUDY CLINICAL)

**PROBLEM STATEMENT:** This report details the use of complementary medical therapies on the Equal Playing Field expedition to Kilimanjaro in June of 2017. **BACKGROUND / LITERATURE REVIEW:** Weight carried and non-renewable supplies are at a premium on any expedition into an austere environment and medical supplies are no exception. Any intervention that can utilize renewable resources to treat common conditions can save resources for other uses, reduce weight carried, and free up space for other materials. This would have the added benefit of avoiding risks for medication side effects and allergic reactions while away from definitive medical care. **CASE PRESENTATION:** Six cases were found in which used nonpharmacological techniques were effectively used to treat pain, nausea, and musculoskeletal injuries. The employed techniques include trigger point massage therapy and acupressure. **OPERATIONAL / CLINICAL RELEVANCE:** This is an attempt to demonstrate the use of techniques with evidence supporting their use in an austere environment to complement pharmacological therapies. These techniques were used without difficulty to treat several players and restore their ability to participate in the record breaking soccer game. The ease of use in this environment and subjective reports on efficacy lend support for the continued use of nonpharmacologic therapy in austere environments and the possibility of more robust field studies on these techniques in the future.

#### Learning Objectives:

1. Evaluate the use of complementary medicine in austere environments.

### [418] LESSONS LEARNED FROM MEDICAL SUPPORT FOR A HIGH ALTITUDE ATHLETIC EVENT

D. Levin

*Aerospace Medicine, UTMB, Galveston, TX*

#### (EDUCATION - PROCESS)

**INTRODUCTION:** Information from expedition medical team members on the successes and failures of their operational plans can be very useful in avoiding pitfalls on future expeditions. The Equal Playing Field expedition of 54 female athletes and support crew to play a regulation soccer game near the summit of Mount Kilimanjaro provides a unique opportunity to report on the lessons learned from operational medical support of a large expedition and high intensity athletic event in an austere environment at extreme high altitude. **METHODS:** Observational and operational reports from the expedition were reviewed and collected for presentation. Successful strategies, unanticipated events, overestimations and underestimations of incidence/supplies needed, and

thoughts on ways to improve were collected, examined and prepared for presentation. **RESULTS:** Several worthwhile operational lessons were learned from the medical support of this expedition ranging from successful use of low cost nebulizers, to unanticipated incidence of non-life-threatening diseases, to missed opportunities to prevent potentially life threatening conditions, to unintentional but effective psychological stress mitigation strategies for placing several dozen highly competitive athletes from different teams and different countries together in close proximity and competition for 2 weeks. **DISCUSSION:** The lessons presented here are intended to allow future expeditions to learn from our successes and mistakes. While the expedition was an unquestioned success no team is without room for improvement and ours was no exception.

#### Learning Objectives:

1. Post mission analysis can provide insight on ways to improve, even if the mission was a success.

**Thursday, May 10**  
**Sapphire**

**1:30 PM**

### **S-085: PANEL: GLOBAL PILOT MENTAL HEALTH INITIATIVES MEDICAL PERSPECTIVES SPONSORED BY THE ASMA PILOT MENTAL HEALTH WORKING GROUP**

*Sponsored by AsMA Pilot Mental Health Working Group*

**Chair: Ries Simons**  
*Soesterberg, Netherlands*

**Chair: Quay Snyder**  
*Centennial, CO*

**PANEL OVERVIEW:** This panel highlights global initiatives to monitor and enhance mental health in commercial pilots. Aerospace medicine specialists will describe new programs and progress following the Germanwings tragedy developing in Europe, North America and Australasia. The panel will also include outlines of initiatives to train aviation medical examiners in pilot mental health preservation and in the successes of programs to recognize and treat pilots with substance abuse and dependence disorders. Finally, strategies for enhancing individual pilot mental health and improving performance are outlined. This panel focuses on aerospace medicine specialists' perspectives and is complementary to a panel hosted by the Air Transport Medicine Committee focusing on the regulators' and pilots' initiatives.

### **[419] PILOT PEER SUPPORT PROGRAMS IN EUROPE - OBSERVATIONS & LESSONS FROM THE FIELD**

A. Bekker  
*Centre for Aviation Psychology, Abbots Bromley, United Kingdom*

#### (EDUCATION - PROCESS)

**MOTIVATION:** Soon all aircraft operators across the 32 member states of Europe will be required to provide their aviators with access to a pilot peer support program (PSP). Given the diversity of cultures, airlines, business models and pilot demographics, there are several considerations to take into account when establishing and running a well-run and appropriately supervised PSP. This presentation will look at the observations and lessons learned from establishing multiple PSP programs across several European countries. It may appeal mostly to company medical and mental health practitioners charged with running or establishing a PSP within their airline. **OVERVIEW:** As airlines vary, so do their requirements and preferences for the type of PSP that best suits their needs. Some of the key topics addressed in the presentation are: PSP models (i.e., in-house vs. outsourced; operator specific vs. networked solution); organizational culture; peer volunteer supervision and utilization; user access; governance; and the vexed issues of confidentiality, escalation, intervention and liability. Initial web analytic data of user trends is also discussed. Within this context, consideration is given to the role played by organizations such as the European Pilot Peer Support Initiative (EPPSI) in defining standards and sharing best practice. **SIGNIFICANCE:** Following the German Wings tragedy, PSPs have become increasingly important as

an efficient and cost effective way airlines can support their pilots through times of personal distress. While PSPs have high face validity, there are crucial considerations in establishing a credible program that is well run, clinically supervised and appropriately accountable.

#### Learning Objectives:

1. An appreciation and discussion of the multiple considerations in establishing and running a PSP suitable to aviation companies of all sizes and business types.

### **[420] PILOT MENTAL HEALTH & WELLBEING: AN HOLISTIC AND COLLABORATIVE APPROACH**

I. Hosegood  
*Aviation Medical and Occupational Health Services, Qantas, Mascot, Australia*

#### (EDUCATION - PROCESS)

**INTRODUCTION:** Pilot mental health is integrally linked to pilot performance and flight safety. The spectrum of mental health includes not only mental illness but also the more common variations in mental wellbeing at any given time. Strategies must focus on identifying and supporting individuals with mental ill-health but a holistic program also needs to create a mentally healthy environment, eliminate risks to mental health and increase resilience. A collaborative approach between airlines, pilot groups and regulators is essential to increasing early access to effective support programs. **METHODS:** Pilot mental ill-health, including AOD issues is the current preeminent aeromedical risk. Historically there have been significant variations in the jurisdictional approach to managing pilot mental ill health. Some licensing authorities traditionally grounded pilots until they were no longer on medication. In Australia pilots were permitted to fly on antidepressant medication under certain conditions since the early 1990s. In recent years, evidence has emerged to support this approach and other jurisdictions have adopted similar policies. Australia also has mature peer support programs (PSP) with one airline program having run for over 25 yrs. These programs reduce the barriers to accessing health care and provide insights into the nature of risk and protective factors for pilot mental health and therefore assist in targeting health promotion. Pilot wellbeing is a topic where the interests of airlines, regulators and pilot representative organizations align. Collaborative approaches to the promotion of mental health and the management of mental-ill health are more likely to lead to early identification and management of individuals who need it and therefore result in improved flight safety. **RESULTS:** This paper describes the approach of one airline to an holistic and collaborative pilot mental health program. The program has three domains: (i) Raising awareness / reducing stigma, (ii) Creating a mentally healthy culture, (iii) Supporting individuals with mental ill-health. Activities for each domain are presented. **DISCUSSION:** The etiology of pilot mental ill-health is a complex combination of genetic, biological, psychological, and environmental factors and is largely unpredictable. Risk and protective factors can be identified and addressed. It is vital that the aeromedical environment supports self-disclosure with clear pathways for a return to flying once safe.

#### Learning Objectives:

1. Mental ill-health is not only the presence of mental illness but also includes the more common variations in individual mental wellbeing at any given time.
2. Evidence suggests that a successful program needs to have strategies focused on (i) reducing risks to mental health (ii) raising awareness and reducing stigma and (iii) supporting individuals with mental ill health.
3. Success is more likely with a collaborative approach between airlines, regulators and pilot representative organizations with clarity and transparency on the approach to individuals who disclose.

### **[421] FAA AVIATION MEDICAL EXAMINER TRAINING IN PILOT MENTAL HEALTH**

M.A. Berry  
*Office of Aerospace Medicine, Federal Aviation Administration, Washington,*

#### (EDUCATION - PROCESS)

On May 11, 2015, the Administrator of the Federal Aviation Administration chartered the Pilot Fitness Aviation Rule Making Committee (ARC). This was done in response to a recommendation by the



Civil Aviation Safety Team (CAST) and its concern over the Malaysia 370 and German Wings 9625 accidents. The ARC and its separate Medical Working Group began its work in June 2015. The final report of the ARC was released by the Administrator on June 9, 2016. Recommendation #1 of this Report called for "Enhanced Aviation Medical Examiner Training." Specifically the report stated, "*The Federal Aviation Administration (FAA) should ensure all Aviation Medical Examiners (AME) demonstrate knowledge in assessing basic mental health concerns, and enhance AME training on this topic.*" In January 2016, the FAA implemented this enhanced AME training. All AME seminars, since that time, have had Pilot Mental Health Issues as a new component of the training received by all FAA designee AMEs. This training is accomplished through regular seminars including Basic Seminars (physicians becoming a designee AME), Refresher Seminars (maintaining AME status). Total AMEs (Basic and Refresher) who have received enhanced mental health training 01/2016 – 10/2017 is 1,443. In October 2017, online AME training was updated to include this same mental health training section, including an 8-minute video of best practices for pilot interviews. This training focuses on the awareness an AME should have for psychological details that they may notice, or should discuss with pilots, regarding mental health issues. They are taught that they, as well as their staff, should strive to gain a general impression of the pilot's mental health, as a part of the aviation medical exam. This is facilitated by knowledge gained in this dedicated lecture. Additionally, the AMEs are given separate lectures on the Medical Certification policy on Aviation Psychiatry and Addiction Medicine. The specifics of all of this training will be discussed in greater detail.

#### Learning Objectives:

1. Understand the FAA requirements and rationale for basic, and recurrent training for all Designated Aviation Medical Examiners.
2. Learn the impetus for implementing new training for Aviation Medical Examiners.
3. Understand the purpose of the new training for Aviation Medical Examiners in Pilot Mental Health and the content of that training.

#### [422] PROJECT WINGMAN

C. Curreri

American Airlines, Arlington, TX

#### (EDUCATION - CASE STUDY HUMAN PERFORMANCE)

In light of Germanwings 9525, the FAA chartered an Aviation Rulemaking Committee (ARC) on Pilot Mental Fitness for Duty. In November of 2015, the FAA released its report, making 8 recommendations on pilot mental fitness. In the report, the FAA cited Project Wingman as a benchmark for air carrier pilot assist programs that should be implemented by air carriers. In this presentation, we will cover the initiatives implemented by Project Wingman since 2011, beginning with its history, followed by administration aspects, call history and categories of data, and the strong collaborative nature between American Airlines and the Allied Pilots Association.

#### Learning Objectives:

1. Participants should understand some of the basic principles of implementing a robust pilot assist program.

#### [423] IMPROVED APPROACHES TO TREATMENT FOR PROFESSIONAL PILOTS WITH MENTAL HEALTH AND PERFORMANCE-RELATED CONCERNS

M.C. McNeil

LiftAffect LLC, Highlands Ranch, CO

#### (EDUCATION - PROCESS)

**MOTIVATION:** There are unique obstacles professional pilots face when seeking and receiving services for performance-related issues and mental health concerns. For pilots that do receive professional assistance, there are additional challenges to maintaining progress achieved through treatment. Utilizing professional services outside of the traditional in-office visits to mental health professionals/employee assistance programs offers professional pilots more immediate, accessible, and potentially effective treatment options. This presentation will educate aviation medical examiners, airline peer support program coordinators, and mental health professionals (MHPs) that assist professional pilots about viable and effective assistance strategies that exist outside of the

traditional paradigms of treatment. **OVERVIEW:** Accessing and treating professional pilots for mental health and performance-related issues requires an in-depth understanding of not only the barriers pilots face when seeking, receiving, and maintaining gains achieved from professional assistance, it requires a thorough understanding of the ways in which the specific dynamics of the pilots profession contribute to their presenting concerns. Since 2012 this presenter has maintained a private clinical mental health practice providing comprehensive counseling and coaching services exclusively to professional pilots. Through the process of treating over 500 professional pilots across multiple continents, this practice has implemented specific strategies and procedures to adequately address these challenges. Although outcome data gathered from this practice is largely anecdotal, some results have been quantified. The various strategies, procedures, and outcome data mentioned here will be presented. **SIGNIFICANCE:** Optimizing accessibility of care and establishing best practices for the treatment of professional pilots with mental health and performance-related issues provides multiple operational, economic, safety-related, and personal benefits to all relevant stakeholders. As professional pilots are consistently an underrepresented and underreporting population with mental health issues, this information provides greater understanding of barriers to treatment, as well as proposed solutions to those barriers. This work is of interest to MHPs that assist professional pilots and relevant industry stakeholders that are in a position to refer pilots for clinical mental health treatment.

#### Learning Objectives:

1. The most widely utilized and accepted methods of providing treatment pose significant accessibility barriers to many professional pilots with mental health and performance-related issues.

Thursday, May 10

Chantilly East

1:30 PM

#### S-086: SLIDE: HEAD TO TOE

Chair: TBD

Chair: TBD

1:30 PM

#### [424] DOES CONTRAST SENSITIVITY REMAIN RELEVANT TO MILITARY MEDICINE?

H. Gao<sup>1</sup>, S.E. Kaupp<sup>2</sup>, N.L. Delallana<sup>1</sup>, M.A. Mirzaoff<sup>1</sup> and D.M. Murdoch<sup>1</sup>

<sup>1</sup>Ophthalmology, Naval Medical Center San Diego, San Diego, CA;

<sup>2</sup>Retired, San Diego, CA

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Patients during recovery after laser eye surgery (e.g., LASIK, PRK), or with eye diseases (e.g., diabetes, keratoconus) often experience deficits in visual perception. Although visual acuity (VA) is the most widely used metric of visual function, patients often note visual difficulties that are not measurable by simple VA testing. Contrast sensitivity (CS), a more comprehensive evaluation of vision, can more easily document functional vision loss. Military clinics currently use chart-based CS tests; however, they are cumbersome and often limited by testing only one or a few spatial frequencies or levels of contrast, preventing them from detecting or sensitively measuring vision losses.

**PURPOSE:** To evaluate a novel computer-based CS method, Quick Contrast Sensitivity Function (qCSF) as a clinical tool in military eye clinics; to examine visual recovery after LASIK and PRK. **METHODS:** The study included sixty subjects with myopia/astigmatism who had elected for PRK or LASIK. Standard clinical tests were visual acuity (ETDRS, Precision Vision), manifest refraction, 5% CA (contrast acuity, Precision Vision), and wavefront measurements. Monocular photopic and mesopic qCSF measurements were made at Preop (spectacle-corrected) and Postop (uncorrected) 1, 2, 4, and 13-wk. **RESULTS:** Changes of area under CSF curve ( $\Delta AULCSF$ ) and CSF limit acuity ( $\Delta qCSF$  Acuity) from Preop showed significant interaction between Postop visits and treatment types ( $p=0.0000$ ). Most affected spatial frequency were 3.0-18 cycles per deg.

Both lower and higher order astigmatism significantly affected  $\Delta$ AULCSF ( $p < 0.05$ , power  $> 0.99$ ) and explained 30% of AULCSF variation. Both photopic AULCSF and qCSF Acuity were significantly correlated with VA of 100% contrast ( $p = 0.000$ ) and 5% CA ( $p = 0.000$ ). qCSF Acuity was 0.142 logMAR lower than VA. qCSF estimated 5% CA were significantly correlated but was 0.225 logMAR lower than 5% CA ( $p = 0.0000$ ).

**DISCUSSION:** On average, LASIK photopic vision recovers at Postop 1 wk; however, some mesopic vision may not fully return to the baseline by 3 mo after the surgery. Vision begins to recover at PRK Postop 2 wk, both photopic and mesopic vision returns to the baseline at Postop 1 mo. One third of CSF loss can be explained by optical aberrations, primarily due to residual astigmatism. qCSF method is a more sensitive, comprehensive measurement of visual recovery after refractive surgery. CS testing is a valuable vision assessment tool in military medicine.

#### Learning Objectives:

1. To evaluate a novel computer-based CS method, Quick Contrast Sensitivity Function (qCSF) as a clinical tool in military eye clinics.
2. To examine visual recovery after LASIK and PRK.

1:45 PM

### [425] POSSIBLE AEROMEDICAL SOLUTION IN INNER EAR FINDINGS

A.K. Knoeffler

Bundesaufsichtamt für Flugsicherung, Langen, Germany

#### (ORIGINAL RESEARCH)

It is certainly no longer in keeping with the times to forbid people with hearing aids to fly, just as it is no longer appropriate to deny pilots with an already partly impaired hearing performance being provided with hearing aids simply because they want to fly. By now, there are quite a few pilots who use hearing aids and fulfil their flying duties without problems. The presentation will look deeper into this and provide one case. For a long time now, however, the rehabilitation of hearing-impaired people has not been limited anymore to conventional hearing aids. Increasingly cochlear implants (CI) are being preferred when treating serious hearing impairments. Up to now there is no active crew member (in military or civil aviation) wearing CI who had the possibility to go back to his working area. This is different to the United States and Australia. In this presentation I want to introduce the first German case that could possibly have the possibility to go back into the cockpit wearing a CI. In the second case we organized a pilot's going back into the cockpit of an Eurofighter who was suffering from otosclerosis and underwent an operation on both ears.

#### Learning Objectives:

1. You have to know what is important for the flying service to use a CI.
2. What can exclude flying serve after stapedotomy?
3. What kind of examinations are important after stapedotomy?

2:00 PM

### [426] ACUTE MIDDLE EAR BAROTRAUMAS AND EUSTACHIAN TUBE DYSFUNCTION IN FIGHTER PILOT: A CASE REPORT

T.K. Leino<sup>1</sup> and S. Sinkkonen<sup>2</sup>

<sup>1</sup>Air Force Command Finland, Tikkakoski, Finland; <sup>2</sup>Helsinki University Hospital, Helsinki, Finland

#### (EDUCATION - CASE STUDY HUMAN PERFORMANCE)

**PROBLEM STATEMENT:** This case report describes a fighter pilot who experienced repeated right middle ear barotraumas in hypobaric chamber and in F/A-18C Hornet flights. **BACKGROUND:** Military fighters are able to decent 30000 ft per minute challenging middle ear and paranasal sinus gas buffering systems due to air volume decrement according to Boyle's law. Failure in pressure equalization can cause acute barotrauma in middle ear and severe pain can even leading to pilot incapacitation. Acute respiratory infection or allergy are the most common causal factors for equalization problems. Also, adenoid hypertrophy, esophageal reflux, septum deviation, mucosa hypertrophy, soft palatine abnormalities and iatrogenic trauma (e.g., adenoidectomy scar) may be causal factors. Optimal function of Eustachian tube and ability to perform Valsalva maneuver may prevent middle ear barotraumas. **CASE PRESENTATION:** The subject was a 25-yr old Finnish Air Force F/A-18 Hornet pilot with atopic eczema and nasal septum deviation. He had mild right ear pain in hypobaric chamber test (from 15000 ft to sea

level in one minute) during military pilot selection in 2009. After that he experienced acute right middle ear barotrauma in hypobaric chamber 4 years after start of pilot training. The next incident occurred 2014 during a tactical fighter training exercise, with rapid decent in Hornet. In Aeromedical Centre, again acute right middle ear barotrauma was confirmed and treated with paracentesis and culture was taken with negative bacterial finding. After upper respiratory infection and during 12000 ft rapid decent with Hornet, again right middle ear barotrauma was diagnosed and nasal topical steroids were prescribed in March 2017. Due to recurrent middle ear barotrauma, ENT consultation was performed in the Helsinki University Hospital. **OPERATIONAL RELEVANCE:** This case highlights the potential danger of Eustachian tube dysfunction. Preventive measures of middle ear barotrauma are highlighted: never fly fighters until upper respiratory infection is resolved and nasal corticosteroids should be used for treatment of nasal mucosa swelling. This case illustrates the need for more research in Eustachian tube dysfunction of military pilots with repeated middle ear barotrauma. Balloon dilation treatment to cartilaginous portion of Eustachian tube could enhance the pressure equalizing function of middle ear in selected patients.

#### Learning Objectives:

1. To understand etiology and treatment options of repeated middle ear barotrauma in fighter pilots.

2:15 PM

### [427] EARLY DETECTION OF BACK PAIN, EVALUATION OF POTENTIAL PREDICTION FACTORS TO ENSURE (MILITARY) PILOTS MISSIONS

U. Heggli<sup>1</sup>, P. Wyss<sup>1</sup>, M.R. Aepli<sup>1,2</sup>, A. Kunz<sup>1</sup> and D. Bron<sup>1</sup>

<sup>1</sup>Swiss Airforce, Aeromedical Centre, Duebendorf, Switzerland; <sup>2</sup>Sport Sciences, University of Lausanne, Lausanne, Switzerland

#### (EDUCATION - CASE STUDY CLINICAL)

**INTRODUCTION:** The high prevalence of low back and cervical pain in military pilots and Special Forces is well known. Reasons behind such symptoms remain unclear and different causes have been well described, such as scoliosis and disc herniation. Low back pain could have a negative impact for mission endurance causing personal discomfort in cockpit. The aim of this study was to find a correlation between lumbar and cervical pain, radiographies of these regions, and the flexibility ability of the subjects. **METHODS:** Fifty-two Swiss military male helicopter and jet pilots ( $31 \pm 11$  years old) answered a medical questionnaire about their clinical lumbar and cervical symptoms during the last 12 months. Convention x-rays scans examination of each subject's lumbar and cervical regions was assessed. Radiographies were then examined and discussed with medical doctors and a physiotherapist. Afterwards, pilots performed three current movement control tests and flexibility testing's (Ott' signs, finger floor distance and Schober's sign). Results of all clinical, movement and flexibility tests were compared to investigate about potential link with radiographies and its validity to prevent back and cervical pain in pilots. **RESULTS:** Questionnaires showed that 40.4% of subjects suffered of lumbar and/or cervical pain within the last 12 months. A greater part of the study group (59.6%) did not report any pain. However, no significant difference in the number of abnormal radiographic findings was found between the two groups. In the onset of symptoms in the group with complaints (52% of the values,  $1.5 \pm 1.0$  cm) were below the norm (2-4 cm), as opposed to 23% in the group without complaints ( $2.0 \pm 1.2$  cm) ( $P = 0.159$ ). Clinical testing's (i.e. Ott' signs, finger floor distance and Schober's sign) did not show significant difference when compared to each other. Despite interindividual differences, clinical testing remains a predictive technique helping to prevent back and cervical pain in military pilots. **DISCUSSION:** Military pilots often are affected by lumbar and cervical symptoms. Standardized functional instructions to test the movement control of the spine are difficult to implement on the contrary of clinical flexibility tests. Preventive measures could be beneficial to reduce above described symptoms. Further studies are needed to give more insights about a potential relation between clinical testing and back and cervical pain's prevention for military pilots.

#### Learning Objectives:

1. Participant will be able to understand which clinical or functional tests are suitable for the detection of back problems in military pilots and Special Forces.

**2:30 PM****[428] SENIOR NAVAL AVIATOR WITH AN IMPROVEMENT IN HIS (VAS) VISUAL ANALOGUE SCORE FOR TINNIUS FOLLOWING AURICULOTHERAPY**C.G. Kahl*U.S. Air Force, Washington, DC**(EDUCATION - CASE STUDY CLINICAL)*

**PROBLEM STATEMENT:** A 43-year-old male Naval aviator with over 3000 hours of land, sea, and airfield operations resulting in bilateral tinnitus and (SNHL) sensorineural hearing loss. Very little peer-reviewed treatments show benefit for this condition. Moreover, due to complex and often times austere settings of military operations, treatments like tinnitus retraining therapy and biofeedback are arduous, time consuming and difficult to implement. **BACKGROUND / LITERATURE REVIEW:** Tinnitus is a cochlear pathology that debilitates aviator performance and can lead to insomnia, and further complicates (SNHL). Military aviators and combat operatives are at increased risk to developing cochlear damage resulting in (SNHL) and tinnitus. Ground battle and airfield operations expose military personnel to continuous and punctuated noise exposures well over 100db. It has been well documented that the prevalence of hearing loss and tinnitus in military population are greater than in the general public. Almost every soldier, sailor, airman or marine will be exposed to hazardous noise levels at some point in their career.

**CASE PRESENTATION:** The subject pilot was a 43-yr old Naval F-18 Hornet Pilot with over 3000 hours in the airframe. Inspired by a collection of small clinical trials using auriculotherapy, Battlefield Acupuncture (BFA) techniques were employed. Following needle insertion an abrupt improvement in his VAS for rating tinnitus was noted. Also, a small but measurable threshold shift improvement was recorded as well on interval audiogram. The needle was placed in the (BFA) cingulate gyrus point, near the SI19 Auriculotherapy point that has shown promise for treating tinnitus in other studies. The safety and efficacy of acupuncture has been evaluated in a few case reports and small clinical trials as an alternative mechanism for offering relief to patients with persistent and intermittent ear ringing. **OPERATIONAL / CLINICAL RELEVANCE:** The potential benefit of auriculotherapy as an adjunct treatment in some cases of tinnitus has been demonstrated. (BFA) is safe, rapid and in this case subjectively effective. Larger clinical trials could easily be initiated across multiple Military Treatment Facilities. This case illustrates the need for more awareness the prevalence of tinnitus in the aviation community and the need to investigate alternative treatments that may have merit in improving aviator's performance and quality of life who have this condition.

**Learning Objectives:**

1. Demonstrate the effectiveness of safe alternative therapies in the treatment of tinnitus.
2. Provide a primer on the mechanism and prevalence of tinnitus and SNHL in aviators.
3. Discuss proposed mechanisms, at the molecular level, as to why auriculotherapy may work. Review current literature that suggests up-regulation of mu and delta opioid neuro-receptors seen in positron emission tomography from acupuncture patients, that might provide scientific answers to the long term benefit of acupuncture.

**2:45 PM****[429] VISUAL LOSS DUE TO BRVO IN TWO COMMERCIAL PILOTS; IMPLICATIONS FOR FLIGHT**H. Lester<sup>1</sup>, K. Gildea<sup>2</sup> and B. Lester<sup>3</sup><sup>1</sup>Office of Aerospace Medicine, FAA, New York, NY; <sup>2</sup>FAA CAMI, Oklahoma City, OK; <sup>3</sup>Washington, DC*(EDUCATION - CASE STUDY CLINICAL)*

**PROBLEM STATEMENT:** Two case reports of mid-career commercial pilots with reduced central visual acuity in one eye due to branch vein occlusion (BRVO), implications for flight. **BACKGROUND/LITERATURE REVIEW:** Retinal vein occlusion was described in 1855. Estimated prevalence of BRVO is 4.42/1000 persons, increases with age especially past 50, and is not related to gender. Risk factors include uncontrolled hypertension, increased BMI, arteriosclerosis, diabetes, glaucoma and hypercoagulability. Pathogenesis is related to arterial stiffness and venous

compression at a-v crossings, causing turbulent flow in vessels with endothelial damage. BRVO is not fully understood. Treatments have improved, but macular edema and ischemia reduce visual function for the aviator. **CASE PRESENTATION:** CASE #1, 54 year old male, class 1, 22,500 hours, hypertension and type 2 diabetes, AIC 7.1. Diagnosed 11/16 BRVO left eye, 3 anti-vegf injections, acuity 20/60, widened foveal avascular zone, trace macular edema. 20/20 acuity right eye. Bilateral trace cataracts. Passed medical flight test (MFT) 5/17, special issued. CASE #2, 56 year old male, Class 1, 4500+ hours, marathoner and competitive cyclist with negative medical history. Diagnosed 3/11 ischemic superior branch vein occlusion right eye. Passed MFT, issued statement of demonstrated ability (SODA) for 20/30 vision 11/12. Anti-vegf and steroid injections, developed secondary cataract and glaucoma. 4/13 cataract surgery. 6/15 vitrectomy, endolaser, membrane peel for macular pucker, removal of residual steroid. 10/16 focal laser. 2/17 twisted ankle and developed deep vein thrombosis (DVT), 6 months Xarelto. Coagulation workup reported negative. Repeat MFT 5/17 for vision 20/50, special issued. 6/17 AHMED valve for glaucoma. Post-op 20/100 right eye, 20/15-2 left eye. Glaucomatous cupping right nerve, inferior peripheral visual field defect. Special issuance withdrawn. Continued steroid injections, 11/17 vision 20/70 chronic macular edema. Still cycles. **OPERATIONAL/CLINICAL RELEVANCE:** BRVO is significant to the mid-career aviator when it decreases central visual function. Treatment is variably successful, and complications may occur. 20/20 may still have metamorphopsia or visual field damage. Adaptations to monocular decreased vision include switched eye dominance and increased reliance on monocular depth cues. Early recognition and treatment of risk factors and early recognition and treatment of BRVO symptoms may improve outcome.

**Learning Objectives:**

1. Understand the significance of branch retinal vein occlusion for the aviator.

**Thursday, May 10****Chantilly Foyer****1:30 PM****S-087: POSTER: OPHTHALMOLOGY, MUSCULOSKELETAL, NEURO/PSYCH****Chair: TBD****Chair: TBD****[430] ROLE OF HBOT IN SUDDEN ONSET IDIOPATHIC SNHL: RETROSPECTIVE ANALYSIS**A. Raju*Department of High Altitude Medicine and Hyperbaric Medicine, Institute of Aerospace Medicine, Bangalore, India**(ORIGINAL RESEARCH)*

**INTRODUCTION:** Idiopathic Sensori Neural Hearing Loss (SNHL) with sudden onset is a kind of hearing impairment which develops over a period of few hours to few days. One possible explanation of aetiology is vascular insufficiency in Cochlea causing reduction of perilymph oxygenation which leads to hair cells to lose their function causing sudden deafness. Based on this, Hyperbaric Oxygen Therapy (HBOT) is being successfully used to treat cases of sudden SNHL of idiopathic in origin, where pO<sub>2</sub> in the inner ear raises to reverse the pathogenesis. **METHODS:** Medical records of 42 patients of Sensori Neural Hearing Loss who were referred to Dept of HAP & HM for HBOT during the period Dec 2011 to Jul 2017 were perused. These patients were mix of Bilateral and Unilateral SNHL making a total of 55 ears (n=55) affected with SNHL which were considered for this simple descriptive analysis. All these patients were subjected to HBOT protocol of 2.5 ATA for 90 min. **RESULTS:** The analysis shows that 33 patients made substantial improvement with improvement of >10 dB while 11 patients made marginal improvement of 1 to 9 dB. Analysis further showed that best results are expected if HBOT is started within 14 days of onset. While the study could not find a positive correlation of presence of Tinnitus and outcome of HBOT, but there is definitely a positive correlation with institution of steroids oral or intratympanic, showing that concomitant steroids and HBOT give best results.



**DISCUSSION:** From the analysis of the data it is evident that HBOT is an effective treatment for idiopathic SNHL with sudden onset. While it is seen that earlier the treatment is initiated the better would be the outcome, it is also observed from the analysis that concomitant oral/intra tympanic steroid therapy increases the response of sudden SNHL to HBOT multifold.

**Learning Objectives:**

1. The study establishes the role of Hyperbaric Oxygen Therapy (HBOT) in managing cases of Sudden Onset SNHL.
2. HBOT protocol of 2.5 ATA for 90 min is effective.
3. Steroids administered orally or intra tympanic assists in favourable outcome.
4. Early the treatment is initiated, better would be the response.
5. Common complication observed was Otitic Barotrauma, but this is not a contraindication for continuation of HBOT.

**[431] THE COMPARISON OF AEROMEDICAL STANDARDS ABOUT COUNTERMEASURES FOR HAY FEVER BETWEEN JAPAN AND THE UNITED STATES**

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**(ORIGINAL RESEARCH)**

**INTRODUCTION:** In Japan, patients of "hay fever", which is allergic rhinitis caused by pollen, is increasing and called as national affliction. It is not lethal, but induces risks during flight. In many institutions, only a few pharmacotherapy of "hay fever" are approved for aviator. We reviewed the aeromedical standard of pharmacotherapy for "hay fever" between Japan and the United States. **METHODS:** Using open database or website, we reviewed aeromedical standard about pharmacotherapy for "hay fever". **RESULTS:** Concerning to Fexofenadine and Loratadine, FAA approves to fly after adequate trial period. USAF approves to fly after 72 hours from initial use. U.S. Navy approves to fly after 7 days observation. Japan Civil Aviation Bureau (JCAB) approves to fly without restriction. Japan Air Self-Defense Force (JASDF) approves to fly after 72 hours observation. Concerning to Desloratadine, FAA approves to fly after trial period. USAF disapproves to fly. U.S. Navy approves to fly after 7 days observation. JCAB and JASDF disapprove to fly. Concerning to Montelukast, FAA and USAF approve to fly. U.S. Navy approves to fly after 7 days observation. JCAB and JASDF disapprove to fly. About subcutaneous immunotherapy (SCIT), FAA approves to fly when no side effects are observed for 4 hours from each subcutaneous injection. USAF needs waiver and might approve to fly after 4 hours from each injection. U.S. Navy also needs waiver and might approve to fly after 12 hours from each injection. JCAB approves to fly after 24 hours from each injection. JASDF needs consultation. About sublingual immunotherapy (SLIT), FAA approves to fly after 24 hours from initial use or 4 hours from second use. USAF disapproves to fly. U.S. Navy needs waiver and might approve to fly after 7 days from initial use. JCAB approves to fly without restriction. JASDF needs consultation. **DISCUSSION:** Due to U.S. aeromedical experience, it will be possible to ease Japan's aeromedical standard. We hope JASDF revises standards for Desloratadine, Montelukast and SLIT receiving aviator could fly in near future.

**Learning Objectives:**

1. The difference of aeromedical standards about "hay fever" between Japan and the United States.
2. Aeromedical standard between Japan and the United States is reviewed.
3. Thanks for U.S. aeromedical experience, other countries might ease their aeromedical standard.

**[432] A FIGHTER PILOT WITH CENTRAL RETINAL VEIN OCCLUSION: FLIGHT SAFETY IMPLICATION AND APTITUDE MANAGEMENT**

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**(EDUCATION - CASE STUDY CLINICAL)**

**INTRODUCTION:** Retinal vein occlusions (RVO) are the second cause of vascular retinopathy. They caused a decreased visual acuity. The occurrence of RVO in aircrew member may be the end of his career given their direct impact on flight safety. **CLINICAL CASE:**

A 40 years old fighter pilot came to CEMPN of Rabat for his annual revisionary visit. A central retinal vein occlusion (CRVO) was discovered on systematic fundus even an optimal visual acuity. OCT and angiography confirmed the diagnosis. Etiological diagnosis was negative and an anti-VEGF treatment (Vascular Endothelial Growth Factor) was established with a favorable evolution.

**DISCUSSION:** The mechanisms of RVO remain incompletely understood, but it involves defects in blood viscosity, coagulation and circulatory dynamics. Several risk factors are discussed, the main being arteriosclerosis and ocular hypertension. There are two clinical forms of OVCR, ischemic form, rare with poor prognosis and edematous form, more frequent with better prognosis, which is the case of our pilot. Several factors conditions prognosis, especially the value of visual acuity then diagnosis, macular edema, advanced age. Due to optimal acuity visual recovery, absence of etiology and sequelae, rehabilitation was possible after 2 years per derogation with some restrictions. **CONCLUSION:** This case demonstrates the interest of systematic fundus exam on periodical visit fitness to discover diseases, which can threaten flight security.

**Learning Objectives:**

1. This case demonstrates the interest of systematic fundus exam on periodical visit fitness to discover diseases which can threaten flight security.

**[433] AIRCREW AND HANDHELD LASER EXPOSURE**

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**(ORIGINAL RESEARCH)**

**INTRODUCTION:** Laser devices are ubiquitous in everyday operations. These devices pose a hazard to the eye and numerous injuries have been documented. However, there lies a misunderstanding in the propensity to damage aircrews' eyes during an exposure. Patient encounters and article review is presented in hopes to raise awareness that aircrew laser exposure at altitude, outside of critical phases of flight, is a distraction and not a threat. Also, to propose a change to Air Force policy regarding such exposures. **METHODS:** An electronic medical record (EMR) search at a deployed clinic was performed from July 2016 through Jan 2017. The "reason for visit" column was perused for any reference to the eye and laser exposure. Subsequently, the patient encounters were scrutinized specifically for eye injury, optometry visit, color of laser, and suspension of flight duties. Six months' worth of documented laser exposures were gathered. All members were military aircrew; spanning loadmasters, boom operators, and pilots. 21 encounters were found and of those, one individual sustained two exposures. 12 encounters led to dilated funduscopic exams (DFE), consequently those 12 encounters yielded grounding of exposed air crew. No protective lenses or other forms of optics were employed at time of exposure. **RESULTS:** 21 encounters were reviewed, one patient was seen twice due to two separate instances. 14 encounters were green lasers, 6 did not comment, and 1 indicated white. Zero acute injuries were discovered. **DISCUSSION:** Patients were needlessly sent for further examination and prohibited from performing their duties. Following military patient encounters and civilian literature regarding laser injury, the evidence highly supports the hypothesis that handheld laser exposure in flight from a ground base does not engender eye injury. More emphasis should be placed on recognizing the laser threat as a distraction or disruption to critical phases of flight, and a policy change may be in order for the USAF laser exposure guide.

**Learning Objectives:**

1. Handheld laser exposure from ground base does not engender eye injury in aircrew.
2. Handheld laser exposure is a greater threat during critical phases of flight due to closer proximity of light source.

**[434] OPERATIONAL BASED VISION ASSESSMENT: EXAMINING THE VALIDITY AND RELIABILITY OF CONTRAST AND ACUITY MEASURES**

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**(ORIGINAL RESEARCH)**

**INTRODUCTION:** High-contrast visual acuity (VA) has long been considered the gold standard for measuring spatial vision. However, contemporary research has demonstrated the complex nature of the visual spatial processing system and the inadequacy of using VA alone to measure spatial vision. Contrast sensitivity (CS) testing complements assessments of vision by revealing information about an individual's ability to see low-contrast targets over a range of spatial frequencies or sizes. The aim of this research was to compare several different measures of VA and CS tests, as well as to validate a new, computerized CS test developed by the Operational Based Vision Assessment (OBVA) Laboratory. **METHODS:** Twenty-eight participants completed this Institutional Review Board-approved study. The measures used in this study included the OBVA Landolt C contrast sensitivity test (LCST), which includes a CS test and a VA test, a CS and VA test developed by Adaptive Sensory Technology (AST), and the Super Vision contrast and acuity (SV Acuity) chart developed by Jeff Rabin and commercially produced by Precision Vision. Descriptive statistics were performed on all measures. Eighty participants completed the LCST to begin collecting normative data for this computerized CS test. **RESULTS:** Test-retest reliabilities for all measures used in this study were high ( $r > 0.85$ ), with the exception of SV Acuity ( $r = 0.59$ ). Notably, our log area under the curve composite LCST statistic had a high test-retest correlation of 0.94 ( $p < 0.01$ ). To assess validity, between-test correlations were examined. For contrast, all tests were significantly correlated with each other (combined  $r = 0.81$ ). Surprisingly, visual acuity measures showed poor inter-test agreement (combined  $r = 0.52$ ), particularly AST Acuity and SV Acuity ( $r = 0.29$ ). Within-test measures of contrast and acuity were also high. **DISCUSSION:** This study provides empirical support for the reliability and validity of the LCST contrast test, which could be used as a rapid, robust screening method of Air Force aircrew. Normative data collected for the LCST thus far will also be presented. The OBVA Laboratory has engaged with international and industry partners to further develop and promote the use of automated tests such as the LCST to modernize vision screening.

**Learning Objectives:**

1. Understand the role that acuity and contrast play in the visual system.
2. Understand the procedures for conducting construct validation.
3. Understand the different methodologies and testing procedures for measuring visual acuity and contrast.

**[435] AGREEMENT AND PREDICTIVE VALUES OF COMPUTER COLOR VISION TESTS WITH THE HOLMES-WRIGHT LANTERN AND FARNSWORTH-MUNSELL D15**

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**(ORIGINAL RESEARCH)**

**INTRODUCTION:** In Canada, civilian pilots who have a color vision defect must pass either the Farnsworth-Munsell D15 (D15) or the Holmes-Wright Lantern Type A (HWA) in order to get an unrestricted license. The Canadian military also uses the D15 to determine whether a color-defective candidate qualifies for aircrew positions. Because computer-based color vision tests are becoming more popular, we wanted to compare newer computer tests with the D15 and HWA to

determine whether they could replace the older tests. **METHODS:** The computer-based tests were the Landolt C (LandC) from the USAF Occupational Based Vision Assessment program, Cambridge TriVector (CTV), Cone Contrast (CCT), and Color Assessment and Diagnosis (CAD). Sixty-eight individuals with a red-green color vision defect participated. The Rayleigh color match was used to classify the subjects' color vision. The CAD threshold, HWA and D15 were performed binocularly, the CTV and CCT were performed monocularly and the LandC was performed both monocularly and binocularly. Cut-off scores for the computer tests were determined using ROC curves. The University of Waterloo Research Ethics Committee approved the testing protocol. **RESULTS:** The AC1 level of agreement between the computer tests and the HWA was at least 0.95. The predictive values of the computer tests for failing and passing the HWA approached 1.0 except for the CCT where the predictive value for passing was 0.67. The AC1 agreement values with the D15 were lower, with most tests having values less than 0.50. The exception was the CAD, which had an AC1 value of 0.70. If the total of the sensitivity and specificity of the computer tests was used to determine the cut-off score, then the predictive value for passing the D15 was relatively low. If the cut-off criterion was selected to maximize the sensitivity of the computer test, then predictive value for failing was relatively low. **CONCLUSIONS:** The high level of agreement between the computer tests and HWA was because nearly all of the color-defectives failed the HWA and only those individuals who had near-normal scores on the computer tests passed the HWA. The lower agreement values for the D15 were due to overlap in the threshold scores of subjects who failed or passed the D15. Although the CAD had better predictive values for the D15, there were still discrepancies between the test results for approximately 30% of the subjects.

**Learning Objectives:**

1. To show how the newer computer based color vision compare with the Farnsworth D15 and Holmes-Wright A lantern.
2. To help understand the reasons for the discrepancies between the newer computer based color vision compare with the Farnsworth D15 and Holmes-Wright A lantern.

**[436] 3 CLINICAL COLOUR VISION AVIATION CASES DEMONSTRATING DIFFERENT ASSESSMENT AND OUTCOMES USING THE CAD AND CCT-HT (AVT) TESTS**

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**(EDUCATION - CASE STUDY CLINICAL)**

**PROBLEM STATEMENT:** These case reports highlight the different pass/fail outcomes for definitive color vision testing for pilot candidates using different instruments from different aviation jurisdictions. **BACKGROUND / LITERATURE REVIEW:** Color vision standards are important in aviation, particularly for safety critical tasks. The difficulty lies, however, in defining the safe cutoff level for air crew with mild color vision deficiencies. **CASE PRESENTATION:** Three clinical cases are presented: two pilot candidates and one potential candidate, who failed initial color vision screening with Ishihara Pseudoisochromatic plates. All were tested with the CAD (Colour Assessment & Diagnosis) Test (from City Occupational Ltd) and the AVT (Automated Vision Test) (now the CCT-HD from Konan Medical) (the highest level of color vision testing for the Australian Civil Aviation Safety Authority (CASA) and the United States Air Force (USAF) respectively). All passed the CAD, but failed the AVT. All were mild deuteranomalies, although one of the cases had normal anomaloscopy, a "potential deutan deficiency" on the CAD test and a clear fail on the AVT (CCT score for M cones 40). The two candidates were considered fit to fly without restriction by CASA, but would not have been considered fit for pilot training had they applied to the USAF. **OPERATIONAL / CLINICAL RELEVANCE:** These cases show that the borderline between what is considered safe and unsafe is not clear clinically. The authors, a Designated Aviation Medical Examiner and a Certified Optometrist for the Australian Civil Aviation Safety Authority discuss the cases and the issues involved from their perspectives and the implications of the different jurisdictional outcomes. These cases highlight the need for further work regarding stratification of color vision standards to reflect different occupational demands.

**Learning Objectives:**

1. To understand in general the risk to flying safely for pilots with color vision deficiencies of varying levels of severity.
2. To understand the process for color vision screening and definitive testing for pilots with and without congenital color vision deficiencies.
3. To understand the rationale in determining fitness to fly for a pilot with a congenital color vision deficiency.

**[437] COLOR VISION DETERIORATION IN CHRONIC SMOKERS: A POSSIBLE HAZARD IN AVIATION**S. Karakucuk<sup>1</sup> and H. Arda<sup>2</sup><sup>1</sup>Ophthalmology, Anadolu Medical Center, Kocaeli, Turkey; <sup>2</sup>Ophthalmology, Erciyes Un. Medical Faculty, Kayseri, Turkey.**(ORIGINAL RESEARCH)**

**INTRODUCTION:** Decreased color vision, decreased visual acuity and scotomas were reported for smokers suggesting that these changes may be related to accumulation of toxic substances in the retinal pigment epithelium; a toxic neuropathy affecting photoreceptors; reduction in the antioxidant carotenoids, lutein and zeaxanthin; increased free radicals and lipid peroxidation; reduced choroidal blood supply, ischemia, hypoxia and micro-infarcts. Such hypoxia related changes in human retina in chronic smokers may also affect heavy smoker pilots and accordingly, adversely affect the safety of aviation related duties including military operations. The authors aimed at investigating smoking related changes in chronic smokers. **METHODS:** This study included 80 smokers and 80 non-smokers, a total of 160 volunteers between 18-40 years of age without any ophthalmologic and systemic disease, with a best corrected visual acuity of 20/20, normal anterior and posterior segments including normal intraocular pressures bilaterally. Color vision of the subjects were evaluated with Farnsworth-Munsell 100 hue test (FMHT). Total error scores and axis calculation were performed for each subject and the results correlated with each other. This research was in accord with the ethical standards of the responsible institutional committee on human research and experimentation. **RESULTS:** Median age was 28.0 (range 18-40) years in the smokers group, 25.0 (range 18-39) in the control group. FMHT total error score was significantly higher in smokers (67.5) than non-smokers (53), ( $p=0.015$ ; Mann-Whitney  $U$  test). No significant difference existed between groups between axis ratios. There was no significant correlation between FMHT total error scores and smoking duration or number of cigarettes smoked per day. **DISCUSSION:** We conclude that hypoxia induced by chronic smoking can deteriorate color vision of otherwise healthy individuals. Since the history of smoking, including number of cigarettes smoked on the average day, number of years smoked, whether smoking causes any disability defined as difficulties in activities of daily living in mobility, or in sensory functions such as vision is very important; the issue may particularly be crucial in aviators with a potential to adversely affect flight safety. Further studies are necessary to search adverse effects of smoking on color vision in large aviator groups and whether these color changes are specific for blue/yellow or red/green sectors.

**Learning Objectives:**

1. Understand harms of cigarette smoking on color vision.
2. Develop skills to test color vision deficiencies.
3. Apply the information obtained from general population to the aviators.

**[438] INITIAL PRESENTATION OF MONOMELIC AMYOTROPHY (HIRAYAMA'S DISEASE) IN AN AIR TRAFFIC CONTROLLER: A CASE REPORT**

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**(EDUCATION - CASE STUDY CLINICAL)**

**PROBLEM STATEMENT:** This case report describes an air traffic controller who developed left upper extremity muscle fasciculation, muscle wasting, and decreased strength, and was eventually diagnosed with a rare neurological condition. **BACKGROUND:** Hirayama disease is a rare neurological disorder generally affecting

younger males. The disorder causes ischemia in the lower cervical cord which affects the anterior horn cells, leading to characteristic findings of unilateral distal arm atrophy and weakness which progresses over one to five years. While the member was not subject to any aeronautical environmental stress, it is hypothesized that vigorous physical activity from Basic Military Training could have contributed to symptom development. **CASE PRESENTATION:** The subject was a 30-yr old, right-handed, male who complained of 7 months of persistent neck pain along with left forearm and palmar 'muscle twitches.' On examination, there were fasciculations of the left hand and flexor musculature of the forearm. At this time, there were no described differences in muscle strength nor sensation. A cervical spine MRI revealed linear areas of abnormal T2 cord signal intensity from C5-C7 and paired ventral cord abnormalities from C7-T2. Electrodiagnostic testing showed decreased recruitment in the left FDI and ADM muscles, and decreased left ulnar palmar sensory response amplitude. Laboratory evaluation was within normal limits. A follow-up C-spine MRI with flexion showed ischemic changes in the lower cervical cord that were characteristic of Hirayama disease. Follow-up neurology consultation showed moderate intrinsic left hand and mild left forearm and brachium weakness and atrophy, mild left hand action tremor, and mild to moderate impairment of left hand fine motor skills with some hyporeflexia. As of this time, symptoms have plateaued. The member is currently suspended from flying duties, awaiting determination of military service retention. **CLINICAL RELEVANCE:** This case highlights a rare neurological condition which poses a unique challenge for the aeromedical disposition of a ground-based controller. In theory, if symptoms were not severe or distracting and had shown to plateau, the member might be eligible to return to controlling operations. However, future risk of potential impact on motor function, sensation, and coordination would need to be considered. To our knowledge, there have been no other cases of Hirayama disease submitted for USAF aeromedical waiver.

**Learning Objectives:**

1. To learn about a rare neurological condition and how to diagnosis in a timely manner.
2. To discuss the implications of the disease process on continued military service as well as performance of aeronautical duties.

**[439] FITNESS TO FLY: LOWER CRANIAL NERVE SCHWANNOMA**

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**(EDUCATION - CASE STUDY CLINICAL)**

**PROBLEM STATEMENT:** This case report describes a military helicopter pilot who was diagnosed to have Lower Cranial Nerve Schwannoma and how to approach such cases in future regarding their fitness to fly. **BACKGROUND / LITERATURE REVIEW:** Schwannomas arising from the lower cranial nerves are very rare and occur commonly in the region of jugular foramen. The complications arising due to the tumor at the cerebello-pontine angle have significant aeromedical risk and concerns. **CASE PRESENTATION:** A 29 year old military helicopter pilot presented with reduced hearing in right ear & altered taste perception on right side of the tongue. He was subsequently found to have Right CP angle Lower Cranial Nerve Schwannoma. He underwent surgery & gamma knife radiosurgery for the same. Post-surgery he developed right facial asymmetry, persistent tinnitus & intermittent headache & is now under regular follow up visits for management of the same. **OPERATIONAL / CLINICAL RELEVANCE:** Lower Cranial Nerve Schwannomas have aeromedical implications due to the complications arising predominantly from the compression of the adjacent brain tissue. Worsening of preoperative complaints are frequently noted after surgery with a risk of recurrence thus jeopardizing recovery. This case report aims to propose an algorithm for aeromedical evaluations for a case of Lower Cranial Nerve Schwannoma based on the outcomes of which the aircrew can be considered for flying duties.

**Learning Objectives:**

1. To understand Lower Cranial Nerve Schwannoma.
2. To understand the aeromedical concerns and approach the case accordingly.



#### [440] LATE PRESENTATION OF VESTIBULAR SCHWANNOMA IN AN E-3 MISSION CREW COMMANDER WITH ESTABLISHED ASYMMETRIC HEARING LOSS

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##### (EDUCATION - CASE STUDY CLINICAL)

**PROBLEM STATEMENT:** This case report describes an E-3 mission crew commander with an acoustic neuroma found twenty five years after the onset of asymmetric hearing loss with multiple negative MRIs in the past. **BACKGROUND / LITERATURE REVIEW:** The incidence of vestibular schwannomas in the general population is one per 100,000 person years. The significance and occupational impact of acoustic neuromas in aviators is established and obvious. Permanent hearing loss, chronic headaches, vertigo, and even death can result from surgically treated and untreated tumors alike. Additionally, the utilization of both CT and MRI imaging has increased resulting in more incidentally found vestibular neuromas being discovered in the general population and aviators. Aviators also routinely undergo hearing screening, making it much more likely that incidentally found vestibular schwannomas are discovered in this population. It is imperative that we understand the long term sequelae, treatment options, growth potential, and impacts these tumors have on aircrew. **CASE PRESENTATION:** A 48-year-old male presented for annual periodic health assessment and was found to have asymmetric hearing loss on the right side. The hearing loss was present since early 1990's with multiple audiology consultations and negative MRI studies as the hearing loss worsened gradually from 1992 on to 2017. Audiology consultation in 2017 found sensorineural hearing loss on the right with a conductive component. ENT consultation was recommended. MRI of cochlear canal and brain was ordered and demonstrated 14x7mm mass on right vestibulocochlear nerve with invasion towards the brainstem. Right translabrynthine craniectomy with intradural cerebellopontine angle tumor removal was performed and tumor was completely resected. Two months post operatively the patient has chronic vertigo with quick head movements and complete hearing loss on the right side. **OPERATIONAL / CLINICAL RELEVANCE:** This case highlights the importance of our hearing conservation programs, screening for hearing loss, and specifically the significance of evaluating asymmetric hearing loss in our at risk populations. The case also illustrates the importance of continuing to do our due diligence in following and monitoring individuals with known asymmetric hearing loss without acoustic neuroma due to their continued potential to have a tumor later in life.

##### Learning Objectives:

1. Understand the pathogenesis of vestibular schwannoma.
2. Demonstrate the need for guidelines regarding imaging studies for individuals with chronic asymmetric hearing loss.
3. Understand the occupational impact of vestibular schwannoma.

#### [441] DELAYED ONSET OF POST TRAUMATIC STRESS DISORDER AND CONSIDERATION FOR EARLY WAIVER IN A MILITARY PILOT: A CASE REPORT

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##### (EDUCATION - CASE STUDY CLINICAL)

**PROBLEM STATEMENT:** This case report describes a tilt rotor military pilot who experienced delayed onset post-traumatic stress disorder (PTSD) after witnessing a friend's accidental self-inflicted gun shot wound to the head 7 years ago. **BACKGROUND / LITERATURE REVIEW:** Symptoms of PTSD, such as decreased concentration and situational awareness, inattention, depression, insomnia, fatigue, anxiety, and impaired occupational or social functioning, can significantly impact a pilot's ability to safely operate an aircraft. While military services require periods of time that aviators must be asymptomatic prior to waiver consideration, the period can range between 3 to 12 months depending on service. **CASE PRESENTATION:** The pilot was a 31 y.o. military pilot with approximately 500 total flying hours and 300 hours in the airframe. The incident occurred off duty 7 years prior to his initial presentation to medical. After returning from a deployment in 2015, the pilot experienced insomnia, nightmares and restricted social interactions. He voluntarily sought treatment. A military psychologist diagnosed him with

PTSD and medically disqualified him from his flight duties. After treatment, the pilot reported significant improvement in his sleep and social interactions; 90% and 50%, respectively. Due to his symptomatic improvement and his desire to return to flight duties, he was referred for aeromedical evaluation. An aeromedical psychiatric evaluation did not reveal clinic evidence of other psychiatric disorders such as depression, anxiety, and alcohol misuse. The pilot demonstrated intact impulse and judgment control. His aviation training record was void of substandard evaluations. Based on a comprehensive aeromedical psychiatric evaluation, including neuropsychological testing, a waiver for return to DIACA (Duties involving actual control of aircraft) was recommended with the caveat that he undergo a higher level of medical surveillance. **OPERATIONAL / CLINICAL RELEVANCE:** This case highlights the variability in presentation of PTSD symptoms and its aeromedical disposition. While there exist military waiver guidelines, it is important that subject matter experts be allowed to make case-by-case recommendations.

##### Learning Objectives:

1. Symptoms of PTSD can negatively impact pilot performance and safety.
2. Symptoms of PTSD can manifest up to several years after the traumatic experience.
3. Following a diagnosis of PTSD, pilots require a comprehensive aeromedical psychiatric evaluation as part of the waiver process.

#### [442] AVOIDING THE NEXT GERMANWINGS

J. Meade

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##### (EDUCATION - TUTORIAL)

**PROBLEM STATEMENT:** The Germanwings accident in 2015 and its 150 fatalities highlighted the challenges associated with determining the mental health of pilots. Aeromedical examiners frequently have to rely on self-report by pilots, which are often highly biased. **TOPIC:** A review of current articles, journal entries, and policies regarding pilots and mental health disorders allows us to better understand the barriers associated with treatment and return to flight status. Several studies demonstrate that the prevalence of mental health disorders among pilots is less than in the general population. However, these are generally considered to be underestimates due to the consequences of self-reporting a mental health issue, such as loss of flight status and loss of income. These "penalties" often preclude a pilot from seeking and receiving help. Studies have shown that the risk of recurring depressive episodes often depends on the length and extent of the index episode, punctuating the need for early, effective treatment. The introduction of novel antidepressants, like selective serotonin reuptake inhibitors (SSRIs), provide a safe and effective treatment. Though not tested in the flying environment, many of these medications have been thoroughly tested and been shown to have little to no adverse effect on judgment or dexterity. Several major organizations (U.S. FAA, Transport Canada, Australia's CASA) allow pilots to use, under supervised conditions, these medications for treatment while continuing on flight status. The CASA program, which has been in place since 1987, has been studied and demonstrated no increased risk of mishaps for those approved to fly while taking approved antidepressants. **APPLICATIONS:** Mental health problems can manifest themselves at different stages of life. All civil aviation organizations require regular medical screening. It is important to understand the obstacles pilots face and the relevant regulations in order to encourage early and effective treatment, hopefully averting such disasters as the Germanwings accident.

##### Learning Objectives:

1. To understand the barriers associated with mental health treatment in civil aviation.

#### [443] AERONAUTICAL PSYCHOLOGY: COMPLACENCY VS. DESPLICENCY IN AVIATION

J. Mirabal

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##### (EDUCATION - TUTORIAL)

**INTRODUCTION:** In aviation, complacency has been a major concern as it is a major contributing factor in many unjustified accidents caused primarily by human factors. The complacency is one of item

developed by Gordon Dupont. However, the definition of the concept of complacency as "a state of mind in which an aviator acts, unaware of real danger or deficiencies" This definition is not easy to interpret. The new term proposed by Aeronautical Psychology is "Displacency" and is totally focused on a syndrome that presents an aviation pilot that presents these characteristics, "Displacency" according to Mirabal J, "is an attitude, presented by a pilot after several years of perform a routine flight activity, demotivation accompanied by carelessness, displeasure, discouragement, decreased alertness in safety and lack of creativity to get out of that state of mind." **OBJECTIVE:** This study aims to facilitate the analysis of the presence or not of "Displacency" in a crew studied. **METHODS:** A list of seven characteristics has been made to identify if a pilot has the "Displacency Syndrome." If the evaluated person presents at least three of them can be affirmed of the presence of the syndrome in the same one. And the more items match the greater the severity of the syndrome. List of situations to be observed: 1) Demotivation for work 2) Perform the activity routinely 3) Unconcern for safety 4) carelessness the details and follow rules. 5) Displacer in performing the activity 6) Desidia in all aspects 7) Discouragement in acquiring new updates at work. **CONCLUSIONS:** The review and application of this new concept, "Desplacencia," will expand the interpretation of the traditional term Complacency and make more effective the identification of this important syndrome that has affected many pilots in recent years and has contributed to several general aviation accidents and commercial. **Revised bibliography:** 1. Fahlgren, G and Hagdahl, R. (1990). "Complacency" Proceedings of the 43rd Annual International Air Safety Seminar, Rome, Italy: Flight Safety Foundation. 2. Grey Owl Aviation Consultants. (1997). Complacency. Retrieved from the World Wide Web on 28 Sep 2009. [http://www.greyowl.com/articles/complac\\_article.pdf](http://www.greyowl.com/articles/complac_article.pdf). 3. Jensen, R.S. (1995). Pilot Judgment and Crew Resource Management. Avebury Aviation. 4. Wiener, E.L. (1981). "Complacency: Is the term useful for air safety?" In Proceedings of the 26th Corporate Aviation Safety Seminar. Denver, CO: Flight Safety Foundation.

#### Learning Objectives:

1. This study aims to facilitate the analysis of the presence or not of "Displacency" in a crew studied.
2. Facilitate identification of the concept of Complacency in a pilot crew.
3. Identify the difference between Compliance and Displacency.

#### [444] SYMPTOMATIC MYOCARDIAL BRIDGING IN A 30 YEAR OLD FLYER

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Flight Medicine, USAF, Oklahoma City, OK

#### (EDUCATION - CASE STUDY HUMAN PERFORMANCE)

**PROBLEM STATEMENT:** This case report describes a military aviator who presented with unstable angina and was found to have symptomatic myocardial bridging of the left anterior descending artery. **BACKGROUND/ LITERATURE REVIEW:** Myocardial bridging (MB) is a common anatomical variant that occurs when a segment of an epicardial coronary artery takes an intramuscular course under a "bridge" of myocardium. This can lead to compression of the coronary artery during systole. This bridging is most commonly found in the left anterior descending artery (LAD) and is typically a benign condition. However, there is increasing evidence of association of MB with myocardial ischemia and acute coronary syndromes. **CASE PRESENTATION:** A 30 year old male flyer presented with 1 year of chest pain, dyspnea and lightheadedness that occurred with exertion and rest. The pain was typically sharp, left sided and radiated to his neck and jaw. Extensive cardiac workup revealed two moderately severe MBs in his mid LAD. Treatment with a beta blocker and anti-anginal medication was initiated with improvement in symptoms. He no longer experiences symptoms at rest but continues to have angina with exertion. His increased risk for an acute cardiac event in the future raises concern for his continued service as a military aviator. **OPERATIONAL / CLINICAL RELEVANCE:** MB is a common congenital abnormality, found in approximately 25% of adults. Thus, it is important to consider it as a cause of myocardial ischemia in an otherwise healthy member with little to no cardiac risk factors. The incidence of ischemia may be compounded by the unique stresses placed on the cardiovascular system of aircrew during flight. This risk of sudden incapacitation is of great concern for the welfare of aircrew and safe mission completion.

#### Learning Objectives:

1. The participant will be able to understand the incidence and presentation of symptomatic myocardial bridging in patients with minimal cardiac risk factors.

#### [445] OSTEOPATHIC MANIPULATIVE THERAPY FOR MICROGRAVITY INDUCED LOW BACK PAIN

B. Di Giacinto

GME, Saint Petersburg General Hospital, Saint Petersburg, FL

#### (EDUCATION - TUTORIAL)

**PROBLEM STATEMENT:** Low back pain (LBP) is the most common cause of disability worldwide and is even more common in microgravity environments. Considering the astronomical costs of work-related disability in low earth orbit (LEO) it is important to explore effective treatment and prevention strategies. Osteopathic manipulative therapy (OMT) has the potential to provide rapid and effective relief or even prevent microgravity-induced LBP with minimal to no advanced training. **TOPIC:** LBP is the most common cause of work-related disability worldwide. Initial episodes of LBP typically emerge between 30-50 years of age. Episodes may last from a few days to years. A recent study showed that LBP is 30% more common among astronauts in microgravity than land based-counterparts and the general population, independent of age. Recent multicenter clinical trials have proven that OMT is a safe and effective method for reducing LBP when compared with the current standard of care. Lumbar OMT traditionally involves low impact muscle energy techniques designed to realign the spine using inherent muscle strength or high impact lumbar roll techniques. However, these techniques may prove impractical in LEO given time constraints and negligible gravity. However, a modified OB roll or thoracic HVLA technique could be administered broadly in under five minutes with a teleconsultation from a trained osteopathic physician. The motions required for these modified techniques closely mimics training astronauts already receive for performing CPR in microgravity and the backboard used for CPR could be used as well without any modification. The modified techniques are designed to be broadly effective for musculoskeletal dysfunctions in healthy patients. **APPLICATIONS:** The applications of these specific techniques are limited to the reduction and prevention of LBP in LEO as they were heavily modified for that purpose. However, several new clinical trials are currently underway involving the use of OMT for musculoskeletal injuries and prevention. As certain aspects of OMT transition from the realm of medical art into the world of evidence-based practice, it is likely that OMT will be integrated more broadly. To the best of my knowledge, this would be the first published literature to discuss the application of evidence-based OMT to aerospace medicine. **RESOURCES:** Licciardone JC. Osteopathic Manual Treatment and Ultrasound Therapy for Chronic Low Back Pain. doi:10.1370/afm.1468

#### Learning Objectives:

1. Low Back Pain is present in up to 70% of astronauts that travel to LEO.
2. New studies suggest that osteopathic manipulative therapy is a safe and efficacious modality for the treatment and prevention of low back pain and other musculoskeletal dysfunctions relevant to the field of aerospace medicine.

#### [446] PILOT STUDY: FOAM WEDGE CHIN SUPPORT STATIC TOLERANCE TESTING

A. Fischer<sup>2,3</sup>, W.B. Dodson<sup>2</sup>, J.R. Buhrman<sup>1</sup> and E. Eveland<sup>1</sup>

<sup>1</sup>71<sup>st</sup> Human Performance Wing/RHCP, Wright-Patterson AFB, OH;

<sup>2</sup>Aeromedical Research, USAFSAM, Wright-Patterson AFB, OH; <sup>3</sup>Oak Ridge Institute for Science and Education, Oak Ridge, TN

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Advancements in helmet-mounted technologies have caused an increase in the complaints of neck pain among fixed and rotary aircrew. A U.S. Air Force School of Aerospace Medicine and Defence Research and Development Canada collaboration has resulted in a prototype wedge to help support helmet weight. The purpose of this study was to determine the tolerability of a foam wedge and any interference to cockpit duties during 1-G flight. **METHODS:** The study was approved as non-human research by the Institutional Review Board. Four subjects (two male, two female) were tested for 45 minutes using a

Joint Strike Fighter Generation II helmet with an MBU-20/P mask while strapped into an Advanced Concept Ejection Seat II allowing for the seatback angle to be reclined both 8° and 30°. These seat angles are the extremes that a fixed or rotary wing pilot may experience. Velcro was placed on the clothing or on the harness in the chest area of each test subject, which allowed for the foam wedge to be attached. Various cockpit activities were conducted in 5 minute intervals including reading numbers while checking six, reading numbers forward and on the floor, picking up a pen off the floor, and tying one shoe lace. Afterwards, each participant completed a questionnaire regarding comfort and feasibility of the device using a 1-10 scale. **RESULTS:** All participants successfully completed all number checks forward, below, and checking six. Subjects described some slight rear upper neck soreness during 30° trials and less frequent upper and lower neck soreness during 8° trials. Chest and chin discomfort was described as none to slight, and any activities not able to be completed were due to limited harness mobility. All subjects responded that a more refined wedge would be beneficial to offer pilots. **DISCUSSION:** Due to chest discomfort, a better attachment method will be pursued to more securely hold the foam wedge. Because the only sources of failure during activities were due to harness mobility, the wedge did not impede in normal cockpit activities. The results of this study justify further investigation into the foam wedge's neck pain mitigation performance compared with a control group.

#### Learning Objectives:

1. The participant will be able to understand the main causes for pilot neck pain, as well as the merit for reduction of this neck pain with the use of the prototype foam wedge.
2. The participant will understand the results of the simulated cockpit activities, indicating that there was no impedance on these activities by the prototype wedge device.

#### [447] MUSCULOSKELETAL MODELLING: A POTENTIAL TOOL TO ASSESS HEAD-WORN EQUIPMENT

K.P. Puxley, R.D. Pollock and L.M. Mike  
QinetiQ, Farnborough, United Kingdom

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Neck pain associated with helmet / head mounted mass use is common amongst aircrew, with excessive muscular loading and fatigue implicated in its occurrence. The development of neck pain mitigation strategies requires a better understanding of how neck muscles respond to external loads, although, this is difficult to achieve *in vivo*. The present study aimed to determine whether musculoskeletal modelling is capable and sufficiently sensitive to identify differences in muscle force output in response to changes in head / helmet mass properties.

**METHODS:** Software for Interactive Musculoskeletal Modelling (SIMM) was used to model the effects of altering head mass properties on 26 left-sided neck muscles. Simulations of static head positions, covering the full anatomical range of motion of head pitch, roll and yaw, were performed. Each simulation was conducted with different head mass properties; up to 5kg additional head mass and up to  $\pm 5$ cm centre of mass (CoM) displacements forward-backward, left-right and up-down. A helmet segment addition to SIMM was used to model in-service fast jet and rotary wing aircrew helmets. All modelling was performed using the default model parameters. **RESULTS:** Eleven muscles, predominantly head extensors, were sensitive to changes in head mass properties while the remaining muscles, mostly head flexors, were not. Under the conditions modelled, in general, a head mounted mass of <2kg maintained muscle forces below maximal levels while CoM positions below or rearward of the neutral head CoM minimised muscle loading. With head flexion angles greater than 30°, mass had a greater effect on muscle force production than CoM displacement. The muscle force output in response to modelling two in-service helmets differed indicating that SIMM can differentiate between helmets.

**DISCUSSION:** SIMM is sufficiently sensitive to detect differences in neck muscle force output in response to changes in head / helmet mass properties under static conditions. A helmet that minimises the levels of muscle force production would be expected to reduce the risk of neck injury. While specific conclusions regarding helmet mass properties / mitigation strategies to reduce muscle force output, and consequently the risk of neck pain and injury, cannot be made from the current study it does highlight the potential to utilise SIMM, with further development, for this purpose.

#### Learning Objectives:

1. To understand how helmet mass properties can influence neck muscle force.
2. Recognise the potential for musculoskeletal modeling to inform the helmet design / procurement process.

#### [448] THE INFLUENCE OF A 12-WEEK FUNCTIONAL STRENGTH TRAINING ON NECK MUSCULAR STRAIN UNDER G-FORCES

M. Rausch<sup>1</sup>, C. Ledderhos<sup>1</sup>, A. Gens<sup>1</sup>, C. Zinner<sup>2</sup>, F. Weber<sup>1</sup> and B. Sperlich<sup>2</sup>

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#### (ORIGINAL RESEARCH)

**INTRODUCTION:** The ongoing technological progress and the associated increase in the weight of modern helmet systems results in a steadily increasing strain on the spine. Therefore, it seems reasonable to assume that a strong muscular system stabilizing the spine could have a protective influence on G-induced neck and back strain. The objective of this study was to develop a functional whole-body training program which mainly focused on muscular strength in the neck and shoulder areas and subsequently check this training under flight-like conditions in a human centrifuge. The primary purpose of the study was to address the question of whether the said training can reduce the "physiological costs" in the area of the cervical spine which occur when a person is subjected to G-forces. **METHODS:** Development and performance of a functional strength training program, with the main emphasis being placed on muscular strength in the neck and shoulder areas. In order to check the training, the following data were collected before and after the intervention for 18 test persons (12 treatment group, 6 control group): electromyographic-measurements (EMG) of the neck and shoulder muscles during a ride in the human-use centrifuge with a maximum acceleration of +3 Gz without and with helmet; maximum strength values in the area of the cervical spine; questionnaire regarding the effectivity, quality and performance of the training program. **RESULTS:** The training group showed significant increases in strength values in all directions of movement. EMG results revealed that the physiological costs for the neck muscles have decreased in the treatment group both without and with helmet. Subjectively most of the persons in the training group felt better prepared for their flight-specific tasks owing to the training. **DISCUSSION:** This study clearly shows the potential of an approach that supports the preservation of the flying personnel's health by means of functional whole-body training focused on muscular strength in the neck and shoulder areas. When developing modern combat aircraft the physical performance of flying personnel must also be adapted to the ongoing technological progress to ensure that the system performance remains balanced.

#### Learning Objectives:

1. The participant will be able to understand the structure of a functional neck strengthening program specifically for fighter pilots and knows that training can reduce muscular strain under G-forces.
2. The participant will be able to understand that interdisciplinary synergies should be used and combined including findings from the fields of ergonomics, performance physiology and training science.

#### [449] WHAT THE PHYSICAL THERAPIST WANTS THE FLIGHT SURGEON TO KNOW ABOUT DRY NEEDLING

S.E. Smithey<sup>2</sup>, D.J. Pawlik<sup>2</sup> and J.J. Pavelites<sup>1</sup>

<sup>1</sup>Graduate Medical Education, School of Army Aviation Medicine, Fort Rucker, AL; <sup>2</sup>Physical Therapy, Lyster Army Health Clinic, Fort Rucker, AL

#### (EDUCATION - CASE STUDY CLINICAL)

**PROBLEM STATEMENT:** This case series presents the use of dry-needling (DN) as part of the treatment of lateral epicondylitis in five service members on flight status. **BACKGROUND/LITERATURE REVIEW:** Lateral epicondylitis, or "tennis elbow," is a persistent disorder that does not tend toward spontaneous resolution. Often with insidious onset and gradual progression of symptoms, pain in the lateral elbow and forearm



is produced with gripping objects, extending the wrist, or elbow supination. Though the prevalence in the aviation community is unknown, the annual U.S. incidence is 1-3%. Lateral epicondylitis presents equally in men and women and is correlated with increased BMI, tobacco use and ages greater than 40 years. Treatments are numerous with no singular management option being completely effective. Systematic reviews and meta-analyses have demonstrated pain reduction with needling techniques such as acupuncture and DN. DN was performed in the presented cases by physical therapists at a military aviation medicine clinic in conjunction with aeromedical providers. Dry-needling cases were chosen by flight status and not final disposition. **CASE PRESENTATIONS:** Lateral epicondylitis case descriptions of four males and one female on flight status, with an average age of 40 years and average BMI of 29.75 are presented. Three cases used tobacco. All cases received DN in conjunction with combinations of soft tissue mobilization (STM), stretches, strengthening and mobilization with movement (MWM). Four cases were returned to duty (RTD) with three reporting complete resolution and one reporting near full resolution. The final case had improved symptoms but moved from the area before treatment was completed. **OPERATIONAL RELEVANCE:** Lateral epicondylitis can produce distracting pain with repeated gripping and twisting motions of the wrist common in the flight environment. Dry needling may provide a reliable option for resolving lingering symptoms that decrease in-flight performance and delay return to duty.

#### Learning Objectives:

1. Participants will list health factors correlated with developing lateral epicondylitis.
2. Participants will be able to identify benefits and limitations of dry-needling in the treatment of lateral epicondylitis.
3. Participants will describe a typical dry-needling treatment plan for lateral epicondylitis.

#### [450] AVIATION PODIATRY: IS THERE A NEED?

M. Grace

*Podiatric Medicine, Glasgow Caledonian University, Dubai, United Arab Emirates*

#### (EDUCATION - CASE STUDY HUMAN PERFORMANCE)

**INTRODUCTION:** What place does podiatry have in aviation medicine? Observations at a leading airline in the Middle East found that many of the industrial injuries occurring amongst its cabin crew, were frequently related to the lower limbs. Problems associated with poor foot mechanics often presented as symptoms in the lower back, hips, knees, ankles, feet and connective tissues in these areas. **GATHERING EVIDENCE:** Screening of 250 *ab-initio* cabin crew over a 12 month period revealed many to have abnormal foot mechanics. Whilst many were asymptomatic and/or compensating for such abnormalities at this early point in their career, it was noted that many crew started to develop symptoms after they started to fly. In 2012 – *ab-initio* cabin crew were assessed over a 12m period. Over that time, 34% of crew were found to have a podiatric issue with 30% requiring orthoses. Of the 34%, 30% of this group had footwear issues. It was considered that the occupational role of cabin crew along with the wearing of a corporate style shoe, fatigue and physiological changes over 10,000ft altitude were largely responsible for the apparent rise in symptoms following the commencement of a flying career. Differences in the number of crew presenting with issues amongst cultural and gender groups also existed. The screening of crew also served to highlight common biomechanical problems. Each person was screened once using an electronic pressure plate scanner and a hands on assessment to check the range and type of motion in the lower limbs. Six common conditions were noted amongst the group: Hypermobility; Over-pronation with/without secondary issues including plantar fasciitis; Forefoot Equinus; Morton's Neuroma / Intermetatarsal Bursitis; Plantarflexed 1<sup>st</sup> Ray – with (functional) hallux limitus; Achilles Tendonitis. Resource management meant that it was necessary, initially to focus on rehabilitating those crew who were symptomatic as opposed to taking a preventative approach. Referring patients to external podiatric clinicians had historically proved to be a costly exercise since such clinicians lacked industry specific knowledge (uniform requirements, effect of altitude and occupational role etc) and were often prescribing orthotics that could not fit into shoes. Such orthotics were therefore not tolerated well and were not worn.

#### Learning Objectives:

1. To identify a need for podiatric interventions in the aviation medical setting.
2. To explore current biomechanical theories and how they can influence orthotic prescription.
3. To identify trends and common musculoskeletal problems among aviation cabin crew staff.

**Thursday, May 10**  
**Wedgewood**

**3:30 PM**

#### S-088: SLIDE: SPACE MEDICINE OPERATIONS

**Chair: Mark Campbell**  
*Paris, TX*

**Chair: Kris Lehnhardt**  
*Washington, DC*

**3:30 PM**

#### [451] A FRAMEWORK FOR MULTINATIONAL MEDICAL SUPPORT FOR INTERNATIONAL SPACE STATION - TRANSITION TO EXPLORATION

C.R. Doarn<sup>3,4</sup>, J.D. Polk<sup>4</sup>, A. Grigoriev<sup>5</sup>, J. Comtois<sup>6</sup>, K. Shimada<sup>1</sup>, G. Weerts<sup>7</sup> and A.E. Sargsyan<sup>2</sup>

<sup>1</sup>Flight Research Unit, JAXA, Mitaka, Japan; <sup>2</sup>Flight and Medical Operations, KBRWyle, Houston, TX; <sup>3</sup>Family and Community Medicine, University of Cincinnati, Cincinnati, OH; <sup>4</sup>Chief Health and Medical Office, NASA, Washington, DC; <sup>5</sup>Institute for Medical and Biological Problems, Moscow, Russian Federation; <sup>6</sup>Canadian Space Agency, Montreal, QC, Canada; <sup>7</sup>European Space Agency, Cologne, Germany

#### (EDUCATION - TUTORIAL)

**INTRODUCTION:** In the 1990s, the space agencies of Canada, the European Union, Japan, Russia, and the United States, entered into a multilateral agreement to build and operate an international space station. One of the unique infrastructure challenges was to develop a comprehensive medical system and processes that enabled crew selection, crew certification, and medical support for all phases of flight, and a framework to support the multilateral nature of an international undertaking, which had no precedents of this size and scope. **METHODS:** During the Shuttle/Mir Program, medical personnel and subject matter experts from the U.S. and Russia established medical systems for long duration space flight and compatibility of life support systems between different spacecraft through the Multilateral Medical Operations Working Group. This group began to establish a variety of systems and processes that led to the creation of the Multilateral Medical Operations Panel (MMOP), the Multilateral Space Medicine Board (MSMB) and the Multilateral Medical Policy Board (MMPB). These three entities were codified in the International agreements between the agencies of each of the five partners in January 1998, which served as the foundation and authority for international medical collaboration in the International Space Station (ISS) Program. **RESULTS:** For nearly a quarter of a century, this collaboration in space between nations has been highly successful. It has supported the construction and operation of the ISS. The Space Shuttle, Russian Soyuz spacecraft, and commercial spacecraft have transported crews, supplies, and research materials to and from the ISS since 1998. As the ISS approaches the end of its life cycle in the late 2020s, it is prudent to review the established framework and determine its utility moving forward in exploration initiatives. **DISCUSSION:** Each nation involved in the ISS Program and new space agencies that are beginning to form, concomitant with commercial endeavors in human spaceflight, will look toward the success of this framework to develop the necessary systems to support human missions to the Moon, Mars and beyond.

#### Learning Objectives:

1. Gain an understanding of how the international community developed a multilateral approach for addressing medical support of the ISS.

2. Gain an appreciation for how this successful framework will evolve to support exploration initiatives in the coming decades.
3. Gain an understanding of the challenges NASA may face in developing healthcare policy in exploration initiatives.

**3:45 PM****[452] MODELING THE MEDICAL OUTCOMES BETWEEN PHYSICIAN AND NON-PHYSICIAN CAREGIVERS IN A SIMULATED SPACE FLIGHT ENVIRONMENT**

E.L. Kerstman<sup>3</sup>, J. Arellano<sup>2</sup>, L. Saile<sup>1</sup>, D. Reyes<sup>3</sup>, V. Byrne<sup>1</sup>, A.E. Sargsyan<sup>1</sup> and D. Ebert<sup>1</sup>

<sup>1</sup>KBRwyle, Houston, TX; <sup>2</sup>MEI Technologies, Houston, TX; <sup>3</sup>UTMB, Galveston, TX

**(ORIGINAL RESEARCH)**

**INTRODUCTION:** The Clinical Outcome Metrics for Optimization of Robust Training (COMFORT) project was designed to measure the differences in clinical outcomes between physicians and non-physicians. Results from the COMFORT project were used as inputs to a modified version of the NASA Integrated Medical Model (IMM) to estimate overall space flight mission medical risks between the two groups. The ultimate goal of this work was to address several knowledge gaps defined by NASA's Human Research Program (HRP). **METHODS:** The COMFORT team designed training protocols and software training and testing tools that included "hands on" medical procedure modules and a differential diagnosis exercise to evaluate the diagnostic skills of participants. The success of diagnostic decision making and procedure outcomes between physicians and non-physicians were determined. Test subjects were evaluated one week after their initial training and also at 3, 6, or 9 months to assess their retention of knowledge and skills. The outcomes were then input into the modified IMM to analyze the impact of each group on mission medical outcomes. **RESULTS:** The success rates were higher and time to completion shorter for physicians than for non-physicians. The modified IMM outputs also showed that physicians performing medical procedures resulted in lower risks of evacuation and loss of crew life across several different mission profiles. The modified IMM risk estimates for both physicians and non-physicians were higher than the default IMM estimates, because the model normally defaults to 100% successful diagnosis and treatment of all medical conditions. **DISCUSSION:** Incorporating the methodology and results of the COMFORT analyses into risk estimation tools such as the IMM may better account for the variable success of medical interventions and allow for more accurate model predictions. Although the modified IMM outputs showed that physician medical care resulted in lower risks of adverse outcomes, the differences between physicians and non-physicians was not as great as expected. These results can be used to better define the appropriate levels of medical training and capability for deep space missions, thereby addressing HRP gaps in this area.

**Learning Objectives:**

1. To understand how the results of a clinical training protocol can be combined with modeling to assess the difference in mission medical outcomes between physician and non-physician providers.

**4:00 PM****[453] COMPARISON OF SIMULATED MEDICAL CARE BETWEEN PHYSICIAN AND NON-PHYSICIAN MEDICAL PROVIDERS**

R. Cole<sup>2</sup>, A.E. Sargsyan<sup>1</sup>, V. Byrne<sup>1</sup>, S. Dulchavsky<sup>3</sup>, K. Garcia<sup>1</sup>, C. Gibson<sup>1</sup>, E.L. Kerstman<sup>2</sup>, D. Reyes<sup>2</sup>, M. Young<sup>4</sup> and D. Ebert<sup>1</sup>

<sup>1</sup>KBRwyle, Houston, TX; <sup>2</sup>University of Texas, League City, TX; <sup>3</sup>Henry Ford Hospital, Detroit, MI; <sup>4</sup>NASA, Houston, TX.

**(ORIGINAL RESEARCH)**

**INTRODUCTION:** Medical care for exploration missions will be largely autonomous and delivered by a Crew Medical Officer (CMO). The Clinical Outcome Metrics for Optimization of Robust Training (COMFORT) experiment compared the performance of physician and non-physician CMOs through standardized training and simulation testing at different elapsed times. In addition, the project sought to improve on CMO training. **METHODS:** The standardized training included modules for fundoscopy, kidney/urinary ultrasound, endotracheal intubation with a laryngeal mask device, ultrasound-guided intravenous (IV) catheter

insertion, and the application of a differential diagnosis exercise tool. The test subjects (34 physicians, 33 non-physicians) were divided into three groups, re-tested in simulations at 3, 6, and 9 months after initial training and testing. Data collected included time of software review, time to completion, success rate, and procedural compliance. These raw measures were also input into a modified version of the NASA Integrated Medical Model (IMM) to calculate the potential clinical outcomes on long-duration missions. **RESULTS:** Physicians had better procedure times and success rates, but differences between physicians and non-physicians were not as great as expected. Success rates for physicians ranged from 62-94% for baseline sessions and 78-94% for retest sessions, while non-medical providers ranged from 45-85% for baseline sessions and 47-81% for retest sessions. No clear decline in success rates was seen over the course of nine months in either group, with performance levels paradoxically increasing at later time points in some non-physicians. **DISCUSSION:** Inclusion of a physician CMO is advantageous yet does not guarantee successful execution of medical procedures. Non-physicians when provided with high quality training tools perform at modestly lower levels, and can retain their skills up to nine months. This may be due to the effectiveness of the just-in-time training tool, which was always available to all subjects. This work suggests that training of CMOs can continue to be refined and improved to better support robust medical care during exploration missions.

**Learning Objectives:**

1. Recognizing considerations on the professional background of autonomous inflight medical care providers.
2. Understanding novel Crew Medical Officer training paradigms and the potential of just-in-time procedural support software.
3. Raising awareness of the procedural success rates in spaceflight risk models.

**4:15 PM****[454] DETECTION OF SPACE-FLIGHT ASSOCIATED VISUAL CHANGES USING PORTABLE AUTOREFRACTORS**

K.S. Masterova<sup>2</sup>, D. Cowan<sup>1</sup>, A. Anderson<sup>3</sup>, A. Fellows<sup>1</sup> and J. Buckley<sup>1</sup>

<sup>1</sup>Geisel School of Medicine at Dartmouth, Lebanon, NH; <sup>2</sup>School of Medicine, UTMB, Galveston, TX; <sup>3</sup>Smead Department of Aerospace Engineering Sciences, University of Colorado at Boulder, Boulder, CO

**(ORIGINAL RESEARCH)**

**INTRODUCTION:** The spaceflight-associated neuro-ocular syndrome (SANS) often manifests in flight as a change in refraction due to a change in the axial length of the eye. There is no capability to assess refractive changes on the International Space Station (ISS). A self-administered auto-refractor would provide a way to obtain in-flight data to estimate the time-course of the changes in axial length that occur in flight. This study evaluated two portable self-administered autorefractors (the EyeNetra and the SVOne Pro) for repeatability, accuracy, and potential for use on the ISS. **METHODS:** Fourteen subjects participated in the study. Baseline refractive error and axial length measurements were taken under cycloplegia in the seated position. Subjects were exposed to lower body positive pressure (LBPP) in the prone posture to induce an axial length increase. Refractive error and axial length were measured 5 times in both the seated and LBPP conditions over five sessions. Test-retest reliability of the devices was quantified using the Coefficient of Repeatability (CR) index. A post-study Likert scale survey was administered to quantify the device preferences of the subjects. **RESULTS:** The CR between measurements was 0.91 D for the SVOne and 1.15 D for the EyeNetra. For comparison, the clinical autorefractor had a CR of 0.50 D for consecutive measures. For test-retest reliability between sessions, the CR was 1.09 D for the SVOne, 0.81 D for the EyeNetra, and 0.48 D for the clinical autorefractor. Subjects generally preferred the SVOne. **DISCUSSION:** The SVOne had better test-retest reliability between consecutive measurements and would be best suited for use on the ISS. The SVOne inter-session CR of 1.09 D (about 300  $\mu$ m) should be used to determine whether a refractive error measurement difference is due normal variation. The small axial length increases (39  $\mu$ m on average) induced in our study were not detected well. Axial length changes associated with SANS tend to be on the order of 100s of micrometers, which are more feasible

to detect using the SVOne. The SVOne can be easily self-administered with minimal crew time commitment and could be used to track refractive and axial length changes over time on the ISS.

#### Learning Objectives:

1. Understand why measuring refractive error is important in space-flight.
2. Understand what makes the SVOne a more practical device for use in space-flight.

#### 4:30 PM

#### [455] COLLISION AVOIDANCE FOR MINIMALLY-INVASIVE ROBOTIC SURGERY WITH DEEP NETWORK VISION DETECTION

J. Carlson<sup>3</sup>, M. Losey<sup>4</sup>, E.T. Psota<sup>3</sup>, S. Farritor<sup>4</sup>, N. Bills<sup>1</sup>, D. Oleynikov<sup>1</sup>, M. Morien<sup>2</sup> and L. Pérez<sup>3</sup>

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<sup>2</sup>College of Public Health, University of Nebraska Medical Center, Omaha, NE;

<sup>3</sup>Electrical & Computer Engineering, University of Nebraska-Lincoln, Lincoln, NE;

<sup>4</sup>Mechanical & Materials Engineering, University Of Nebraska-Lincoln, Lincoln, NE

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** High-latency robotic telesurgery succumbs to the danger of accidental *in-situ* collision with tissue, creating risk-laden complications for applications that include deep-space exploration and battlefield trauma care. Even when performing low-latency robotic-assisted surgery, similar risks of collision exist due to indirect interaction with the environment lacking realistic tactile feedback, reduced visual acuity, and depth perception. **METHODS:** This paper introduces a novel collision avoidance algorithm harnessing a deep convolutional neural network to automatically identify contact with tissue when operating a telesurgical robot. The network is trained using video feedback while the robot is operating on three different biological tissue samples. The trained network tracks the robot end-effectors and detects collisions in real-time with low latency using only video footage as input. **RESULTS:** A trained video ethnographer visually scored video for both training and testing. The video was then sampled to extract an equal set of positive and negative examples (contact and no contact, respectively). Results demonstrate that both collisions and non-contact situations that are detected by the ethnographer can also be reliably recognized by the trained network. Additionally, the position of the end effector and the identity of the robot arm can be reliably tracked from the video footage, providing useful feedback that can be used to enable semi-autonomous primitive operations. **DISCUSSION:** As surgical robotics sees increased prevalence in the operating theatre, reducing complications due to operator error and communications latency will reduce the contraindications for robotic-assisted surgery in emergency scenarios where a surgeon is unreachable — either aboard Earth-orbiting space stations, deep-space missions, or remote expeditions and conflict zones. The proposed method provides reliable, low-latency collision detection that can be used to augment the human feedback loop and reduce the risk of complications due to unintended contact with tissue. Results demonstrate that the method achieves suitable reliability for deployment, and an essential step toward semi-autonomous surgical operations.

#### Learning Objectives:

1. The participant will be able to describe how telesurgery can be used to improve patient outcomes in remote environments, and describe the challenges associated with high-latency remote connections.

#### 4:45 PM

#### [456] URINARY CATHETER SELECTION FOR SPACEFLIGHT - A SYSTEMATIC LITERATURE REVIEW

D. Levin<sup>1</sup> and R. Cole<sup>2</sup>

<sup>1</sup>Aerospace Medicine, UTMB, Galveston, TX; <sup>2</sup>University of Texas, League City, TX

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** There have been 16 cases (1.8% events per person-flights) of urinary retention during modern U.S. space flight (Shuttle STS-1 through International Space Station Expedition 38). While it can be easily treated with bladder catheterization, the practice bears

both engineering and medical challenges. An astronaut with urinary retention is 25 times more likely to have a urinary tract infection (UTI) with a 17% infection rate per mission. Additional challenges include urethral trauma and balancing the number of catheters needed with upmass and storage constraints. This summary was prepared to evaluate the available literature on strategies that may reduce these challenges to inform decisions about what should be carried on board current and future spacecraft. **METHODS:** A systematic review was performed via Ovid, PubMed, the Defense Technical Information Center, the Institute for Scientific Information Web of Science, and Google Scholar. The aim was to identify English language studies examining various indwelling or intermittent catheter strategies concerning infection and complication rates. The level of evidence and clinical relevance of each study was assessed. **RESULTS:** Eighty relevant studies were identified. Study types included, in vitro assessments animal studies, human observational trials, and randomized controlled clinical trials. Thirty-one studies dealt with intermittent catheterization. Of these, 17 examined hydrophilic coatings, nine examined reuse, three examined no touch technique, and two general reviews were performed. Of the 49 studies examining indwelling catheters, 13 examined hydrophilic coatings, nine examined antibiotic coatings, 19 examined silver-coated catheters, and 5 were reviews or involved other techniques. Most studies involving antibiotic and silver-coated catheters showed either lower infection rates or no difference when compared with controls. Results from other strategies were too varied or flawed to report meaningful conclusions. **DISCUSSION:** The use of silver-alloy hydrophilic catheters or antibiotic hydrophilic catheters seems a reasonably low risk and potentially helpful option for reducing infections; however, the evidence supporting a clinical benefit is weak. The concept of reusable catheters is promising but existing evidence is not sufficient to recommend their use in spaceflight. More well-designed trials to evaluate relevant clinical outcomes are needed before strong recommendations can be made.

#### Learning Objectives:

1. Understand that Urinary Retention in Spaceflight is a Significant Concern.

Thursday, May 10

Senators

3:30 PM

#### S-089: PANEL: RESIDENT RESEARCH AND QI/PI PRESENTATIONS – PART 2

Chair: Richard Allnutt

Beavercreek, OH

Chair: Mark Coakwell

Beavercreek, OH

**PANEL OVERVIEW:** This panel will consist of Aerospace Medicine residents presenting the findings from their scholarly activity. During their residency practicum years, residents develop and execute either a research project or a quality improvement/process improvement (QI/PI) project on a topic of aeromedical importance and prepare a presentation to report their results. Residents will here present the findings from their projects. Engaging in scholarly activity advances resident learning and produces information that contributes positively to the body of knowledge relevant to Aerospace and Operational Medicine.

#### [457] AIRCRAFT MISHAP INVESTIGATION HANDBOOK, 2018, 7TH EDITION

M.B. Brough and D. Hatcher

USAFSAM, Wright-Patterson AFB, OH

#### (EDUCATION - PROCESS)

**MOTIVATION:** Mishap investigations can be extremely difficult, time consuming, and stressful. However, a thorough mishap investigation is essential. It is the only way we can learn more about the aircraft and its crew to try and explain why the crew's decisions and actions made sense at the time of the mishap and establish remedies to prevent similar mishaps from occurring. The Society of U.S. Air Force (USAF) Flight



Surgeons publishes an Aircraft Mishap Investigation Handbook to provide a ready reference for practicing USAF flight surgeons. The most current handbook was published in 2010. Over the past 8 yr, many updates occurred on how the USAF investigates mishaps. This project involved a general update of the handbook with a focus on current investigation guidelines and procedures. **OVERVIEW:** Since 2010 (6<sup>th</sup> edition), methods used in USAF mishap investigations have changed significantly. A literature review was completed to determine current trends, and a search of up-to-date directives and policies was conducted. Subject matter experts were invited to contribute to the 7<sup>th</sup> edition handbook and enthusiastically supported the process. Although not all inclusive, lists of changes and updates to the 7<sup>th</sup> edition include the following: 1) updated forms and publications appendices, 2) expanded internet references and current recommended readings, 3) updated reference phone numbers and contact information, 4) updated 72-h and 7-d histories and interviews, 5) updated description of the USAF Safety Center's Department of Defense Human Factors Analysis and Classification System to coincide with the most recent (2014) version, 6) new section on biomechanics in investigation, and 7) new section on investigating unmanned aerial vehicle mishaps. **SIGNIFICANCE:** As most flight surgeons infrequently investigate mishaps, developing and maintaining sharp investigative skills are very difficult. This updated reference guide has been compiled and reviewed by subject matter experts to help investigating flight surgeons avoid some of the common pitfalls encountered in these frequently chaotic situations. The Aircraft Mishap Investigation Handbook, 7<sup>th</sup> edition is to be used as a ready reference in the field, ensuring data retrieval and evidence preservation are complete and accurate. It will also serve as a reference to assist all flight surgeons during their investigation of a mishap.

#### Learning Objectives:

1. The participant will be aware of current USAF aircraft mishap investigation tools available to the practicing flight surgeon.

#### [458] A DESCRIPTION OF U.S. AIR FORCE AIR TRANSPORTATION FATALITIES FROM THE AIR FORCE MORTALITY REGISTRY

R.O. Speakman<sup>2</sup> and J.D. Voss<sup>1</sup>

USAFSAM, Wright-Patterson AFB, OH

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** U.S. Air Force (USAF) personnel and retirees participate in aviation both on and off duty. Aviation mortality is investigated by military and civilian agencies. The combined mortality rate for on and off USAF military duty flying is not known. Similarly, aircraft-associated mortality among USAF retirees is not known. **METHODS:** Mortality data were obtained from the Air Force Mortality Registry and population data from publicly available demographic reports. Air transport deaths were defined as V95-V97 diagnoses from the International Classification of Diseases, 10<sup>th</sup> Revision. USAF active duty (AD), Air National Guard, Air Reserve Component (ARC), aggregate, and retiree rates were calculated for 1988-2008. Sex-, age-, and rank-stratified AD and retiree rates were compared with U.S. rates obtained from the National Center for Health Statistics for years 2001-2008. **RESULTS:** Between 1988 and 2008, the accidental aviation mortality rate for all USAF personnel was 4.72/100,000 person-years. This was 2.34 (95% confidence interval (CI) 2.02, 2.71) times more than USAF retirees. ARC members had the highest aviation fatality rate of 9.48/100,000 person-years. Between 2001 and 2008, USAF male enlisted retirees did not have a higher rate of aviation deaths (standardized mortality ratio (SMR): 1.23 [95% CI: 0.83, 1.77]) compared to the U.S. population. As compared to the U.S. population, male AD officers had the highest SMR [SMR: 20.32 (95% CI: 14.45, 27.79)]; male retired officers had an SMR of 7.69 (95% CI: 5.90, 9.86) and male AD enlisted had an SMR of 5.08 (95% CI: 3.42, 7.25). **DISCUSSION:** Overall rates of aircraft death differ by component, sex, rank, and retirement status. Among USAF components, ARC members had the highest aviation mortality. Underlying reasons for these differences and population-specific mitigation strategies should be investigated. Rates of off-duty aircraft deaths among USAF populations are notable, particularly among male officer retirees.

#### Learning Objectives:

1. Describe the Air Force Mortality Registry as a unique military data repository that includes retiree mortality information.

#### [459] REMOTELY PILOTED AIRCRAFT MISHAP GUIDANCE CHAPTER FOR THE SOCIETY OF USAF FLIGHT SURGEONS MISHAP INVESTIGATION HANDBOOK

L.R. Lusterio

USAFSAM, Wright-Patterson AFB, OH

#### (EDUCATION - PROCESS)

**MOTIVATION:** The Society of U.S. Air Force Flight Surgeons Aircraft Mishap Investigation Handbook was last updated in 2010. The previous edition does not discuss remotely piloted aircraft (RPA) mishaps and the unique aspects of these aircraft. Aerospace medicine professionals have seen an increase in RPA operations during the past 10 yr which, unfortunately, has brought an unexpected rise in aircraft mishaps. **OVERVIEW:** The role of RPAs in the battlefield has expanded during the War on Terror. With the increase in operations, there have been numerous mishaps involving RPAs and unmanned aerial vehicles (UAVs). This project adds historic insight on prior RPA mishaps from 1993-2011 and provides guidance to investigating flight surgeons on proper RPA mishap investigation techniques. **SIGNIFICANCE:** Providing historic insight on the causal factors in RPA mishaps will enhance knowledge of RPAs and provide flight surgeons with valuable mishap techniques. Addressing these causal factors may also lead to a decrease in the number of mishaps. This process also studied RPA/UAVs from the Army and Navy, and while it does not address civilian UAV mishaps, studies from the Federal Aviation Administration have been referenced.

#### Learning Objectives:

1. Providing historic insight on the causal factors in RPA mishaps will enhance knowledge of RPAs and provide flight surgeons with valuable mishap techniques. Addressing these causal factors may also lead to a decrease in the number of mishaps.

#### [460] ASSESSMENT OF A UNITED STATES AIR FORCE POPULATION VARIABILITY OF CHEMICAL PHARMACOKINETICS BASED ON INDIVIDUAL CYP2E1 STATUS

R. McCoy, H. Pangburn, J. Gearheart, D. Ott and T. Covington

U.S. Air Force, Granville, OH

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Genetic variability continues to be a component of interest in assessing the expected impact of chemical exposures on human health. Until the advent of modern "omics" rapid assessment technologies, broad assessment of genetic variation on individualized outcomes was limited to single gene variants. **METHODS:** We enlisted genetic information from the DMET<sup>TM</sup> Plus array, measured on ~2000 personnel in the Air Force Medical Service Patient-Centered Precision Care Program as implemented by the Coriell Personalized Medicine Collaborative. We assessed the expected impact of genetic variation in metabolic and transporter processes related to chemicals commonly encountered in the U.S. Air Force environment. Specifically, 10 putatively functional variants in CYP2E1 (Cytochrome P450, Family 2, Subfamily E, Polypeptide 1) were chosen for initial consideration given the role of this locus in processing volatile organic chemicals such as isopropyl alcohol, cyclohexane, and aliphatic hydrocarbons. Measured CYP2E1 variation and its expected impact were then incorporated into analyses via PK-Sim<sup>®</sup> (Bayer) Open Systems Pharmacology Suite to assess the likely influence of genetic variants on blood time course of the aforementioned chemicals. **RESULTS:** Simulated area under the curve measures for the different chemicals examined varied by as much as one order of magnitude depending on individual CYP2E1 genetic status, indicating the need to expand assessment of the genetic architecture of detoxification downstream of this key enzyme step. **DISCUSSION:** Application of these genome-informed insights will allow a refined estimate of expected exposure response and potentially the prediction of personalized health outcomes.

#### Learning Objectives:

1. The participant will be able to understand how genetic variation on cytochrome P450, Family 2, Subfamily E, Polypeptide 1 (CYP2E1) can effect an individual's metabolic processing when exposed to volatile organic solvents and the impact on human toxicology.

#### [461] THE SURVEY OF AVIATION HEALTH AND RELATIONSHIPS IN THE U.S. AIR FORCE (SAHARA): ASSESSING THE PILOT-FLIGHT SURGEON RELATIONSHIP

C.D. Nowadly<sup>2,1</sup>, Z. Albaugh<sup>2,3</sup> and J. McCann<sup>2</sup>

<sup>1</sup>U.S. Air Force, Williamsburg, VA; <sup>2</sup>Georgetown School of Medicine, Washington, DC; <sup>3</sup>California National Guard, Point Hueneme, CA

##### (ORIGINAL RESEARCH)

**INTRODUCTION:** In the United States Air Force, flight surgeons act as both primary care physicians for pilots in addition to acting as aerospace medicine specialists. Situations arise in which the pilot and flight surgeon may have conflicting goals, such as when a pilot is reluctant to share medical information. Very limited research was available characterizing the pilot-flight surgeon relationship. The Survey of Aviation Health and Relationships in the U.S. Air Force (SAHARA) was an electronic survey designed to define and analyze the relationship between pilots and flight surgeons. **METHODS:** An electronic survey of 12-25 personalized questions was completed by a convenience sample of 172 U.S. Air Force pilots and student-pilots who were recruited using social media and e-mail. The participant identities were blinded to the research team and limited demographic information was asked to ensure respondent anonymity. **RESULTS:** Nearly 40% of pilots stated they would feel uncomfortable seeking care from a flight surgeon for a major medical concern. There is evidence that airframe type may strongly influence the relationship, with single-seat aircraft pilots more likely to strongly agree that flight surgeons are a vital member of the squadron (45.3% vs. 8.3%). Additionally, there was evidence that pilots knowingly withhold medical information and believe flight surgeons lack general aviation knowledge. **DISCUSSION:** Very limited research is available characterizing the pilot-flight surgeon relationship despite rare, but disastrous events, such as the intentional crashing of Germanwings Flight 9525 in 2015. The SAHARA study was able to identify factors which both positively and negatively influence the pilot-physician relationship. Despite a limited statistical analysis, there were concerning trends which highlighted areas for improvement. The data has been shared with the U.S. School of Aerospace Medicine and future studies including both U.S. Air Force pilots and flight surgeons are currently in development to further characterize the pilot-physician relationship and improve aviation safety and pilot health.

##### Learning Objectives:

1. The learning objective of the SAHARA project is to help define the pilot-physician relationship and explore factors that positively and negatively impact this relationship.

Thursday, May 10  
Topaz

3:30 PM

#### S-090: SLIDE: PEEKING, PUKING & PINGING-- THE SPECIAL SENSES IN THE AEROSPACE ENVIRONMENT

Chair: Mary Brueggemeyer  
Bethesda, MD

Chair: Rahul Goel  
Houston, TX

3:30 PM

#### [462] STABILITY OF INDIVIDUAL DIFFERENCES IN CONTRAST SENSITIVITY AND ACUITY ACROSS PHOTOPIC AND MESOPIC LIGHT LEVELS

J.P. Gaska<sup>1</sup>, M. Winterbottom<sup>3</sup>, E. Shoda<sup>2</sup> and S.C. Hadley<sup>4</sup>

<sup>1</sup>FHOH, 71<sup>st</sup> Human Performance Wing/USAFSAM, Wright-Patterson AFB, OH; <sup>2</sup>KBRWyle, Fairborn, OH; <sup>3</sup>Obva Laboratory, USAFSAM, Wright-Patterson AFB, OH; <sup>4</sup>Ophthalmology, USAFSAM, Wright-Patterson AFB, FL.

##### (ORIGINAL RESEARCH)

**INTRODUCTION:** Although airmen operate in a wide range of ambient light levels, most vision screening tests are only performed at

photopic (> 30 cd/m<sup>2</sup>) light levels. This research examines if there could be a need to routinely test individuals at different luminance levels. Stated differently, this research examines whether individuals with high contrast sensitivity in daylight conditions maintain that advantage in dim viewing conditions (e.g., night vision goggle use). **METHODS:** Contrast sensitivity (CS) for 25 participants was measured using a monitor-based test provided by Adaptive Sensory Technology. Average light levels were manipulated using neutral density filters to generate one photopic and two mesopic adaptation conditions. Each participant was tested twice under all three adaptation conditions – photopic (86.5 cd/m<sup>2</sup>), high mesopic (18.3 cd/m<sup>2</sup>), and low mesopic (2.2 cd/m<sup>2</sup>, similar to night vision goggle maximum luminance). Two metrics, acuity and area under the log CS function, were obtained and correlations of individual metrics between luminance condition pairs were computed. **RESULTS:** The coefficient of determination (r<sup>2</sup>) values were large, ranging from 0.74 to 0.89. For area under the log CS function, r<sup>2</sup> was 0.89 for the photopic-high mesopic comparison, 0.78 for the photopic-low mesopic, and 0.88 for the high mesopic-low mesopic comparison. For acuity, r<sup>2</sup> was 0.74 for the photopic-high mesopic comparison, 0.80 for the photopic-low mesopic comparison, and 0.88 for the high mesopic-low mesopic. A separate analysis showed that magnitude of r<sup>2</sup> for conditions with different luminance pairs was similar to those obtained from repeated measurements at the same luminance value. **DISCUSSION:** These results suggest that routinely testing acuity and CS at different luminance levels is not an efficient procedure for medical screening. However, it is well established that CS testing can detect optical or neural vision pathologies with greater sensitivity than acuity tests alone and that testing at mesopic levels may increase sensitivity. The Operational Based Vision Assessment Lab has developed an efficient contrast test that can be administered on the newly developed cone contrast test platform and we recommend that U.S. Air Force should consider adding CS testing as a standard screening test.

##### Learning Objectives:

1. Understanding and quantifying the stability of individual differences in contrast sensitivity under different light intensity conditions.

3:45 PM

#### [463] OPERATIONAL BASED VISION ASSESSMENT RESEARCH AND DEVELOPMENT INTRODUCTION AND HELMET MOUNTED DISPLAY RESEARCH

S.C. Hadley<sup>1,4</sup>, J.P. Gaska<sup>1</sup>, L. Williams<sup>1</sup>, E. O'Keefe<sup>2</sup>, S. Wright<sup>4</sup>, E. Shoda<sup>2</sup>, A. Van Atta<sup>2</sup> and M. Winterbottom<sup>3</sup>

<sup>1</sup>FHOH, 71<sup>st</sup> Human Performance Wing/USAFSAM, Wright-Patterson AFB, OH; <sup>2</sup>KBRWyle, Wright-Patterson AFB, OH; <sup>3</sup>OBVA Laboratory, USAFSAM, Wright-Patterson AFB, OH; <sup>4</sup>Ophthalmology, USAFSAM, Wright-Patterson AFB, FL

##### (ORIGINAL RESEARCH)

The Operational Based Vision Assessment (OBVA) Laboratory is engaged in F-35 helmet-mounted display (HMD) research and development (R&D), OBVA cone contrast test (OCCT) R&D, automated vision test R&D, color vision standards research, and KC-46 remote vision system boom operator vision standards research. A biocular HMD is expected to serve as the primary flight instrument for the F-35; thus, HMD human performance research has become a high priority. The OBVA Lab is examining the effects of green glow, ocular misalignment, canopy distortion, and monocular symbology on human performance and determining whether existing U.S. Air Force (USAF) vision standards are adequate for optimizing performance. To accomplish this ambitious research agenda, we have engaged with international and industry partners. **METHODS:** HMD Research: An alignment and distortion characterization toolset was developed to quantify HMD image misalignment. An F-35 HMD targeting task simulation was developed to examine the level of misalignment noticeable by observers with varying ocular health. OCCT Development: Approximately 1100 USAF pilot candidates were tested using the OCCT and the current USAF standard Rabin CCT during medical screening. The contributions of OBVA partners to these research efforts are also described. **RESULTS:** The HMD distortion toolset enables accurate characterization of distortion changes experienced

as a user's eyes move to view different regions of the display. Example distortion measurements are described, as well as preliminary data for the detection of misaligned HMD imagery. The improved precision capable with the OCCT enables differences in color sensitivity among color normal to be quantified (mean binocular L- and M-cone log contrast sensitivities were -2.21 and -2.15, respectively). **DISCUSSION:** The OBVA Lab has developed the unique capability to accurately measure HMD misalignment and to evaluate the effect of HMD misalignment on human performance. The improved sensitivity of the OCCT will enable research into the importance of color vision for operational performance and, potentially, enable earlier detection of disease. The OBVA Lab is working with international and industry partners to commercialize new tests to better characterize vision, collect normative data and modernize vision screening, and support research into human performance with the use of advanced technologies such as HMDs.

#### Learning Objectives:

1. The USAFSAM Operational Based Vision Assessment Laboratory (OBVA) is examining the human in the loop for HMDs pushing the technology boundaries. OBVA lab is examining the effects of green glow, ocular misalignment, canopy distortion, and monocular symbology on human performance.
2. OBVA is utilizing international collaboration with six partner nations as well as Department of Defense tri-service vision scientists.
3. The OBVA lab can accurately measure HMD misalignment and evaluate the effect of HMD misalignment on human performance.

#### 4:00 PM

#### [464] COMPARISONS BETWEEN TRADITIONAL DRUM AND VR OKN ON THE NEUROENDOCRINE AND SUBJECTIVE SYMPTOMS OF MOTION SICKNESS

J. French

*Human Factors and Aerospace Physiology, Embry-Riddle Aeronautical University, Daytona Beach, FL*

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Motion sickness is a common and uncomfortable result of vection, the sense of unusual motion; illusory or real. The rotating optokinetic nystagmus (OKN) drum is a traditional and reliable means to generate vection induced motion sickness symptoms in a duration dependent, step wise manner. The effectiveness of a virtual reality (Oculus Rift) OKN device (VR-OKN) was compared to the traditional OKN drum in inducing subjective symptoms of motion sickness.

**METHODS:** A repeated measures, cross-over design was used to compare the neurohormonal and subjective symptoms of vection during 30 minutes of exposure in the VR-OKN and the OKN devices. All 12 participants were selected based on self-reported moderate to severe motion sensitivity in this IRB approved study. Both devices rotated a black and white striped pattern at 4 cycles per minute around the stationary participant. The Subjective Symptoms Questionnaire (SSQ) was completed 10 and 20 minutes pre-rotation, every 10 minutes during the 30 minute rotation, and 10 and 30 minutes post-rotation. Saliva samples for neurohormonal assays were collected 10 minutes pre-rotation, immediately following rotation, and 10 and 20 minutes post-rotation.

**RESULTS:** A Friedman's repeated measures test was used to determine the total SSQ significance and Dunn's planned comparisons test determined which comparisons were significant ( $p < 0.05$ ). The pre-rotation SSQ scores were different from the 20 and 30 minutes exposure scores in both conditions. The 30 minute exposure scores were different from the 10 minutes post-rotation scores in both conditions. Cortisol data for both conditions was positively correlated with SSQ total scores using Spearman's correlation coefficient ( $p < 0.05$ ). Melatonin data were negatively correlated with SSQ scores for the VR-OKN, but not the OKN drum. **DISCUSSION:** Based on these findings, VR-OKN induced vection is as effective as traditional OKN drum vection in creating symptoms of motion sickness and supports the use of VR-OKN as a reliable means to produce vection. No differences were found in the nystagmus created by VR than by the drum, measured electrographically (EOG). VR-OKN will allow far more flexibility in manipulating the motion stimuli (off-axis; stationary, foveal, peripheral) allowing for more in depth vection induced motion sickness research.

#### Learning Objectives:

1. Virtual reality goggles can be programmed to produce a traditional optokinetic nystagmus (OKN) drum experience of vection and motion sickness symptoms. The VR OKN is far less expensive and far more flexible in that many parameters can be quickly evaluated (such as off-axis tilt, pattern of OKN, peripheral or foveal OKN) that would be unavailable to the traditional OKN Drum.

#### 4:15 PM

#### [465] AIRSICKNESS DESENSITISATION TREATMENT IN AIRCREW - PERSPECTIVES FROM THE RSAF AEROMEDICAL CENTRE EXPERIENCE (2008 - 2017)

J. Kwong, E. Tay, C. Koh and B. See RsaF Aeromedical Centre, Republic of Singapore Air Force Medical Service, Singapore, Singapore

#### (EDUCATION - PROCESS)

**MOTIVATION:** Motion sickness is encountered in civil and military aviation ("airsickness"), and presents with varying severity. Airsickness in aircrew is generally not compatible with flying duties, due to potentially distracting or incapacitating symptoms, and medications to manage airsickness are usually contraindicated due to sedative side effects. (In contrast, passengers are not involved in the conduct of flying operations, and have the option to use pharmacotherapy.) The treatment of airsickness is often a therapeutic challenge - while characteristics of susceptibility and adaptability have been observed in human subjects, the precise physiological mechanism behind motion sickness is unclear, despite a few reasonable hypotheses (e.g., Reason's neural mismatch model) that have been postulated. In the training of aviators, the susceptibility to motion sickness does not correlate with flying ability, and motion sickness is not often screened for prior to flying training. Therefore, in military aviation, the management of airsickness generally seeks to achieve adaptation to airsickness, while avoiding pharmacological intervention as far as possible. The basic principle involves the habituation of affected aircrew through exposure to provocative motion stimuli, repeatedly until adaptation is achieved. A durable adaptation against airsickness is ideal for the safety and success of military flying operations. **OVERVIEW:** In the Republic of Singapore Air Force, severe airsickness in aircrew is managed through a Systematic Progressive Airsickness Desensitisation (SPADE) programme. This programme provides a systematic methodology of habituation through the progressive exposure to cross-coupled coriolis stimuli in an enclosed-cabin turn-table. It involves multi-disciplinary management with an Aviation Medical Officer, Physiological Training Officer, and an Aviation Psychologist. We studied a retrospective case series of 23 consecutive SPADE subjects from 2008 to 2017, and describe our experience and observations. **SIGNIFICANCE:** In reviewing our experience and observations from the SPADE programme, we discuss areas where the management of airsickness in militaries can be optimised or enhanced. This includes the areas of screening for airsickness in flying trainees, exploring novel treatment paradigms to improve airsickness desensitisation outcomes, and reviewing aeromedical policy on the retention and attrition aircrew with airsickness.

#### Learning Objectives:

1. To learn about an airsickness desensitisation programme, and understand its outcomes and limitations.
2. To gain awareness of areas for further applied research in the area of airsickness management.

#### 4:30 PM

#### [466] HEARING CONSERVATION PROGRAM AT THE KENNEDY SPACE CENTER, CAPE CANAVERAL AIR FORCE STATION

J. Darwood and M. Salsbury  
NASA KSC, Merritt Island, FL

#### (EDUCATION - TUTORIAL)

Aviation and spaceflight operations have hazardous noise exposures. The hearing conservation program (HCP) is multidisciplinary and a part of aerospace medicine. The Kennedy Space Center (KSC) and the Cape Canaveral Air Force Station (CCAFA) is a multi-user spaceport with multiple employers. Regulatory requirements are designed to



implement a hearing conservation program. The Council for Accreditation in Occupational Hearing Conservation (CAOHC) is recognized by U.S. regulatory agencies to educate, develop guidelines, train, and certify occupational hearing conservationists (OHC). According to CAOHC, the major components of HCP are noise measurement, noise control, hearing protection, audiometric monitoring, worker training and motivation, recordkeeping, and program evaluation. The Kennedy Environmental and Medical Contract (KEMCON) is involved in noise measurement, audiometric monitoring, recordkeeping, and program evaluation. The individual employers provide noise controls, worker training, hearing protection devices (HPD), recordkeeping, and program evaluation. The Occupational Safety and Health Administration (OSHA) has set the action level of 85 dB(A) 8 hour time-weighted average (TWA) as requiring participation in a HCP. KSC uses an action level of 82 dB(A) 8 hour TWA. There are over 1100 employees in the HCP at KSC/CCAFS. The permissible exposure level (PEL) is the amount of noise exposure time allowed for the intensity of the noise exposure. The OSHA PEL is 90 dB(A) 8 hour TWA. KSC uses a PEL of 85 dB(A) 8 hour TWA. Audiometric monitoring is designed to detect a change in hearing. The employer is interested in finding noise induced hearing loss that may be occupationally related. Audiometric monitoring starts by establishing a baseline. KSC/CCAFS have baselines going back over 30 years. An audiogram is obtained annually to look for a standard threshold shift (STS). A STS is a 10 dB or greater loss or shift from the baseline of the average of 2000, 3000, and 4000 Hz. The employer is notified of a confirmed STS. The employee is referred to Environmental Health for evaluation of the noise environment. KSC does not determine work relatedness and referral to ENT/audiologist is recommended to the employer. The employee is further protected with a PEL of 82 dB instead of 85 dB. Confirmed number STS at KSC/CCAFS is 37 in 2011, the last year of the space shuttle, low of 6 in 2014, 18 in 2016, and 23 at the end of September 2017.

#### Learning Objectives:

1. To gain an understanding of the hearing conservation program by using the example of the Kennedy Space Center and Cape Canaveral Air Force Station.

4:45 PM

#### [467] INDIVIDUAL DIFFERENCES IN BRAIN ACTIVITY DURING COMPLEX TASK COMPLETION: IMPLICATIONS FOR REAL-TIME OPERATOR STATE MONITORING

K. Feltman<sup>1</sup>, A. Kelley<sup>1</sup>, I. Curry<sup>1</sup>, K. Bernhardt<sup>1,2</sup> and J. Basso<sup>1,2</sup>

<sup>1</sup>U.S. Army Aeromedical Research Laboratory, Enterprise, AL; <sup>2</sup>Oak Ridge Institute for Science and Education, Oak Ridge, TN

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Future systems will continue to become increasingly complex to operate. In addition to increased complexity, there will likely be a parallel increase in duration of operations, with future aircraft systems, such as the Army's Future Vertical Lift, anticipated to extend the range operations. Both of these pose challenges for maintaining the human operator in the loop. Real-time operator state monitoring has frequently been identified as a means to enhance human-machine integration. In order for real-time monitoring to move to operational applications, further research is needed to evaluate its effectiveness in a variety of settings and scenarios, including the determination of the effects of individual differences. The present study examined whether time of day of testing and circadian preference identified by chronotype significantly predicted changes electroencephalogram recordings measured at the Fz site for theta, alpha, and beta activity. **METHODS:** A total of 60 participants ( $M = 20$  years) participated in the study; however usable EEG data were analyzed for 46. Participants were scheduled for either morning ( $n = 22$ ) or afternoon ( $n = 24$ ) participation. Participants completed a variety of questionnaires, including the Morningness-Eveningness Questionnaire (MEQ) to indicate chronotype. Participants then completed a simulated aviation task with varying levels of workload while EEG data were recorded. **RESULTS:** Three separate hierarchical multiple regressions were conducted for each of the three bands examined to evaluate the predictive contribution of the following variables: time of day, MEQ score, time on task, and workload. The full model significantly predicted theta ( $R^2 = .09$ ,  $F(5, 263) = 5.08$ ,  $p < .001$ ) and beta ( $R^2 = .22$ ,  $F(5, 263) = 2.69$ ,  $p < .05$ ) values, the model for

alpha values was non-significant. Time of day, MEQ scores, and time on task were significant predictors within the models. **DISCUSSION:** The present findings support the identification of individual differences in physiological response as predicted by chronotype (e.g., Reske et al., 2015; Schmidt, et al., 2012). Furthermore, new evidence is provided for changes in theta and beta activity relative to individual differences and complex task performance. These findings provide further support for the necessity to consider individual differences while developing real-time monitoring methods.

#### Learning Objectives:

1. Individual differences contribute to differences in physiological response under complex task conditions and should be considered when developing methods of real-time operator state monitoring.

Thursday, May 10

Sapphire

3:30 PM

#### S-091: PANEL: AIRCREW MENTAL HEALTH - PERSPECTIVES FROM PILOTS AND REGULATORS

Sponsored by Air Transport Medicine

Chair: Quay Snyder

Centennial, CO

Chair: Elizabeth Wilkinson

Harmondsworth, United Kingdom

**PANEL OVERVIEW:** Initiatives to address pilot mental health challenges following the Germanwings disaster include the encouragement of pilot peer support programs and removal of institutional barriers for pilots seeking assistance for the full spectrum of psychological conditions. The ultimate goal is to have healthy pilots remaining in or returning to flight duties following treatment for various mental health conditions. Historic mistrust of regulators and employers by pilots has been a major barrier to recognizing the benefit of, and seeking treatment for, psychological conditions facing most pilots during their careers. This panel explores the initiatives and progress made by regulators and employers in removing barriers. The panel also will have pilots educate the attendees regarding progress made in this area and barriers that remain in fully implementing pilot mental health initiatives.

#### [468] AIR LINE PILOTS ASSOCIATION INTERNATIONAL PILOT PEER SUPPORT INITIATIVES

J. DePete<sup>1</sup> and Q. Snyder<sup>1,2</sup>

<sup>1</sup>Air Line Pilots Association International, Washington, DC;

<sup>2</sup>Aviation Medicine Advisory Service, Centennial, CO

#### (EDUCATION - PROCESS)

**MOTIVATION:** The Germanwings murder-suicide dramatically highlighted the importance of pilot mental health and its role in aviation safety. Regulatory authorities, airlines and pilot groups all have actively addressed reducing stigma and barriers for pilots seeking mental health support. The world's largest airline pilot union, The Air Line Pilots Association, International (ALPA) is establishing a Pilot Peer Support Program and will be described as part of the Aircrew Mental Health panel sponsored by the Air Transport Medicine Committee. **OVERVIEW:** Non-occupational mental health challenges and personal stressors are present sometime during every pilot's career. These situations potentially compromise safety and definitively adversely impact aircrew performance and life satisfaction. Numerous barriers exist to pilots seeking help – mental health stigma, regulatory reporting requirements, employer involvement, insurance coverage, and others. Pilots trust fellow pilots more than doctors, medical examiners, employers and regulators and are more open to receiving support from their peers rather than professionals initially. ALPA has a long history of robust programs to deal with occupational problems – the PA umbrella of Aeromedical, Critical Incident Response Program, HIMS, Professional standards and Canada Pilot Assistance, but recognizes need to close the loop of support for pilots encountering stressors outside of work. A network of trained peer pilots readily accessible in a confidential manner employs proven techniques

for barrier reduction, early support and improved mental health outcomes. Peer volunteer training is essential. Expected benefits include a reduction in serious mental health conditions requiring removal from flight status, early identification and professional referral for more serious conditions, improved occupational performance and enhanced aviation safety. **SIGNIFICANCE:** The Air Line Pilots Association, International's Pilot Peer Support Program addresses previously underserved areas of pilot health serving to improve pilot mental health and aviation safety.

#### Learning Objectives:

1. Participants will be able to understand the range of common personal life stressors that adversely affect airline safety and pilot performance.
2. Participants will be able to identify barriers to professional pilots seeking mental health assistance from traditional medical resources.
3. Participants will understand the desired components and qualifications for an airline pilot peer support volunteer network.

#### [469] THE BRITISH AIRWAYS PILOT ASSISTANCE NETWORK

S.J. Houston

*British Airways Health Services, British Airways, London, United Kingdom*

#### (EDUCATION - PROCESS)

**MOTIVATION:** An overview of the British Airways Pilot Assistance Network (PAN) as a model for a Pilot Peer Support Program. The presentation is part of the Aircrew Mental Health Panel sponsored by the Air Transport Medicine Committee. **OVERVIEW:** The PAN model used provides more than 'drugs and alcohol' or 'post-incident' counselling because it allows pilots to be guided to help and support for many other mental health conditions which are far more common, show patterns that facilitate early detection, and have proven effective treatment strategies. **SIGNIFICANCE:** The British Airways PAN forms part of an integrated approach to pilot wellbeing within the airline.

#### Learning Objectives:

1. A well-organized peer support system can help prevent mental or personal issues from becoming a greater liability to both the individual's career and the organization's safety performance.

#### [470] MENTAL HEALTH ASSESSMENT IN EUROPEAN AVIATION ENVIRONMENT

C. Panait, J. Vegers and V. Valentukevicius

*Aircrew and Medical Section, European Aviation Safety Agency, Köln, Germany*

#### (EDUCATION - PROCESS)

**BACKGROUND:** Following the Germanwings flight 9525 accident on the request of the European Transport Commissioner EASA initiated and led an international taskforce that included the most important stakeholders, in order to identify possible gaps that have led to this tragic event. The Taskforce issued 6 recommendations meant to address the safety concerns identified during their investigation. Recommendations 2 and 4 include the introduction of a psychological evaluation of commercial pilots before employment as well as an enhanced psychological evaluation during initial and recurrent class 1 medical examination and respectively improved AME training regarding the psychological assessment. Based on the above mentioned recommendations and with support from external experts and stakeholders EASA developed draft regulatory proposals to address the recommendations of the Taskforce that included a holistic mental health assessment during class 1 medical assessments as well as enhanced AME training requirements to help improve their assessment skills related to mental health issues and their overall communication with the applicants. Additionally EASA mandated the psychological evaluation before employment for commercial pilots in order to ensure an improved suitability between the pilot and the operational profile of the airline that they applied to as well as the pilot peer support programs as an early stress coping and preventive measure to ensure that issues that could have a potential safety impact are identified and addressed before reaching the severity level where specialist treatment and unfitness are required. **CONCLUSION:** The investigation following the Germanwings accident revealed gaps in the aero-medical assessment system and especially regarding the mental

health assessment of the applicants. EASA has started addressing these issues by consulting with experts representing the European Member States and other stakeholders in order to develop and publish draft regulatory material. Additionally, EASA intends to enhance the aero-medical assessment by means of safety promotion and implementation support provided to all categories of stakeholders.

#### Learning Objectives:

1. The presentation will describe to the participants the measures that EASA proposed after consultation with the stakeholders in order to enhance the mental health assessment of flight crew members with the goal of improving flight safety.

#### [471] NEW ZEALAND AVIATION PEER ASSISTANCE NETWORK FOR PILOTS AND AIR TRAFFIC CONTROLLERS

H. Bongers

*Peer Assistance Network, New Zealand Airline Pilots' Association, Wellington, New Zealand*

#### (ORIGINAL RESEARCH)

**INTRODUCTION:** Even prior to the tragedy of Germanwings it became evident to NZALPA that there was a lack of overall mental health support trusted by pilots. Suicides had affected our membership and the barriers to seeking direct assistance were evident. Stigma, shame, misinformation and fear of consequences (real or imagined) create a barrier which rationale has little impact upon. **METHODS:** Aviation Peer Assistance Network was formed by NZALPA and Psychologist Allan Baker. The founding document is the PAN NZ Manual, which sets out the following: Objectives and Principles; Scope and Structure; Signed commitment pledge; Roles and responsibilities; Women's assistance forum; Revenue and expenditure; Training; Case management; Protocol for case referral and escalation; and Confidentiality protocol. This document is reviewed by the PAN steering committee attend by employer and Union representatives. Participating organizations fund the program based on the number of license holders they represent. Assistance is sought through multiple channels including a toll free 0800 dedicated assistance line, Union and airline management referral. Regulator endorsement was given for the processes of PAN. Socializing of the PAN program is by industry multi-platform mental health articles, posters, and website links. **RESULTS:** Annual contact rate sits at 10% of the total captured population. Some have been significant cases with referral to professional assistance. The reasons for seeking assistance include: work training; employment disputes; changes to employment circumstances; personal relationship; family grief; financial stress; protracted aviation medical issues; substance dependency; and operational accident or incident. **DISCUSSION:** From a time when mental health issues were a taboo subject amongst aviation professionals for fear of career curtailment, to the provision now of a formalized collegial "safe harbor" assistance program is a step change. PAN provides improvements not only to quality of life and welfare of individuals, but also a greater safety to the aviation industry as a whole by a reduction of the effects of compromised mental health on the operational environment. The reduction of operational error rates by an overall improvement of mental wellness in the workplace gives corollary enhancement to flight safety. PAN NZ provides a trusted conduit for aviation license holders to seek confidential assistance and industry organizations to trust that the protocols are sufficiently robust to rely on.

#### Learning Objectives:

1. Application.

#### [472] AIRCREW MENTAL HEALTH - THE AUSTRALIAN REGULATOR'S PERSPECTIVE.

A.M. Drane

*Client Services - Aviation Medicine, Civil Aviation Safety Authority, Phillip, Australia*

#### (EDUCATION - PROCESS)

**MOTIVATION:** There is a crucial distinction between the role of the regulatory authority and an employer and associated labor organization(s). This presentation considers key elements in building a collaborative framework to support aircrew as well as ensuring public safety. **OVERVIEW:** Studies have highlighted the serious safety consequences

resulting from psychiatric disease: in particular, the contribution to passenger fatalities from air transport accidents. The findings of the Germanwings accident investigation expanded the focus to include the place of effective communication between health providers and regulators. Australia has adopted a policy to promote disclosure of mental health problems over several decades. The certification of aircrew who have recovered from an episode of psychiatric illness and continue to take approved maintenance therapy has led to an increasing awareness that a diagnosis of "depression" for example, is not a terminal career event. A follow-up study has confirmed there were no adverse safety consequences resulting from this policy. This presentation summarizes the approach to case-finding and aeromedical assessment in Australia. It finds that the rate of Complex Case assessment (those which include the ICAO concept of flexibility) is 13% of all such cases, and is notably higher than other published figures: zero in one study reviewed. Parallel findings are seen with substance use, particularly alcohol which form 10% of cases. **SIGNIFICANCE:** The conclusion drawn is that there is merit in promoting a "reporting culture". It is proposed that increased trust within the aviation community has led to a higher reporting rate than evident in some authorities with differing assessment paradigms. In Australia, the early identification of illness or potential illness is encouraged, and the regulatory framework drawn up to facilitate a carefully risk managed return to work. Parallels to the HIMS (Human Intervention and Motivation Study) methodology are drawn. Sole reliance on a punitive culture has demonstrably failed to manage these known-unknowns. The importance of good communication and a collaborative framework with unions and employers is highlighted.

#### Learning Objectives:

1. Good communication between the applicant and the examiner and regulator remains the foundation of effective aeromedical assessment.
2. Illness prevention and support in recovery are both important aspects of promoting flight safety.
3. Familiarity with case-finding tools and assessment skills are essential to identify both early and overt disease.

**Thursday, May 10**  
**Chantilly East**

**3:30 PM**

### **S-092: PANEL: ANTIDEPRESSANT USE IN UNITED STATES AIR FORCE AVIATORS-FIVE YEAR ANALYSIS**

**Chair: Kevin Heacock**

*Wright-Patterson AFB, OH*

**PANEL OVERVIEW:** The United States Air Force (USAF) has long made various psychiatric disorders disqualifying for flight duties due to their potential adverse aeromedical impact on aviation safety and flying duties. Cognitive, emotional, and behavioral difficulties secondary to these disorders can lead to observable as well as subtle changes in functioning that negatively affect performance under physically and psychological taxing conditions in aviation. Unidentified, untreated, or undertreated psychiatric conditions may have potentially disastrous consequences. To mitigate such outcomes, the FAA, Transport Canada, Australia, and the U.S. Army have policies allowing selected aviators to fly while on certain antidepressants. The USAF followed suit in 2013, allowing select FC II/III personnel to be considered for waivers on the following monotherapies: Zoloft up to 200 mg/day; Celexa up to 40 mg/day; Lexapro up to 20 mg/day; Wellbutrin XL up to 450 mg/day. Despite initial aeromedical concerns, the USAF has had positive outcomes to date.

#### **[473] ANTIDEPRESSANT USE IN UNITED STATES AIR FORCE AVIATORS-FIVE YEAR ANALYSIS**

K.F. Heacock

*Aeromedical Consultation Service, USAFSAM, Wright-Patterson AFB, OH*

#### **(EDUCATION - TUTORIAL)**

The United States Air Force (USAF) has long made various psychiatric disorders disqualifying for flight duties due to their potential

adverse aeromedical impact on aviation safety and flying duties. Cognitive, emotional, and behavioral difficulties secondary to these disorders can lead to observable as well as subtle changes in functioning that negatively affect performance under physically and psychological taxing conditions in aviation. Unidentified, untreated, or undertreated psychiatric conditions may have potentially disastrous consequences. To mitigate such outcomes, the FAA, Transport Canada, Australia, and the U.S. Army have policies allowing selected aviators to fly while on certain antidepressants. The USAF followed suit in 2013, allowing select FC II/III personnel to be considered for waivers on the following monotherapies: Zoloft up to 200 mg/day; Celexa up to 40 mg/day; Lexapro up to 20 mg/day; Wellbutrin XL up to 450 mg/day. Despite initial aeromedical concerns, the USAF has had positive outcomes to date.

#### **Learning Objectives:**

1. This panel will examine the use of antidepressant medication to reduce the aeromedical risk associated with psychiatric disorders.
2. This panel will update the clinical experience on aviators treated with antidepressants.

#### **[474] HISTORY, BACKGROUND, AND CURRENT STATUS OF ANTIDEPRESSANT USE IN U.S. AIR FORCE AVIATORS**

T.L. Correll

*Aerospace Medicine Consultation Division, USAFSAM, Wright-Patterson AFB, OH.*

#### **(EDUCATION - TUTORIAL)**

**PROBLEM STATEMENT:** U.S. Air Force (USAF) aviators have routinely avoided addressing mental health symptoms and conditions for fear of the negative impact on their flying careers. This can significantly impact safety to the individual, crew, and mission. **TOPIC:** The USAF has always promoted thorough assessment and optimal treatment of individuals suffering from psychiatric symptoms and disorders. In USAF aviators, such treatment hopefully leads to a full resolution of symptoms, followed by a customary waiting period to ensure stability, and waiver submission and consideration to resume full flying duties thereafter. This presentation will examine the history of psychiatric treatment prior to antidepressant use in aviators, the background that led to approving the limited use of antidepressants, and the current status of such use from 2013 to 2018. **APPLICATIONS:** This presentation will examine the history of mental health treatment of USAF aviators prior to and after the ability to utilize certain aeromedically approved antidepressants. This will be of interest to any aviation community utilizing or contemplating the use of psychotropic medications.

#### **Learning Objectives:**

1. This presentation will examine the history of psychiatric treatment prior to antidepressant use in aviators, the background that led to approving the limited use of antidepressants, and the current status of such use from 2013 to 2018.

#### **[475] EPIDEMIOLOGY OF U.S. AIR FORCE AVIATORS ON ANTIDEPRESSANT MEDICATION: 5-YEAR ANALYSIS**

J.E. Heaton

*Neuropsychiatry Branch, USAFSAM, Wright-Patterson AFB, OH*

#### **(EDUCATION - TUTORIAL)**

**PROBLEM STATEMENT:** Antidepressant medications are among the most commonly prescribed drugs in the United States used to treat common mental health conditions like depression and anxiety. U.S. Air Force aviators are required to meet enhanced medical standards, and conditions such as depression and anxiety are disqualifying and require an aeromedical waiver to return to duties. Only in recent years have aviators been allowed to return to duty on prescribed antidepressants. **TOPIC:** The records of 93 study group participants evaluated at the Aeromedical Consultation Service (May 2013 – Oct 2017) for an initial waiver due to disqualifying mental health conditions and antidepressant medications were reviewed. Subjects include 54 (58.06%) officers and 39 (41.94%) enlisted, 80 (86.02%) males and 13 (13.98%) females, from various aircraft, aircrew, and special duty positions, primarily pilots (27, 29.03%) and flight surgeons (15, 16.13%). The majority of participants are Caucasian (76, 81.72%) and range between ages 31-40 (45, 48.39%). Eighty-three (89.25%) cases received a waiver to return to flying status



upon completion of evaluation. In contrast, 10 (10.75%) cases did not receive a waiver, due primarily to continued symptomology requiring continued psychotherapy and monitoring. Most prevalent diagnoses of the study group are adjustment disorders (32, 34.41%), anxiety disorders (28, 30.11%), and depressive disorders (27, 29.03%); relational distress (25, 26.88); and posttraumatic stress disorder (14, 15.05%). **APPLICATIONS:** Descriptive findings help put the data in perspective. The findings allow aeromedical standards and policy makers, including major command waiver authorities and flight surgeons, to better understand the potential implications and future direction of aviators on antidepressant medications.

#### Learning Objectives:

1. Descriptive analysis of antidepressant study group results at five years.

#### [476] LESSONS, QUESTIONS, AND MOVING FORWARD

R. Peirson<sup>1,2</sup>

<sup>1</sup>Aeromedical Consultation Service - Neuropsychiatry, USAFSAM, Wright-Patterson AFB, OH; <sup>2</sup>Psychiatry, Wright State University School Of Medicine, Dayton, OH

#### (EDUCATION - TUTORIAL)

**PROBLEM STATEMENT:** Since 2013, the U.S. Air Force (USAF) has waived over 100 individuals with medically disqualifying conditions and who continue to take antidepressant medication. Much concern was raised prior to this policy change, warranting a cautious approach. Most of these individuals have been seen at the USAF Aeromedical Consultation Service, and it is appropriate to begin analyzing initial data and trends. **TOPIC:** Building on the data presented at earlier stages in the panel, the presentation will synthesize the findings, draw conclusions as to whether the initial hypothesis was proven, determine if any questions were answered, and highlight surprising results. The presentation will highlight any additional questions prompted by the data and critique potential weaknesses and any inconsistencies. A discussion with the audience will serve to elucidate more ideas and reinforce what we might learn from the data. Finally, the panelist will present clinical, policy, and procedural recommendations based on the initial findings. **APPLICATIONS:** The historical background of antidepressant use in aviators, the practical and clinical experience of the USAF's first 100 aviators waived while taking antidepressant medications, and lessons learned after analyzing this change in policy are of most interest to military audiences, but provide insights into commercial and general aviation. Clinical and policy recommendations will be of interest to flight surgeons in general.

#### Learning Objectives:

1. Participants will learn the most commonly prescribed antidepressant medication, dose, and how it compares to established treatment guidelines.
2. Participants will learn the management group's response to treatment.
3. Participants will appreciate the general success of those in the management group who were recommended for waiver.

#### [477] ANTIDEPRESSANTS – CLINICALLY RELEVANT FINDINGS AFTER 5 YEARS OF STUDY

T. McBride

USAFSAM, Wright-Patterson AFB, OH

#### (EDUCATION - TUTORIAL)

**PROBLEM STATEMENT:** In 2013, the U.S. Air Force approved the use of four antidepressant medications by individuals required to meet enhanced medical standards. Since that time, 105 individuals with medically disqualifying conditions who continue to take antidepressant medication have been waived to return to full duty status. Significant concerns were raised prior to this policy change and, subsequently, waived individuals have been closely followed. The majority of these individuals have been evaluated by the Air Force Aeromedical Consultation Service (ACS). **TOPIC:** Of the 105 individuals on antidepressant medication evaluated by the ACS, 49% have been on Zoloft, 24% on Wellbutrin, 17% on Lexapro, and 10% on Celexa. Eighty-eight percent were waived to return to full operational duties as opposed to 72% not on medication. Individuals rated the medication as very effective; on a 0-10 Likert scale (0 ineffective, 10 extremely effective), the average effectiveness of the medication was rated 8.14. Longitudinal disposition of aviators from 1 to 5 yr after initial ACS evaluation will be reported. Additionally, several other clinical relevant details and implications will be elucidated and discussed. **APPLICATIONS:** The detailed findings of these 105 individuals evaluated by the ACS on antidepressant medication have far-reaching implications. Lessons learned after analyzing 5 yr of data are of most interest to military audiences, but additionally provide insights for commercial and general aviation.

#### Learning Objectives:

1. Attendees will have an understanding of the clinically relevant details of antidepressant usage by USAF personnel required to meet enhanced medical standards.
2. Attendees will understand the relevant findings and clinical implications of antidepressant usage by aviators after five years of study.