[411] THE NORWEGIAN INITIATIVE TO AVIATOR HEALTH AND SAFETY- "THE BIG PICTURE" APPROACH

H. Ranfelt and V. Fonne
Norwegian Armed Forces Medical Service, Norwegian Institute of Aviation Medicine, Hovik, Norway

MOTIVATION: In the wake of the 2015 GermanWings aircraft accident, increased attention worldwide has been placed on the topic of pilot mental health and its role in the continuous development of aviation safety management systems (SMS). In addition; regulatory bodies, such as The International Civil Aviation Organization (ICAO) and The European Aviation Safety Agency (EASA), have recently proposed an upgrade of current requirements to address aviator mental health issues in a wider and more structured context than before. **OVERVIEW:** These regulatory advances are in line with the ongoing, exhaustive approach to aviator health currently conducted by the Norwegian Armed Forces Medical Services, Institute of Aviation Medicine (IAM). An overview will be presented of the Norwegian effort. These efforts include further development of the Flight Surgeon/AMEs responsibility in the yearly "medical" examination, revitalization of its "Care of the Flier" program, continuous initiatives in psychoeducative processes implemented throughout the Norwegian Air Force Operational Community, recent implementation of a Peer Support System and finally the implementation of "pilot-in-the-loop" Human Factors Councils for individual aviator support when indicated. **SIGNIFICANCE:** The ongoing effort of the Norwegian IAM proposes a continuous and tireless focus on mitigating risk in aviation safety by adapting a "Big Picture" approach to aviator health. This effort proposes a tool-box of approaches that recognizes the utilization of academic resources across several specialties, and that aims at making a significant contribution to flight safety both in the civilian and military sectors alike.

Learning Objectives:

1. The need for increased focus on mental health issues in aviation safety.
2. Big picture approach - the need for inititatives throghout the aviation community to mitigate risk and enhance flight safety.
3. Interdiciplinary focus needed to assess and manage Aviators overall health.

[412] THE ELITE PERFORMANCE INITIATIVE CENTER: SUCCESSFUL IMPLEMENTATION OF HUMAN PERFORMANCE OPTIMIZATION FOR THE OPERATIONAL U.S.AIR FORCE

C. Wherry[1,2]
[1]711 Human Performance Wing, Valdosta, FL; [2]WACoE, Moody AFB, GA

In recent years, the Air Force Medical Service has transformed its strategy to include the component of Human performance optimization in an effort to improve long term functioning of Air Force members and improve their overall capability. As part of this effort, the 711 Human Performance Wing has reached out to assist Air Force bases that include units with higher operational requirements for physical performance, such as Pararescue and Tactical Air Control Party Airmen. Strenuous mission requirements result in "hot spots" of musculoskeletal injury among these Airmen. By working side by side with in-place medical and line assets, 711 Human Performance Wing Elite Performance Initiative Centers (EPIC) have started to implement processes to evaluate and correct musculoskeletal issues within operational squadrons (Pararescue, EOD, and Base Defense). After the initial year of implementing these processes, a significant improvement in most of the musculoskeletal tenets of Human performance were noted (in this application they are: reduced injury rate, reduced injury severity, reduced injury recovery time, and improved capability). Injury recovery time decreased from an average of 218 days to 126 days six months later, then finally 111 days after one year. Overall injury rate was unchanged going from 11.7 to 4.6 after six months then back up to 11.6 at the one year point. Injury severity decreased at six months and one year. Also, screening tests, such as the Functional Movement Screen (FMS) showed relevant improvement. Together, these improvements show that a new paradigm in musculoskeletal care for operational Airmen is beneficial and worthy of further investment.

Learning Objectives:

1. Identify the obstacles in treating and optimizing the warrior athlete.
2. Identify the unique resources used in athletic departments that can assist the warrior athlete.

[413] TRAINING ISSUES FOR THE ADOLESCENT STUDENT PILOT

H. Munoz[2] and D. Kazdan[1,3]
[1]Electrical Engineering and Computer Science, Case Western Reserve University, Cleveland Heights, OH; [2]Special Education, Cleveland Heights/University Heights School District, Cleveland Heights, OH; [3]Anesthesiology, Case Western Reserve University, Cleveland, OH

PROBLEM STATEMENT: Teenagers constitute much of the nation's population of student pilots, including those flying solo. These students are our future pool of pilots and astronauts and their educational needs should be considered carefully. FAA training material provides no information on the adolescent learner. We will discuss current research as it pertains to flight training and suggest additions to *The Flight Instructor's Handbook*. **TOPIC:** The FAA identifies the mean age of new student pilots as 35. *Flight Instructor's Handbook* discusses extensively the educational needs of the adult learner. Glider solo, however, is 14, and powered aircraft 16; most career aviators begin flight training before 18. The educational needs of adolescents differ from those of adults in ways contemporary neuropsychiatric research is clarifying. Adolescence is now defined as the period of development ending in the early 20s. NIMH research indicates continued development of the prefrontal cortex during this period, specifically in the areas of impulse control, planning, and emotional judgement making. Using the FAA's "five hazardous attitudes" model as a springboard, we will discuss approaches for teaching adolescents with emphasis on when to temper these attitudes and when to employ them in aviation decision making. We will include a proposal for adding material on adolescent flight instruction to the FAA's curriculum. **APPLICATIONS:** Flight instruction needs to be conducted with full understanding of the individual student pilot. Material presented here will assist instructors in planning curricula and in anticipating instructional challenges both in classrooms and in cockpits for adolescent students. The material will also further understanding and anticipation of the young student pilot's reactions to critical situations and rapid decision making, to help the student prepare optimally for responsible pilot-in-command flight. **RESOURCES:** FAA *Flight Instructor's Handbook,* http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/aviation_instructors_handbook/media/faa-h-8083-9a.pdf. NIMH on adolescent brain development http://www.nimh.nih.gov/health/publications/the-teen-brain-still-under-construction/teen-brain_141903.pdf.

Learning Objectives:

1. The participant will be able to discuss the neuropsychiatric basis of learning in adolescents and apply this knowledge to flight training.

[414] DESCRIPTIVE ANALYSIS OF PILOTS IN THE F-22 MEDICAL REGISTRY

E. Ennis[1], R.S. Mayes[2] and G. Maupin[2]
[1]FHCF, Air Force Research Laboratory School of Aerospace Medicine, Wright-Patterson AFB, OH; [2]Aeromedical Research, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: Beginning in 2008, F-22 pilots reported in-flight physiologic incidents at greater-than-expected rates. In 2011, the fleet was temporarily grounded and an investigation by the U.S. Air Force Scientific Advisory Board was initiated. In 2012, the Scientific Advisory Board published a report on aircraft oxygen generation, summarizing their findings and recommendations. **METHODS:** One of the recommendations from this report was to "create a medical registry of F-22 personnel who are exposed to cabin air or OBOGS [on-board oxygen generation system] product gas, and also initiate epidemiological and clinical studies that investigate the clinical features and risk factors of common respiratory complaints associated with the F-22." At the U.S. Air Force School of Aerospace Medicine, personnel data from the years 2004 to 2015 (inclusive) for all F-22 pilots were collected. Sortie data were obtained from the Aviation Resource Management System, and aircraft integrity data was obtained from Lockheed Martin. The Aviation Resource Management System data provide the ability to connect personnel data with aircraft data, a key linkage that had not been previously accomplished. **RESULTS:** Over the 12-yr period, there were 367 pilots, most of whom were active duty (259, 70.6%), but also included Air National Guard (58, 15.8%) and Air Force Reserve (50,

13.6%) members. For those with available flight data (n=334, 91.0%), the average number of career flying hours was 1,700.1 (range 250.8-3980.0, median 1658.0). In 2015, most pilots (223/269, 82.9%) were stationed at one of five locations. **DISCUSSION:** This effort provides a comprehensive, longitudinal look at a high-interest population. The next steps include linking individual pilots to individual aircraft, incorporating medical data into the registry, and utilizing novel statistical methods for data discovery. These techniques developed may also be used to study other high-interest populations. This project will greatly simplify data collection for future studies and demonstrates the capability of data management and mining techniques to improve scientific knowledge of the warfighter.

Learning Objectives:

1. Understand the demographics and workload of the F-22 Pilot population.

[415] THE NEED FOR CLOSER INTEGRATION OF AEROSPACE MEDICINE AND ENGINEERING; LESSONS FROM A SERIES OF FAST-JET LIFE SUPPORT SYSTEM HAZARD REVIEWS

P.D. Hodkinson[1,2], A. Cowin[3], R.S. Welburn[4] and N.D. Green[1]
[1]RAF Centre of Aviation Medicine, Hitchin, United Kingdom; [2]Department of Medicine, University of Cambridge, Cambridge, United Kingdom; [3]QinetiQ, Warrington, United Kingdom; [4]Royal Aeronautical Society, Hullavington, United Kingdom

MOTIVATION: During 2014 there were a series of engineering-led hazard reviews of UK MOD Fast-Jet life support systems (LSS). One of the outcomes of these reviews was the recommendation for aerospace and LSS engineers to have training in aerospace medicine. **OVERVIEW:** Following the death of a pilot due to two previously un-identified hazards in the Crew Escape System, the reviews were undertaken to try and identify previously un-identified hazards in the LSS that pose a Risk to Life. LSS were defined as the systems that provide the aircrew with altitude and G protection. The approach adopted was an adapted Functional Failure Analysis technique. Only critical failure modes were considered looking at possible causes of failure, together with existing mitigations and controls. Each review commenced with an aerospace medicine brief on the potential environmental hazards during routine and emergency flight scenarios and potential LSS failure modes, which highlighted that experienced aerospace and LSS engineers may never have had such training. It was recommended that training should be developed to address this including the inherent physiological variability in response to these scenarios and the critical role their work and the LSS play in mitigating these risks. A recurring theme from these reviews was also the reliance on the human in the system as the sensor for LSS failure modes whilst also potentially being impaired as a sensor by the effect of the failure. This draws focus on the validity, efficacy, and frequency of aircrew aerospace medicine training and whether aircrew are aware just how critical they are in the detection and identification of multiple potential failure modes. **SIGNIFICANCE:** Aerospace medicine training packages for aerospace and LSS engineers are being developed as a result of the Fast-Jet LSS hazard reviews. Such education also serves to inform future risk-based decisions regarding aircraft and LSS failure modes and their implications. The output of the hazard reviews reinforces the need for evaluation of potential in-flight monitoring systems but we must ensure appropriate validation work is undertaken to understand the physiological, as well as technological, limitations of these systems. Furthermore, these issues highlight the need to re-invigorate the interaction and understanding between aerospace medicine and our engineering counterparts.

Learning Objectives:

1. Appreciate that fast-jets and their life support systems are complex systems that may have as yet unidentified hazards that could pose a Risk to Life.
2. Recognize that aerospace and life support system engineers benefit from aerospace medicine training.
3. Understand that there is a reliance on the human in the aircraft system as the sensor for life support system failure modes whilst that person is also potentially being impaired as a sensor by the effect of the failure.

Thursday, April 28 ***10:00 AM***
Avalon 7-9

S-78: PANEL: AEROSPACE MEDICAL PRACTICE UPDATES--PART 1

Sponsored by ASAMS

Chair: Patrick Storms
Dayton, OH

Chair: Daniel Van Syoc
Springboro, OH

PANEL OVERVIEW: This panel will consist of speakers providing clinical updates on medical conditions of aeromedical interest. Aeromedical clinical experts and aerospace medicine residents will present clinical updates on topics related to the assessment and treatment of aviators and special duty personnel suffering from specified medical conditions of aeromedical interest. Presentations will include recommendations for treatment and discussions of the aeromedical implications of the specified disease conditions.

[416] WHAT YOU NEED TO KNOW ABOUT HIV POLICY IN AVIATION

D. Van Syoc
U.S. Air Force, Wright-Patterson AFB, OH

PROBLEM STATEMENT: Human immunodeficiency virus (HIV) infection is a unique clinical situation and presents the aeromedical decision makers with unique challenges. These cases normally get the attention of many senior personnel in the operational and medical communities. Therefore, aviators with HIV can be expected to survive for many years with current medication protocols. How has that fact impacted these people and their ability to remain on flight status or become medically certified? **TOPIC**: HIV infection, once thought universally fatal, now can result in a fairly normal lifestyle and life expectancy. Patients will need to be on multiple medical regimens and watched carefully for the rest of their life. Current therapeutic agents are more effective and safer than most of the earlier medications. This has led to a renewed interest in affected aviators being returned to flight duties. This presentation will explore the epidemiology, pathogenesis, unique military concerns, and aeromedical approaches to decisions regarding flight duties. I will discuss the differences between the purely clinical and the aeromedical perspectives and how this influences the decision makers. **APPLICATIONS**: Current aeromedical guidelines will be reviewed related to HIV-infected aviators and the waiver experience will be discussed. There will be discussions about possible future policy changes/initiatives.

Learning Objectives:

1. Neurocognitive problems are not uncommon in individuals with HIV infection. The unpredictability of these deficits has led to the current discomfort with all the U.S.military branches to waive aviators with this infection.

[417] SICKLE CELL DISEASE, SICKLE CELL TRAIT, AND THE AVIATOR

R. Allnutt
USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

PROBLEM STATEMENT: The syndromes associated with hemoglobin S (Hb S) remain an important, although infrequently encountered, condition, but must be considered when initially clearing an individual to fly. **BACKGROUND/LITERATURE REVIEW:** Hemoglobin S results from substitution of a valine for glutamic acid in the beta globin portion of normal hemoglobin A. Other abnormal hemoglobin variants that may present in adulthood include the hemoglobins of beta 0 thalassemia and beta + thalassemia, hemoglobin C, and the persistence of fetal hemoglobin, Hb F. **CASE PRESENTATION:** Sickle cell disease, the homozygous condition of Hb SS, often results in severe, incapacitating, and sometimes fatal episodes associated with hypoxia, exertion, and dehydration. Pain due to a vaso-occlusive event is the most likely clinical syndrome, but

numerous other syndromes involving the central nervous system, heart, lungs, and kidneys are frequent. Similar syndromes also occur when an individual has Hb S and one of the other abnormal hemoglobins. Such variants include Hb S – beta 0 thal, Hb S – beta + thal, Hb SC, and Hb SF. In contrast, heterozygous Hb AS, also called sickle cell trait, has a much better clinical course. Heterozygous Hb AS is present in 7-9% of sub-Saharan African populations and in individuals with African and southern-European genetic backgrounds. **OPERATIONAL/CLINICAL RELEVANCE:** During screening for military service, all recruits receive screening for Hb S. For those with positive screening, hemoglobin electrophoresis is performed. Individuals with Hb AS but less than 45% Hb S, no history of symptomatic sickle cell trait, and no evidence of any of the other variants of sickle cell disease (such as Hb SC) require no waiver for military service or aviation service. Those individuals with Hb SS, variants of sickle cell disease, and those with history of symptoms attributed to sickle cell trait are not qualified for military service and do not receive waivers for flying status.

Learning Objectives:

1. Understand how Hemoglobin S affects a pilot's health.

[418] ASAMS CLINICAL UPDATES: HYPERLIPIDEMIA

R. Suresh[1,2] and C. Mathers[2]
[1]Internal Medicine, UTMB, Galveston, TX; [2]Clinical Preventive Medicine, UTMB Health, Galveston, TX

PROBLEM STATEMENT: Treatment of hyperlipidemia is beneficial for secondary prevention in individuals with known cardiovascular disease. In those without known cardiovascular disease, treatment decisions depend on the presence of risk factors. There are several methods for determining cardiovascular risk, of which a more recently published risk assessment tool from the ACC/AHA has garnered controversy. In addition, novel treatments such as PCSK9 inhibitors are emerging for the treatment of hyperlipidemia. **TOPIC:** This presentation will provide an overview of the epidemiology, diagnosis, and treatment options for hyperlipidemia, review current screening recommendations, and discuss aeromedical implications of this condition. **APPLICATIONS:** Attendees will gain an understanding about diagnosis and treatment options for hyperlipidemia, learn about calculators available for the determination of cardiovascular disease risk, and review current FAA aeromedical standards regarding the management of hyperlipidemia. **RESOURCES:** 1. American College of Cardiology/ American Heart Association. Atherosclerotic Cardiovascular Disease (ASCVD) Risk Estimator. 2014. Available at: http://tools.acc.org/ASCVD-Risk-Estimator/. 2. Cardiovascular Disease (10-year risk). Based on: D'Agostino RB Sr, Vasan RS, Pencina MJ, et. al. General Cardiovascular Risk Profile for Use in Primary Care. The Framingham Heart Study. Circulation. 2008 Jan 22. Available at: https://www.framinghamheartstudy.org/risk-functions/cardiovascular-disease/10-year-risk.php.

Learning Objectives:

1. Gain an understanding about diagnosis and treatment options for hyperlipidemia.
2. Learn about currently available cardiovascular disease risk assessment calculators.
3. Review FAA medical standards regarding the management of hyperlipidemia.

[419] AEROMEDICAL ASPECTS OF POLYCYSTIC OVARIAN SYNDROME

J.T. Lavan
Residency in Aerospace Medicine, NAMI, Pensacola, FL

Among women of childbearing age, 5-10% develop Polycystic Ovarian Syndrome. While the syndrome itself may have only limited aeromedical implications, it is associated with significant comorbidities and several treatments utilized for this condition have significant aeromedical implications. In this presentation, the Syndrome is reviewed and aeromedical implications of the condition itself, the comorbidities and the treatments will be reviewed.

Learning Objectives:

1. Identify the criteria for the diagnosis of Polycystic Ovarian Syndrome.
2. Describe comorbidities of Polycystic Ovarian Syndrome which have significant aeromedical implications.
3. Discuss treatments of Polycystic Ovarian Syndrome which have significant aeromedical implications.

Thursday, April 28 ***10:00 AM***
Avalon 10-12

S-79: SLIDE: ENVIRONMENTAL CHALLENGES IN AEROSPACE MEDICINE

Chair: Frederick Bonato
Belleville, NJ

Chair: Bruce Wright
Wright-Patterson AFB, OH

[420] AIRSICKNESS PREVENTION METHODS

P.E. Hays
Aerospace and Operational Physiology, U.S. Air Force, Vance AFB, OK

MOTIVATION: Airsickness is a normal response for healthy individuals to experience in flight of an aircraft. In the military aviation community, airsickness is not only a discomforting response, but it affects the way aviators are able to perform in the aircraft as well. One key factor to airsickness is the preventative measures that can be put in place prior to flying within the aircraft. This presentation will prepare educators with tools that help reduce the number of airsickness referrals. **OVERVIEW:** Vance Air Force Base has made changes to the Airsickness Program to help future Air Force Pilots identify many of the self-imposed stressors that may be effecting their flying performance prior to flying in the T-6 Texan II for the first couple of flights, otherwise known as the 'dollar flight'. Education on prevention techniques were provided to pilot training students the day before going on their dollar flight, instead of weeks prior to the flight. The education included proper rest, hydration, diet, physical fitness, biofeedback training, progressive relaxation training, diaphragmatic breathing, and motion acclimation therapy using the Barany Chair. **SIGNIFICANCE:** Implementation of educating student pilots of preventative measures showed a correlation in the total number of individuals reporting and/or referred to aerospace physiology for airsickness by 17% from fiscal year 2013 to fiscal year 2015. Although not a scientific study, Vance Aerospace Physiology's data suggests that strategic airsickness management education may improve/refresh student pilot prevention techniques and reduce overall airsickness reporting. Fewer airsickness cases will reduce number of man hours required to support airsickness counseling and training, as well is improved individual performance in the aircraft for the student during their flying phase of training.

Learning Objectives:

1. Learn about airsickness preventative measures.

[421] NARROWING OF ATTENTION AND FUNCTIONAL FIELD OF VIEW FOR HELICOPTER PILOTS IN A DEGRADED VISUAL ENVIRONMENT

J.W. Geeseman
Human Systems, Naval Air Systems Command, Patuxent River, MD

INTRODUCTION: During highly stressful tasks, "narrowing" of attention has been observed in military personnel in experimental paradigms including deep sea diving, parachuting, and during bombing missions (Baddeley, 2010). Only anecdotally scrutinized, helicopter pilots state that while landing in a degraded visual environment (DVE), their visual scan reduces from their normal scan, which includes flight instruments, to focusing mostly on what is visible out the "bubble," or windshield near their feet. The objective of this project is to quantify the proportion of scan reduction, latency changes in landing, decrement in functional field of view, and variability changes in operation of the cyclic and collective during DVE. **METHODS:** Eleven male participants were recruited to complete the study. In a simulator, participants attempted to land a CH-53E in a clear visual environment, a partially occluded visual environment, or a fully occluded visual environment in a fully-counterbalanced design. While on approach and landing, a peripheral visual cue (i.e., random alphanumeric character) was presented to the participants for response. On a horizontal plane approximating eye-level, the eccentricity of the visual stimulus varied about the center field of view. Dependent variables included successful/unsuccessful landing attempts, latency to land, variability of cyclic/collective movements, eye tracking, head tracking,

whether or not they can identify a peripheral visual cue presented on screen during landing, and latency to identify the peripheral visual cue. **RESULTS:** Participants produced more landing errors, more variable movements, and demonstrated less sensitivity to the secondary task during DVE conditions than during normal landing conditions. Performance on these tasks began to diverge at later phases of flight, which supports additional hypotheses that as stress increases beyond a threshold, performance decreases. Additionally, eye-tracking data and performance data support the hypothesis that functional field of view decreases during highly stressful landing tasks. **DISCUSSION:** These results support the previous conclusions of Baddeley (2010), in that, attention or functional field of view decreases during highly stressful tasks. Furthermore, these results support the anecdotal evidence from helicopter pilots stating that landing in DVE changes their visual scan in ways not supported by training (i.e., maintaining good instrument scan).

Learning Objectives:

1. Human performance metrics, such as response latency or hit/false alarm rate, can be used to assess stress (i.e., "workload") without the need for post-event questionnaires.
2. Tasks demanding high attentional allocation lead to poorer performance in secondary tasks, but this effect can be mitigated with experience.

[422] SURVIVAL ANALYSIS OF U.S. MILITARY AVIATION SHOOT-DOWN EVENTS: A PILOT STUDY

S. Bernstein[1], D. Wise[1], S. Van Horn[3] and J. Crowley[2]
[1]SAD, U.S. Army Aeromedical Research Lab, Laulima Government Solutions, Enterprise, AL; [2]U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL; [3]SAD, U.S. Army Aeromedical Research Lab, Fort Rucker, AL

INTRODUCTION: Existing aircraft survivability evaluation methodologies have historically focused on what happens to the aircraft in a combat event, with only a limited consideration of personnel casualties resulting from combat-related aircraft losses. The Aviation Survivability Development and Tactics (ASDAT) team (Fort Rucker, Alabama) requested the Joint Trauma Analysis and Prevention of Injury in Combat partners, via the Survival Analysis Division at the U.S. Army Aeromedical Research Laboratory, to conduct a multiphase retrospective analysis to assess injuries sustained by U.S. military personnel in combat aviation events. The goal is to better understand these events to improve personal protective and aviation life support equipment. This report details the pilot phase of the project. **METHODS:** Four combat events were selected for analysis, one from each Army rotary-wing airframe (AH-64, UH-60, CH-47, and OH-58D), for preliminary analysis. Cases were identified and data extracted using the Combat Damage Incident Reporting System (CDIRS) database with cross-references from the Defense Casualty Information Processing System (DCIPS) to ensure completeness. Inclusion criteria were all U.S. combat aviation events from 2003 through 2014. Excluded were non-U.S., contractor, and classified combat aviation events. Event data include airframe, threat, kinematics (as available), and casualties. The Naval Health Research Center (for wounded) and the Armed Forces Medical Examiner System (for fatalities) provide injury-coded data. Kinematic, scenario, and injury analyses were performed and the results correlated to elucidate injury causation and potential protective equipment implications. **RESULTS/CONCLUSIONS:** This pilot study showed that the relevant databases can be linked to enable damage-injury analysis, although detailed information will not be available for many combat-related events in the past. The study's analytic methodology was validated. As these combat aviation events are not investigated by formal safety investigation teams, this retrospective analysis will be of great benefit to survival equipment designers. The project will proceed into six stages of Operations Iraqi Freedom and Enduring Freedom.

Learning Objectives:

1. Describe retrospective systematic analysis of combat aviation events that occurred with Operation Iraqi Freedom and Operation Enduring Freedom.
2. Compare/contrast combat aviation events with aviation accident and mishap events.
3. Discuss the unique difficulties of analyzing combat events, given the sensitivity of protecting the involved identities as well as operational vulnerabilities.

[423] LONG DURATION HELICOPTER FLIGHT WITH MODERN PROTECTIVE ENSEMBLES: PAIN DETERMINES ENDURANCE

A. Estrada[2], S. Jackson[2], B. Ranes[2], B. Cadarette[1], B. Laprise[3] and J.G. Ramiccio[2]
[1]U.S. Army Research Institute of Environmental Medicine, Natick, MA; [2]U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL; [3]Natick Soldier System Center, Natick, MA

INTRODUCTION: Chemical/biological protective ensembles provide a barrier between the aircrew and the environment. MOPP 4, the greatest protection level, includes a bulky suit, gloves, boots, and mask, and can hinder the endurance and performance of Army aviators during lengthy flights. Recent operational requirements dictate flights beyond eight hours while under potential threat from chemical/biological attack. **METHODS:** Eight UH-60 pilots participated in a test of an aviator ensemble (Estrada et al., 2014). Employing a repeated measures design, the study generated physiological and performance data reflecting the effectiveness of the ensemble, which featured a microclimate cooling unit (MCU). Each test session was planned to last longer than eight hours simulating a typical July temperature profile in Afghanistan (a cockpit environment of up to 100 °F and 50% humidity). **RESULTS:** Of the eight participants, only one was able to remain in MOPP 4 for the entire mission (> eight hours). The average was 6.04 hours. All participants reported moderate to severe head and face discomfort (e.g., pain, hot spots, pressure, skin abrasion). Seven participants self-terminated before mission completion. The MCU provided sufficient cooling to keep physiological measures (core and skin temperatures, and heart rate) within safe parameters. The mood and symptoms questionnaire indicated moderate to low workload with moderate energy and boredom. Nausea, anger, depression, and dizziness were virtually absent. Flight performance was not substantially affected for any of the flight maneuvers. **DISCUSSION:** The results were consistent with previous studies conducted at the U.S. Army Aeromedical Research Laboratory (Leduc et al., 2002; Katz, Wildzunas, and Cadarette 1999; Reardon et al., 1997, 1996). When a functioning MCU is used, environmental heat stress does not limit endurance; rather, it is the fit, comfort, and encumbrance of the ensemble. Katz, Wildzunas, and Cadarette (1999) found that despite each participant being fitted by subject matter experts, mask-induced pressures on the nose and forehead were consistent irritants. Reardon et al. (1996) recommended that fit and comfort for the mask and helmet combination be improved. Ensemble comfort, especially that of the mask, must be improved before extended flight operations (> eight hours) in MOPP 4 are planned.

Learning Objectives:

1. Understand that, when considering long duration flights in MOPP 4 protective gear, equipment comfort is as important a factor as sustaining physiological measures within safe parameters.

[424] IMPACT OF CLIMATE CHANGE AND EXTREME WEATHER ON WORLDWIDE AEROMEDICAL OPERATIONS

D.P. Reyes
PMCH, University of Texas Medical Branch, Webster, TX

INTRODUCTION: The increasing frequency of extreme weather attributable to climate change will have significant impact on worldwide aeromedical operations. Awareness of these impacts is crucial to mitigate adverse health outcomes in air and ground crews, and in other populations. **METHODS:** A literature review was done for climate change topics relevant to aerospace medicine, with an emphasis on extreme heat and precipitation. The impact of these factors is described. **RESULTS:** Seventy-five percent of current extreme heat events can be attributed to the 0.85 degree centigrade increase in the global average temperature above pre-industrial levels. Extreme heat events contribute most to the mortality of extreme weather. For example, extreme heat linked to climate change contributed to 14,947 excess deaths during the French heat wave of 2003. Worldwide, extreme precipitation has increased by 12% since the 1980s due to climate change, with local increases of 56% in Southeast Asia, and 31% in Europe. According to the U.S. National Climate Assessment, extreme precipitation events have increased in the U.S. by 30% above the 1901–1960 years average, with a concurrent increase in major flooding. Flooding causes population displacement and economic loss. Over the past 40 years, worldwide insurance payouts from natural disasters, mostly from flooding, have increased from 5 to 27 billion U.S.

dollars per year. In the future, for a likely 2 degree centigrade average increase in global temperature there will be an exponential increase in extreme heat and a 40% increase in extreme precipitation events. Other significant climate changes that are, and will, continue to impact health include: increased frequency and magnitude of drought and forest fires, changes in the distribution of vector driven disease, increased storm surge from hurricanes due to sea level rise, and other impacts. **DISCUSSION:** Observed and projected increases in extreme heat and other climate driven events will adversely impact aeromedical operations worldwide. Heat stress in ground and aircrew will increase without appropriate adaptation measures. The tempo of aeromedical operations will increase significantly in a world where major natural disasters are becoming more common. Therefore, the impacts of climate change should be a significant consideration for the planning and conduct of current and future aeromedical operations and capabilities.

Learning Objectives:

1. Learn about the potential impacts of climate change on aerospace medical operations, and use that knowledge to plan appropriate adaptation measures to ensure aircrew safety.

Thursday, April 28 ***10:00 AM***
Avalon 13-14

S-80: PANEL: INTERNATIONAL AIR AMBULANCE OPERATIONS

Sponsored by ATM Committee

Chair: Anthony Evans
Montreal, Quebec, Canada

PANEL OVERVIEW: International transport of patients through air ambulances entails a series of logistics and medical considerations. The panel will discuss those aspects with particular focus on all phases of those missions as well as the associated international public health concerns.

[425] LOGISTICAL AND OPERATIONAL ASPECTS IN INTERNATIONAL COMMERCIAL AEROMEDICAL TRANSPORTATION

V.D. Scutt and R. Nicholas
Operations, International SOS Assistance, Inc., Willow Grove, PA

An international aeromedical evacuation requires many parts and people working together for a successful outcome. That includes coordination between the flight desk; physicians, nurses and security experts; the patient's family and employer; the sending and receiving hospitals; and the aviation provider. Evacuations are an exercise in logistics, where all moving parts must be practiced and happen in just the right order to be successful. Individual clearances (passport, visas for patient and escorts) as well as operational and security aspects (air space restrictions) must be considered and addressed along with the plan for contingencies of the unexpected. This paper will take a look at what goes into a successful evacuation, as well as best practices for putting together a plan that helps meet Duty of Care responsibilities, drawing on case studies from recent events. The experience of a flight coordination desk from a major assistance company handling and average of 14,000 missions a year will be shared.

Learning Objectives:

1. The participant will be better able to understand the efforts in coordinating an aeromedical evacuation, from the notification call to patient handoff at receiving care.

[426] INTERNATIONAL REPATRIATIONS ON COMMERCIAL AIRLINES

T.J. Doyle[1,2]
[1]Emergency Medicine, University of Pittsburgh, West Mifflin, PA; [2]STAT-MD, Pittsburgh, PA

An airline or other entity that wishes to repatriate an ill or injured passenger or employee must evaluate the severity of the victim's condition against the medical suitability of travel on a commercial airline. This panel presentation will outline the 3 major categories for medical repatriation. These categories are 1. Passenger can travel alone or with family with some assistance from airline personnel. 2. Passenger would require a medical escort and additional medical equipment. 3. Passenger would not be suitable for travel on a commercial airline and would require a dedicated Air Ambulance. The presentation would discuss different medical conditions and which category they would most likely fall under. Commercial Airline capabilities and limitations would be discussed. A general discussion of the different costs associated with each category would occur. Geographic and logistical issues would also be discussed.

Learning Objectives:

1. Have an understanding of the 3 categories of medical repatriation.
2. Understand the difference between the 3 categories of medical repatriation including capability and cost.
3. Understand the limitations of commercial airlines with regard to medical repatriation.

[427] OPERATIONAL AEROMEDICAL CHALLENGES OF TRANSFERRING HIGHLY INFECTIOUS PATIENTS – A PERSPECTIVE FROM THE UK

I.A. Mollan[1], B. Mollan[2] and A. Manson[3]
[1]Aviation Medicine Training Wing, RAF Centre of Aviation Medicine, CARTERTON, United Kingdom; [2]HQ Tactical Medical Wing, RAF Brize Norton, Infection Prevention Control Flight, CARTERTON, United Kingdom; [3]HQ Tactical Medical Wing, RAF Brize Norton, UK Strategic Aeromedical Evacuation Control Centre, CARTERTON, United Kingdom

INTRODUCTION: Globally, over 300 billion passengers travel by air [i]. As trans-border mobility has increased, so has the threat of spread of infectious disease [ii]. Whilst the International Health Regulations place responsibility on all 194 nations to prevent, protect against and control the spread of disease, the regulations also require the avoidance of unnecessary interference with international traffic and trade [iii]. In recent years, following several notable disease outbreaks, more nations and militaries have developed the ability for air movement of patients with highly infectious disease. **METHODS**: All end-to-end aeromedical operational planning and deployment factors which were considered during the deployments of the UK Air Transportable Isolator (ATI) from Nov 06 to Oct 15, were examined. Their rationale and their basis in international agreement, legislation and UK hospital procedures were summarized. Capability reviews of the UKs ATI were examined. Design characteristics of transport isolation systems, hospital systems and operational aeromedical procedures were also examined. **RESULTS**: The factors comprised: Pre-mission aeromedical and flight planning, mission activation, diagnosis-specific aeromedical operational procedures, post-mission regeneration, team surveillance and post-mission health-care governance review procedures. **DISCUSSION**: With the continuing threat of spread of infectious disease and the associated economic and political concern, air transport capabilities for the movement of patients with highly infectious disease will continue to persist. The operational and medical planners of these highly specialized capabilities need broad understanding of legal, aviation, medical, financial and political requirements. Appropriately trained and experienced aeromedical personnel require specialist knowledge, access to highly-specialist advice, pan-government support and regular practical rehearsal of in-flight and transfer procedures.

Learning Objectives:

1. The participant of the activity identify the operational aeromedical factors required to be considered in mission planning and execution of highly infectious disease patient movement.

[428] MEDICAL EVACUATION FROM HIGH RISK LOCATIONS: GOOD MEDICINE IN BAD PLACES

J. Babicki
RMSI, Dubai, United Arab Emirates

INTRODUCTION: We all appreciate that despite meticulous planning; MEDEVACs often present us with unforeseen challenges from both a logistic and human standpoint. Add into the mix hostile activity and no-fly zones and one can immediately understand that these missions are not for the faint hearted. **METHODS**:

The experience of a civil aeromedical company engaged in high-profile MEDEVAC missions in hostile zone is reviewed. **RESULTS**: Pre-mission aeromedical and flight planning, mission activation, diagnosis-specific aeromedical operational procedures are discussed along with statistics on the nature of medical problems. **DISCUSSION**: Our case presentations illustrate that with the correct approach and attitude very little stands in the way of a successful medical evacuation.

Learning Objectives:

1. Understand the additional complicating factors when operating civil air ambulances in hostile zones.

Thursday, April 28 ***10:00 AM***

Avalon 15-16

S-81: PANEL: FROM THE BRIEFING ROOM TO THE EXAM ROOM: ADAPTING COGNITIVE SCIENCE DEVELOPED FOR AVIATION TO CLINICAL MEDICINE

Sponsored by the Aerospace Human Factors Association, the Asma Aerospace Human Factors Committee, and the Aerospace Physiology Society

Chair: Keith Ruskin
Chicago, IL

PANEL OVERVIEW: PROBLEM STATEMENT: Medicine and aviation both involve high-risk activities in which there is a "command and control" hierarchy that places life-or-death decision making in the hands of a small number of operators. Life-critical processes are composed of complex sequences of actions that require continuous communication and coordination with a team of professionals who vary in training and expertise. Both require continuous education to keep pace with constantly evolving tools, techniques and procedures. **TOPICS:** Military and civilian aviation has addressed human performance issues by introducing standardized instruction and procedures that reduce risk for all phases of flight. For example, over a half century ago the United States Navy introduced the Naval Air Training and Operating Procedures Standardization (NATOPS) program, which codifies training requirements, crew resource management and other activities that have collectively helped to reduce the mishap rate by over 20-fold. Similarly, in 1978 the National Safety Transportation Board recommended changes in commercial aviation training, emphasizing the management of crew coordination and communication. In an effort to increase patient safety, the medical community is adopting techniques developed by the aviation community, and has dramatically improving patient safety. Tools such as checklists, cognitive aids, and advanced training can also increase safety. **APPLICATIONS:** Psychologists and other human performance experts are translating the extensive literature on aerospace human factors into operational recommendations that benefit clinical practice in all specialties. This work is of broad interest to physicians and other healthcare or aerospace professionals who would like to apply human performance research in the areas of cognitive aids and enhanced training to operational problems. This presentation will help attendees to adapt recent scientific advances in human performance for use in clinical settings and to identify opportunities for future research.

[429] RETROSPECTIVE REVIEW OF HUMAN FACTORS MODELS FOR ACCIDENT ANAYSIS AND PREVENTION AND A NEED FOR FUTURE MODEL UNIQUENESS

D.J. White
Colonel, USAF (Ret.), Washington, DC

MOTIVATION: The investigation and modeling of aviation accident causation is dominated by linear models. Aviation and more recently other domains, however, are complex systems and as such suffer from being artificially manipulated into non-complex models and methods. This presentation looks at possible future model uniqueness. **OVERVIEW:** This presentation focuses on accident causation models, (1890s to present), and in particular their application to the field of Human Factors in aviation and other complex systems and domains. In order to fully understand the current position and trends of accident causation modeling it is important to acknowledge the developments and history of the area and where there may be pathways for further investigation and work. This presentation aims to provide an analysis of the history and development of models and where opportunities and validation for model uniqueness arise. **SIGNIFICANCE:** This presentation addresses modeling uniqueness by presenting new performance and research driven approaches to investigating aviation and complex system accident causation. These new models should conceptually identify integrated networks as key indicators of a system's health and risk. This modeling approach will lead to an understanding of complex clinical, operational, aeromedical and human performance accident analysis and prevention.

Learning Objectives:

1. The participant will be able to understand the retrospective review of human factors models for accident analysis and prevention and the need for future model uniqueness.

[430] WELCOME TO THE BORG: ASSIMILATING AIRCEW INTO THE SAFETY CULTURE THRU CREW RESOURCE MANAGEMENT

J. Harvey
Safety Issues Division, Air Force Chief of Safety, U.S. Air Force, Alexandria, VA

The term Crew Resource Management (CRM) is synonymous with safe and effective aviation mission accomplishment. In today's modern U.S.Air Force, it is literally unheard of for an aircrew to fly a mission without extensive review and implementation of CRM concepts from mission planning to execution to mission debriefing. Through a historical look of CRM in aviation history, the presenter will explain the beginnings of CRM with a review of pertinent aviation mishaps and analyze how, through only one generation of aviators, the emphasis on CRM has significantly changed flying safety culture. Further, the presenter will demonstrate that by infusing this culture from the top down, the bottom up and every crack in between--the USAF has been able to maximize effectiveness, preserve combat capability and facilitate mishap prevention.

Learning Objectives:

1. Understand the history of CRM and how the USAF infused it into everyday flying operations.
2. Learn how the USAF's CRM cultural assimilation can provide similar lessons to the medical community.

[432] ADVANCES IN TEAMWORK: THE FUTURE OF CREW RESOURCE MANAGEMENT

K. Ruskin
Anesthesia, University of Chicago, Chicago, IL

This panel presentation will delve into the successful application of crew resource management, with a particular focus on modern advances in teamwork theories and training as used in applied settings. CRM is a proven method for excellent team training in aviation, and has been further adapted into other settings including medical. Although CRM was one of the first forms of team training, it has been followed by a multitude of other types of excellent team training that could further enhance its utility into the future. This section of the panel will discuss the major contributions of the CRM, and potential work to further increase its efficacy within and without aviation.

Learning Objectives:

1. Teach the audience about teamwork, team training, and the use of CRM within aviation and its adaptations to other settings (e.g., medicine).
2. Give individuals in the audience tools for potentially implementing CRM and team training into their own organizations and units.
3. Provide compelling evidence for why team training works, why it's needed, and what the future holds for the science of CRM.

[431] ENABLING EFFECTIVE TRAINING: BUILDING FOR LIFELONG EDUCATION

R. Hubal and D. Schmorrow
Soar Technology, Inc., Ann Arbor, MI

In this presentation we discuss lessons learned from developing adaptive and individualized training to support lifelong education.

Lifelong education represents "a change in how…training is conducted" (Wilson & Helms, 2003), relying not only on encouraging students to explore, expand, and adapt knowledge and skills using their own initiative, but also on the intelligent use of technology for distribution, presentation, and management of educational materials. In aviation as well as other well-studied domains, such as maintenance, educational practitioners have developed the tools and technology necessary to support students' efforts. These technologies include important and obvious equipment: Hands-on trainers like flight simulators for demonstrating and retaining skills; sensing gear to monitor gaze, physical activity, and physiological effects on performance. But they also include a host of just-as-important if less-obvious techniques: Low-fidelity mockups for gaining and sustaining skills; instructor operator stations to support facilitation of learning within and even outside the schoolhouse; dynamic tailoring systems to customize training to the student; intelligent agents to play such roles as crew, Command, and enemy during practice in constructive learning settings; intelligent tutors with whom students establish rapport and who can observe, coach, and mentor as learning takes place; simulation and gaming environments to introduce non-kinetic skills. We present a background on what is now a solid foundation for training in aviation, maintenance, and other domains, and offer insight into novel approaches being designed, developed, implemented, and tested today for building that solid foundation for the medical domain.

Learning Objectives:

1. The participant shall be able to understand what is adaptive, individualized training, what are key elements and findings from past application domains such as aviation, how it is now being applied to medical and clinical skills, and what are its benefits.

[433] A REVIEW OF THE HUMAN FACTORS IN FLIGHT TEST CONCERNS ABOUT THE SPACESHIPTWO OCTOBER 2014 FATAL MISHAP

D.A. Holland
Warfighter Readiness Research Division, 711th Human Performance Wing, Wright-Patterson AFB, OH

INTRODUCTION: SpaceShipTwo was lost in 2014 while conducting atmospheric flight test to expand the envelope of the spacecraft. Scaled Composites, a highly regarded revolutionary organization for producing novel aerospace designs, was the main contractor working for Virgin Galactic on the development of this unique spacecraft. Previously, scaled had won the X-Prize, for flying three sorties in a short window of time into space with a reusable vehicle SpaceShipOne. The return to Earth was stable and slowed by a "feathering" mechanism, that allowed for stable returns from nearly any orientation, thus adding-- it was believed-- a margin of safety (but novelty) to the follow-on similar design for SpaceShipTwo. **DISCUSSION:** Unfortunately, the "feathering" system designed to allow a stable, slow, return to Earth was prematurely unlocked by the co-pilot at 0.8M, well prior to the Mach number target (1.4). The resulting aerodynamic and inertial forces of the deployed feathering mechanism destroyed the spacecraft. The spacecraft began to break apart within seconds of this unlocking. The pilot was thrown from the aircraft during the breakup, manually separating himself from the seat, and surviving with injuries. The co-pilot was killed during impact still strapped to his seat inside the wreckage of the spacecraft. The NTSB investigation asserted that several factors directly related to Human Factors issues in flight test included not properly anticipating catastrophic human error. Others will be reviewed as well. **CONCLUSION:** This mishap highlights that even one of the most innovative organizations in the world can be deeply touched by a mishap where human error, or more specifically, Human Factors in flight test are concerned. This author is a member of the flight test community, and was in the Mojave desert during many of these development events, and was able to talk to Scaled Staff during the years and the "rest of the story" is interesting as well, and not well known to the public, but paints a more complete picture of a dynamic, near-revolutionary organization in action at the cutting edge of aerospace exploration.

Learning Objectives:

1. Learn about the NTSB's conclusions regarding the SpaceShipTwo 2014 mishap.
2. Learn about the various developments in the process of Scaled Composites' spacecraft evolution.
3. Learn about Human Factors in Flight Test Issues.

Thursday, April 28 ***10:00 AM***
Avalon 17

S-82: PANEL: MAINTENANCE OF CERTIFICATION: PILOT AND AIRCREW SELECTION/RETENTION, AEROMEDICAL EVALUATIONS/RISK ASSESSMENT, AND CIVIL AVIATION GOVERNING REGULATIONS

Sponsored by American Society of Aerospace Medicine Specialists

Chair: Cheryl Lowry
Alexandria, VA

Chair: Kimberly Toone
Alexandria, VA

PANEL OVERVIEW: This panel, sponsored by the American Society of Aerospace Medicine Specialists (ASAMS), will address Part 2 of the MOC requirements by providing a lecture series on topics within the core competencies of Aerospace Medicine. This panel will provide a review of Pilot and Aircrew Selection Processes and Retention Strategies, Aeromedical Evaluations and Risk Assessment, as well as Basic Governing Regulations for Civil Aviation (FAR, ICAO, etc.).

[434] MAINTENANCE OF CERTIFICATION: PILOT AND AIRCREW SELECTION/RETENTION, AEROMEDICAL EVALUATIONS/RISK ASSESSMENT, AND CIVIL AVIATION GOVERNING REGULATIONS

K. Toone
ASAMS, Alexandria, VA

PROBLEM STATEMENT: The American Board of Preventive Medicine (ABPM) has four distinct requirements for maintenance of certification (MOC): Part 1: Professional Standing - Diplomates must hold an active, valid and unrestricted medical license in all States, U.S.territories, or Canadian Provinces in which the diplomate is licensed to practice medicine. Part 2: Lifelong Learning and Self-assessment (LLSA) - A total of 250 hours of Continuing Medical Education (CME) over the 10-year span of certification is required. Part 3: Assessment of Cognitive Expertise - Diplomates holding time-limited certificates will be required to take and pass a cognitive exam. Part 4: Assessment of Practice Performance - Diplomates are required to complete two practice performance assessments during their 10 year certification cycle. **TOPIC:** This panel, sponsored by the American Society of Aerospace Medicine Specialists (ASAMS), will address Part 2 of the MOC requirements by providing a lecture series on topics within the core competencies of Aerospace Medicine. This panel will provide a review of Pilot and Aircrew Selection Processes and Retention Strategies, Aeromedical Evaluations and Risk Assessment, as well as Basic Governing Regulations for Civil Aviation (FAR, ICAO, etc.). **APPLICATIONS:** As stated by the ABPM, "Aerospace medicine focuses on the clinical care, research, and operational support of the health, safety, and performance of crewmembers and passengers of air and space vehicles, together with the support personnel who assist operation of such vehicles." In order to provide care to such a diverse and complicated population, continuing education is a vital tool that must be addressed throughout the 10 year certification period and not simply relegated to a few weeks prior to the examination. This series is intended to supplement other continuing education procedures and should not be used as "stand alone" course for MOC. **RESOURCES:** Additional information on MOC can be found at https://www.theabpm.org/moc/requirements.cfm, https://www.theabpm.org/public/studyguide.pdf. Information about ASAMS can be found at http://www.asma.org/about-asma/constituents/american-society-of-aerospace-medicine-specialists.

Learning Objectives:
1. The purpose of this panel is to provide lectures consistent with the core competencies of Aerospace medicine and integral to the maintenance of certification process and lifelong learning.

Thursday, April 28 ***1:30 PM***
Avalon 1-3

S-83: SLIDE: ISSUES IN PSYCHOPHYSIOLOGY

Chair: James Paltry
Patuxent, MD

Chair: Joe Geeseman
Patuxent, MD

[435] W/D

[436] SAFETY OF ELECTROENCEPHELAGRAPHIC (EEG) BASED TRANSCRANIAL DIRECT CURRENT STIMULATION ELECTRODES IN HUMAN EXPERIMENTATION: A META-ANALYSIS

A. McKinley[1], L. McIntire[2], E. Albrecht[3] and J. Nelson[2]
[1]Applied Neuroscience, Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Infoscitex, Dayton, OH; [3]Ohio State University, Columbus, OH

INTRODUCTION: Within the past decade there has been a growing body of research suggesting tDCS can improve cognitive processes in healthy people such as learning, attention, and memory. With this growth and recent improvements in tDCS technology, it is prudent to update the safety of this technique. This effort reviews the data from our own lab in the context of the available safety literature to provide an analysis of the safety of new electroencephalographic (EEG)-based tDCS electrode technology. **METHODS:** A meta-analysis was conducted using data from 5 experiments that utilized electroencephalographic (EEG) based tDCS electrode arrays. In each of these 5 experiments, tDCS was applied at 2mA. Skin sensations during tDCS were assessed through a subjective sensation questionnaire where participants rated itchiness, pain, heat, and general discomfort on a scale from 0-10 with 0 indicating no sensation and 10 indicating severe sensation. This questionnaire was given 1 minute after the onset of the stimulation (i.e. after the sham stimulation had returned to 0 mA but the real tDCS remained at 2 mA). The subjective rating data across the 5 experiments were combined and analyzed to compare rating between the two conditions. A separate meta-analysis was done for studies that had stimulation type (i.e. sham vs. anodal) as a within-subjects variable versus studies that had stimulation type as a between-subjects variable. **RESULTS:** The ANOVAs did not reveal a significant difference between the mean subjective ratings for anodal and sham tDCS in any of the 4 sensation categories. There was a statistically significant difference between the sensation categories. Itching differed significantly from the other 3 sensations in the within and between studies ($p = 0.0001$). Discomfort differed significantly from pain and heat only in the between-subjects studies ($p = 0.0004$). The mean ratings for pain were 1 or less. No adverse alterations in mood, nausea, skin damage, or fatigue due to tDCS were observed in the 5 studies. Headache was present after 2 out of a total of 292 tDCS trials (0.68%). **DISCUSSION:** The results presented in this paper provide evidence that tDCS is safe for use in healthy subjects when used within accepted stimulation parameters. TDCS can be safely administered through EEG based electrodes at 2 mA and provide minimal discomfort and risk to the participant.
Learning Objectives:
1. Observed side effects of transcranial direct current stimulation and the frequency of occurance.
2. The subjective skin sensation ratings reported by research participants that received real transcranial direct current stimulation (tDCS) and how they compared with participants' ratings who received sham tDCS.
3. The overall safety of transcranial direct current stimulation when applied using currently accepted safety guidelines.

[437] SCREENING AND MITIGATION OF ANXIETY IN UNIQUE ENVIRONMENTS

R.A. Mulcahy[2], R.S. Blue[1], J. Vardiman[2], T. Castleberry[2] and J. Vanderploeg[2]
[1]Emergency Medicine, SUNY Upstate Medical University, Syracuse, NY; [2]Preventive Medicine and Community Health (Aerospace Medicine), University of Texas Medical Branch, Galveston, TX

INTRODUCTION: Anxiety and other psychological conditions may present challenges for commercial spaceflight operations, as little is known regarding the psychological effects of spaceflight on laypersons. A recent investigation evaluated measures of anxiety during centrifuge-simulated suborbital commercial spaceflight, highlighting the potential for severe anxiousness to interrupt spaceflight operations. **METHODS**: To pave the way for future research, an extensive literature review identified existing knowledge that may contribute to formation of interventions for anxiety in commercial spaceflight. Useful literature was identified regarding anxiety from a variety of fields, including centrifugation, fear of flying, motion sickness, and military operations. **RESULTS**: Fear of flying is the most extensively studied area, with some supportive evidence from centrifugation studies. Virtual reality exposure (VRE) is as effective as actual training flight exposure (or analog exposure) in mitigation of flight-related anxiety. The addition of other modalities, such as cognitive behavioral therapy or biofeedback, to VRE improves desensitization compared to VRE alone. Motion sickness-susceptible individuals demonstrate higher trait anxiety than non-susceptible individuals; for this reason, motion sickness susceptibility questionnaires may be useful measures to identify at-risk individuals. Some military studies indicate that psychiatric history and personality classification may have predictive value in future research. Medication countermeasures consisting of benzodiazepines may quell in-flight anxiety, but do not likely improve anxiety on repeat exposure. **DISCUSSION**: The scarce available literature addressing anxiety in unique environments indicates that training/repeated exposure may mitigate anxiety. Anxiety and personality indices may be helpful screening tools, while benzodiazepines may be useful countermeasures when needed.
Learning Objectives:
1. Understand the current state of knowledge with regards to the screening and mitigation of anxiety in unique environments, and identify the gaps that can be filled by future research.

[438] MINDFULNESS ALLEVIATES PHYSIOLOGICAL EFFECTS OF STRESS IN A MILITARY HELICOPTER UNIT

A. Meland[1,2], K. Ishimatsu[3], A. Pensgaard[2], A. Wagstaff[1], V. Fonne[1], A. Garde[4] and A. Harris[5]
[1]Norwegian Institute of Aviation Medicine, Oslo, Norway; [2]Norwegian School of Sport Sciences, Oslo, Norway; [3]Graduate School of Health Care Sciences, Osaka, Japan; [4]National Research Centre for the Working Environment, Copenhagen, Denmark; [5]Faculty of Psychology, University of Bergen, Bergen, Norway

INTRODUCTION: Periods of persistent, intensive demand are known to compromise recovery and attentional capacity. The stress reducing effects of four-month mindfulness training (MT) on salivary cortisol and a go/no-go test was tested on a military helicopter unit exposed to a prolonged period of high workload. **METHODS:** MT participants were compared to a waitlist control group, on saliva cortisol, mental demands and performance on a computer-based go/no go test and a test of stimulus driven distractibility. Participants also reported: time of wakeup, sleep duration, quality of sleep, outcome expectancies, physical activity level, self-perceived mindfulness and symptoms of depression and anxiety. **RESULTS:** The results from a mixed between-within analysis revealed an increase in high- and low cortisol slopes, and a decrease in perceived mental demand imposed by the go/no-go test in the MT participants compared to the control group. Paired sample t-tests revealed a pre to post increase in two of the self-perceived mindfulness factors (i.e., observation and description) in the MT participants, but not in the control group. No further between-group pre- to post differences was found in any of the other measures. **CONCLUSION:** MT alleviates some of the physiological stress responses in a military helicopter unit during a period of high workload.

Learning Objectives:
1. You will learn about the effects of a mindfulness intervention on stressreduction and response inhibition.
2. You will learn about some of the challenges of an on-site training based intervention aimed at stress-reduction.

[439] EVALUATION OF AN AUTONOMOUS, COMPUTER-BASED BEHAVIORAL HEALTH COUNTERMEASURE IN AN ISOLATED, CONFINED ENVIRONMENT

A. Anderson[1], A. Fellows[1], M. Hegel[2], K. Binsted[3] and J. Buckey[1]
[1]Geisel School of Medicine, Dartmouth College, Lebanon, NH; [2]Psychology, Dartmouth Hitchcock Medical Center, Lebanon, NH; [3]University of Hawaii, Manoa, HI

INTRODUCTION: Living in an isolated, confined environment (ICE) can induce conflict, stress, and depression. Autonomous and confidential behavioral health countermeasures are important in ICEs. The Virtual Space Station (VSS) is a suite of interactive-media-based, computer-delivered psychological training and treatment programs designed for use on long-duration spaceflights. We evaluated the VSS in the 8-month HI-SEAS 3 Mars analog mission. **METHODS:** Six participants (3 M, 3 F) spent 8 months in group isolation. Subjects were instructed to use the material in the conflict and stress modules at least once, and then to return to it as needed or desired. They were asked to complete the first 2 depression treatment module sessions. Subjects completed acceptability of content questionnaires for the conflict and stress modules. The VSS saves user inputs, including PHQ-9 scores. Exit interviews were conducted. **RESULTS:** Data show there were problems with stress, interpersonal conflict and mood common to ICEs. One crewmember reported depression and another scored in the mild depression range (PHQ-9=8). The crew reported using the material in the VSS and found it valuable. Preferences for modules varied by subject. Three crewmembers returned and used the program beyond what was required. One crewmember did not complete all sessions. The crew felt comfortable using stress and conflict modules (1.75 on a 7-pt Likert scale, 1 = Strongly Agree). The programs were rated highly acceptable (conflict and stress 1.8), and the crew somewhat agreed the programs improved conflict and stress management skills (conflict 3.2, stress 2.5). Crewmembers were neutral on preference for in-person delivery of conflict (4.0) and somewhat preferred in-person delivery of stress (3.3). **DISCUSSION:** Quantitative data show the crew found the material valuable, and interview data show it was retained. Overall, the program was well accepted by most participants and was seen as a worthwhile resource. Opinions on the modules were highly individualized. Additional content to improve the program was identified. The tool proved to be a valuable resource and was used both as intended and in unanticipated ways to help achieve positive behavioral health outcomes.

Learning Objectives:
1. Understand the utility of an autonomous, computer-based behavioral health countermeasure in isolated confined environments.

[440] INVESTIGATION OF WORK STRESS IN FLIGHT CADETS AND AEROMEDICAL PERSONNEL DURING AVIATION PHYSIOLOGY TRAINING COURSE

K. Chiang[3], C. Lai[1], Y. HSIN[2], H. Chu[1] and C. Lai[2]
[1]Aviation Physiology Research Laboratory, Kaohsiung Armed Force General Hospital Gangshan Branch, Kaohsiung City, Taiwan; [2]Institute of Public Health, National Defense Medical Center, Taipei City, Taiwan; [3]Kaohsiung Armed Forces General Hospital Gangshan Branch, Kaohsiung, Taiwan

INTRODUCTION: Military flight training is full of stress and challenge. All flight cadets and aeromedical personnel (flight surgeons, etc.) have to take aviation physiology training course. Both group need to pass the course. We try to investigate and compare work stress level in Air Force flight cadets and aeromedical personnel taking aviation physiology course. **METHODS:** This was a cross-sectional study. Seventy (40 Air Force flight cadets and 30 aeromedical personnel) were included. Data was collected with a structured questionnaire, composed of "Demand-Control-Support" and "Effort-Reward Imbalance" models to quantify work related stress. The Demand-Control-Support model was to assess sources of stress including work control, psychological demands in work and work-related social support. Effort-Reward Imbalance model was to identify the stress resulting from effort and reward imbalance. The data was analyzed with SPSS 20.0. **RESULTS:** In "Demand-Control-Support" model, the scores for work control were 45.98 and 58.52 ($p<0.001$) in flight cadets and aeromedical personnel, respectively. Scores for psychological demands in work were 63.33 and 56.98 ($p=0.050$), respectively; while the scores for work-related social support were 23.23 and 24.50, respectively ($p=0.053$). In "Effort-Reward Imbalance" model, the scores for intrinsic effort were 16.33 and 15.73 ($p=0.256$) in flight cadets and aeromedical personnel, respectively. Scores for extrinsic effort were 16.30 and 14.77 ($p=0.171$) in flight cadets and aeromedical personnel, respectively. Scores for reward in flight cadets and aeromedical personnel were 50.79 and 49.54 ($p=0.466$) respectively. The scores for Effort/Reward ratio were 0.62, 0.58 ($p=0.536$ in flight cadets and aeromedical personnel) respectively. The proportions of effort-reward imbalance (ratio >1) were 13.2% and 3.8% in flight cadets and aeromedical personnel, respectively ($p=0.211$). **DISCUSSION:** In this study, two different work stress models were applied. In "Demand-Control-Support" model, flight cadets had higher stress in work demand but lower work control and work-related social support than aeromedical personnel. In "Effort-Reward Imbalance" Model, flight cadets had higher level of intrinsic effort, extrinsic effort and reward, but the differences were not statistically significant. In brief, flight cadets had higher work stress during aviation physiology course. We will follow these cadets for the change of work stress during flight training.

Learning Objectives:
1. Flight cadets must take aviation physiology training course before their flight training.
2. In "Demand-Control-Support" model, flight cadets had higher stress in work demand than aeromedical personnel.
3. In "Demand-Control-Support" model, flight cadets had lower work control and work-related social support than aeromedical personnel.

Thursday, April 28 ***1:30 PM***
Avalon 7-9

S-84: PANEL: AEROSPACE MEDICAL PRACTICE UPDATES--Part 2

Sponsored by ASAMS

Chair: Patrick Storms
Dayton, OH

Chair: Daniel Van Syoc
Springboro, OH

PANEL OVERVIEW: This panel will consist of speakers providing clinical updates on medical conditions of aeromedical interest. Aeromedical clinical experts and aerospace medicine residents will present clinical updates on topics related to the assessment and treatment of aviators and special duty personnel suffering from specified medical conditions of aeromedical interest. Presentations will include recommendations for treatment and discussions of the aeromedical implications of the specified disease conditions.

[441] ASAMS UPDATE ON MULTIPLE SCLEROSIS

T. Cook
U.S. Air Force, Dayton, OH

INTRODUCTION: Multiple sclerosis is a chronic autoimmune demyelinating neurodegenerative disorder with significant aeromedical concerns. Since the last ASAMS Clinical Guidelines were published in 2008, the diagnostic criteria has changed as well as multiple new therapeutics have emerged, including oral medications. **METHODS:** Explore the epidemiology, pathogenesis, clinical presentation, differential diagnosis, clinical evaluation, and treatment options. Review current clinical guidelines related to the diagnosis and management of multiple sclerosis. Review the USAF Aeromedical Consult Service multiple sclerosis experience. **DISCUSSION:** Multiple sclerosis is a chronic neurodegenerative disorder. Aeromedical disposition considerations of multiple sclerosis vary based on the setting (military, civil, and NASA). Clinical concerns affecting aeromedical disposition include unpredictable radiographic and clinical progression, cognitive impairment, impact on mood, and side effects of

therapies. Also concerning in patients with multiple sclerosis is the adverse effects of heat, stress, and sleep deprivation on clinical symptoms.
Learning Objectives:
1. Understand the clinical presentation, differential diagnosis, and current diagnostic criteria for multiple sclerosis.
2. Understand the available treatment options and their associated side effects.
3. Understand the aeromedical implications of multiple sclerosis in the aviator.

[442] MAXIMIZING TREATMENT OUTCOMES IN USAF AVIATORS WITH PSYCHIATRIC ILLNESS, PART 2

T.L. Correll
Aerospace Medicine Consultation Division, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

PROBLEM STATEMENT: The United States Air Force School of Aerospace Medicine, an internationally renowned center for consultation, education, and operational research, promotes readiness and protects force and community health in a variety of areas, including clinical aeromedical evaluation of rated aircrew to determine readiness to return to flying status. The purpose of this presentation is to highlight key aspects of maximizing treatment outcomes of psychiatric illness in Air Force aviators. **TOPIC:** We will examine how aviators with disqualifying psychiatric diagnoses receive the best possible treatment (including, potentially, psychotherapy, healthy lifestyle interventions, and psychotropic medication) and then obtain a waiver to resume flying duties. **APPLICATIONS:** Air Force aviators have the potential to receive comprehensive and optimal treatment to obtain the best possible outcomes for their psychiatric illness. We will discuss key learning points that can be broadly applicable in many clinical settings.
Learning Objectives:
1. To discuss and highlight key aspects of maximizing treatment outcomes of psychiatric illness in U.S.Air Force aviators.

[443] MAXIMIZING OUTCOMES OF PSYCHIATRIC ILLNESS IN USAF AVIATORS, PART 1

R. Peirson[1,2]
[1]Aeromedical Consultation Service - Neuropsychiatry, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH; [2]Psychiatry, Wright State University Boonshoft School of Medicine, Dayton, OH

PROBLEM STATEMENT: The U.S. Air Force is interested in preserving trained assets as long as the risk of endangering the individual, the crew, and the mission is low. Although most mental disorders are disqualifying, many present heterogeneously and allow for clinical judgment. The basis for this nuanced decision making will be reviewed as well as the justification for the allowance of ongoing treatment and psychopharmacological interventions in many cases. **TOPIC:** The guidance that informs the flight surgeon and others about the clinical elements factoring into the potential for waiver will be discussed. Also, it is recognized that aviators may be reluctant to pursue treatment. This finding is a magnification of the behavior of the general population. As such, encouraging treatment by pursuing administrative population-level interventions will be discussed as well as the need for individualized assessments. **APPLICATIONS:** The estimated prevalence of mood disorders is high, and it is believed that depression alone is the leading cause of disability worldwide, affecting 350 million people. Despite the resiliency and good health of aviators, most especially military aviators, mood disorders do occur and often result in disqualifying presentations based on human performance concerns.
Learning Objectives:
1. Understand USAF mental health policy changes related to certain diagnoses.
2. Appreciate changes in waiver guidance for aeromedically disqualifying conditions.
3. The learner will understand elements of stigma that may affect self-reporting of depression in aviators.

[444] CURRENT AEROMEDICAL PSORIASIS GUIDELINES, POLICIES, AND LITERATURE REVIEW

A. Kothari and E.A. Fine
Division of Aerospace Medicine, Wright State University, Kettering, OH

INTRODUCTION: Psoriasis is a relatively common chronic skin disorder which typically presents as erythematous plaques with silver scales. There is a known genetic predisposition for the disease as well as the development of symptomatic psoriasis in a relatively bimodal distribution. Though many cases of psoriasis can be controlled with topical medications for an initial trial or chronic therapy, more severe forms exist that may result in extensive morbidity or mortality. There are multiple approaches to the treatment of psoriatic skin disorders, ranging from topical steroids, chemotactic immunosuppressants, and biologic agents. Current domestic and international civilian guidelines as well as U.S. military guidelines for psoriasis range from unrestricted flight duty to disqualification without possibility of waiver. **DISCUSSION:** Treatment of psoriatic skin disorders vary depending on the severity of presentation. Treatment may include topical medications, oral immunosuppressants, biologic immuno-modulators, and phototherapy. The issue at hand is twofold: are current guidelines and aeromedical standards consistent with current understanding of the disease? What are the aeromedical limitations with the use of topical or systemic medications with aviators? Treatment guidelines allow for a broad approach to treating psoriasis, and treatment is dependent upon the presentation and symptoms of those affected. Ultimately, for aviators, the policies, restrictions, and guidelines are at the discretion of the governing bodies and the flight surgeons that enact these policies.
Learning Objectives:
1. To understand the Psoriatic disease process and implementation of current treatment protocols.
2. Identify current aeromedical policies for the U.S.military as well as domestic and international civilian agencies.

Thursday, April 28 ***1:30 PM***
Avalon 10-12

S-85: SLIDE: FATIGUE AND AVIATION PERFORMANCE

Chair: Thomas Jarnot
Kettering, OH

Chair: Kai-Wood Ma
Lackland AFB, TX

[445] ASSESSMENT OF FATIGUE IN PERSONNEL IN SUSTAINED OPERATIONS EXERCISE THROUGH A PSYCHOLOGICAL TOOL – SOAP (SUSTAINED OPERATIONS ASSESSMENT PROFILE)

M. Butola
Medical, Indian Air Force, Bangalore, India

INTRODUCTION: Fatigue has been recognized as an important problem in military aviation for some years now. Compared to the people who are well rested, people who are sleep deprived think and move slowly, make more mistakes and have memory difficulties. To date, most research activity has focused on transmeridian international operations, where air crew fly across several time zones. There has been comparatively little research on fatigue in pilots flying short-haul operations, although the work pattern of these pilots often has a number of factors associated with increased reports of fatigue. **METHODS:** The SOAP profile was completed twice (once after 48 hours of the beginning of exercise and once at the end of five days). The subjects were asked to rate their SOAP assessments (measures of concentration, boredom, slowed reactions, anxiety, depression, irritability, fatigue, poor sleep, work frustration, and physical discomfort). Each of these 10 parameters included 9 sub-parameters, each of which could be scored as 1 to 5. **RESULT:** 1521 personnel, aircrew and the ground crew at various Air Force Stations in one of the Command during one exercise were subjected to SOAP questionnaire. They were exhibited SOAP questionnaire on day 2 and day 5 of the exercise. In all 3042 questionnaires from 1521 personnel were analyzed with the non-parametric statistical methods Wilcoxon Matched Paired Test, to access the 2 levels of repeated measures (Day2 versus Day5). **DISCUSSION:** When the effect of sustained Operations was analysed among separate trade categories of personnel, it showed no statistically significant SOAP score on day 5 in comparison to day 2 score among personnel (Air Traffic Services, Air Craft Maintenance Services) who routinely do shift duties. Whereas personnel

who are not accustomed to do shift duties (Air Crew, Administration and other ground duties) showed Statistically significant (p = > 0.05) SOAP score on day 5 in comparison to day 2 score. The remarkable difference was observed in fatigue, boredom and physical discomfort domains as transport and helicopter aircrew are accustomed to undertake long haul sorties in more adverse weather conditions.

Learning Objectives:

1. The participants will be able to understand why there has been comparatively little research on fatigue in pilots flying short-haul operations, although the work pattern of these pilots often has a number of factors associated with increased reports of fatigue.

[446] CONTINUOUS WAKEFULNESS OF SHORT DURATION: EFFECTS ON PSYCHOMOTOR COGNITIVE PERFORMANCE AND SUBSEQUENT SLEEP PHYSIOLOGY

N.K. Tripathy[1] and A. Padhy[2]
[1]Dept of Human Engineering, Institute of Aerospace Medicine, Bangalore, India, Bangalore, India; [2]Av Med, Station Medicare Centre, Lucknow, India

INTRODUCTION: Considering the lifestyle patterns and operational constraints, it is not an uncommon practice that aircrew may be exposed to continuous wakefulness and prolonged duty periods. The present study was thus conducted to understand the effects of continuous wakefulness of varying hours on psychomotor cognitive functions and physiological attributes of sleep in 20 healthy male participants. **METHODS**: Following forced wakefulness of 18 h, the participants were allowed to sleep in the controlled environment of the sleep lab. The psychomotor cognitive functions were assessed by CogScreen Aeromedical Edition (AE) on three sessions, baseline at 0800 h, 2nd at ~15 h of continuous wakefulness and 3rd at ~17 h of continuous wakefulness. The sleep architecture and bio-physiological parameters were studied with Polysomnography System® in subsequent sleep period following 18-h of continuous wakefulness. **RESULTS**: Consistent improvements in performance were observed in many tasks as a result of repetitive practice effects. The overall response time was found to be significantly increased following ~17 h of continuous wakefulness as compared to ~15 h. The speed measures pertaining to computational math skills, reading comprehension and logical reasoning, sustained attention and visual motor tacking were significantly affected following 17 h of continuous wakefulness as compared to 15 h. Similarly, immediate and delayed visual paired associate memory were significantly decreased following 17 h of continuous wakefulness as compared to 15 h, whereas spatial processing and visual working memory showed a significant longitudinal decrement in accuracy scores following both 15 and 17 hours of wakefulness. The sleep architecture and the bio-physiological variables of sleep were found to be within the normal physiological limits. **DISCUSSION**: Few aspects of higher cognitive functions were found to be adversely affected during periods of continuous wakefulness, even though such a period would not affect sleep architecture and bio-physiological variables of sleep.

Learning Objectives:

1. CogScreen AE Tests have repetitive learning effects as a result of practice outcome.
2. Few aspects of higher cognitive functions could be adversely affected during periods of continuous wakefulness, even though such a period is short and would not affect sleep architecture and bio-physiological variables of sleep.

[447] THE EFFECT OF NUMBER OF SECTORS AND OTHER RISK FACTORS ON FATIGUE AMONG SHORT-HAUL COMMERCIAL PILOTS IN INDONESIA

I. Yuliawati[1] and M. Siagian[2]
[1]Medical, Civil Aviation Medical Center, Greater Jakarta, Indonesia; [2]Physiology, Universitas Indonesia, Jakarta, Indonesia

INTRODUCTION: Fatigue could impair pilots' cognitive function to safely operate an aircraft and becoming a major concern for high domestic short-haul flight passenger growth in Indonesia. This is an initial study of pilots' fatigue in Indonesia that aimed to investigate the risk factors of fatigue among short-haul commercial pilots. **METHODS:** Cross-sectional study with purposive sampling was directed to commercial pilots who were taking medical examination at Civil Aviation Medical Center, Jakarta from May 5-26th 2014. Ethical approval was granted from Universitas Indonesia. Data were collected by completing an anonymous self-reporting questionnaire on Fatigue Severity Scale (FSS), workload (number of sectors in 24 hours, flight time in 7 days and flight time of unplanned flights in 30 days), sleep restriction using Epworth Sleepiness Scale, personal factor using Home Stress Checklist, and managerial support using Social Support Whitehall II. Risk factors and fatigue were analyzed using linear regression. **RESULTS:** During data collection, 382 pilots were willing to participate and 239 Boeing 737 series typed-rating pilots were chosen as subjects. None of the subjects were excluded from taking hypnotics or stimulant. Average FSS was 4.66±1.20 and average of sector was 3.58±1.33 in 24 hours. Dominant factors of fatigue were number of sectors in 24 hours, flight time of unplanned flights in 30 days, and sleep restriction. Each additional sector correlated significantly to 0.371 increase on the FSS [regression coefficient (β) = 0.371; p=0.000] while each additional flight time of unplanned flights correlated significantly to 0.033 increase on the FSS (β = 0.033; p = 0.000). **DISCUSSION:** This study was particularly directed to Boeing 737 type-rating short haul commercial pilots thus the effect of vibration and automation were expected to be similar among subjects. Number of sectors was the highest factor to significantly increase fatigue. This was because take-offs and landings are critical phase of flight that requires high concentration. In addition, short-haul pilots had early starts and late finishes which lead to sleep restriction and disrupted circadian rhythm. Furthermore, each additional flight time of unplanned flights in 30 days caused less rest period and sleep restriction. Thus repeated several sectors and unplanned flights accumulatively lead to fatigue.

Learning Objectives:

1. The participant will be able to identify risk factors of fatigue among short-haul commercial pilots in Indonesia.
2. The participant will be able to understand that sleep restriction could be resulted from short-haul flights, especially in a high domestic passenger growth such as in Indonesia.
3. The participant will be able to interpret fatigue as a multi-factor physiological condition fatigue that was caused by an imbalance between workload and recovery sleep.

[448] WORK PATTERNS AND FATIGUE IN AIR TAXI (AT) AND EMERGENCY MEDICAL SERVICE (EMS) PILOTS WITHIN EUROPE

B.M. Stone, M. Spencer and C. Turner
FRMSc Ltd, Farnham, United Kingdom

INTRODUCTION: Flight Time Limitation (FTL) Regulations for Commercial Air Transport (CAT) within Europe to be implemented in February 2016 exclude AT and EMS operations pending further data. This study was commissioned to measure sleep, duty and fatigue in AT and EMS pilots. **METHODS:** Data were collected using diaries and questionnaires. Sleep was measured in a subset of pilots using actigraphy. **RESULTS:** Work patterns differed from those of many CAT operations. Based on diaries from 87 pilots (33 EMS), the average annual flight time was <750 h for EMS and <500 h for AT, with 50% of duty time spent on the ground before or between flights. The work was mainly during the day and there were frequent rest days, with 75% of consecutive duties lasting no longer than 2 days. Mean sleep duration from the actiwatches (35 pilots; 14 EMS) and diaries was similar at around 7 h. In questionnaires completed by 78 pilots (25 EMS), 60% of EMS and 30% of AT reported that their performance had been affected by fatigue, but mainly only once, during the preceding 2 weeks. There was little evidence of cumulative fatigue, with 70% EMS and 80% AT crews reporting themselves fully recovered at the start of duty. Fatigue was a function of flying time plus positioning time, length of duty and time of day. Contrary to CAT experience, the number of sectors flown was not an issue. Insufficient data were obtained in respect of long haul duties. **DISCUSSION:** Based on these findings, the question arises whether some modification to the existing CAT rules might be permitted in short- and medium-haul AT and EMS operations, if the lower overall workload can be ensured. Three areas are worthy of special consideration. Firstly, the current provision of a reduction in maximum flight duty period (FDP) related to the number of sectors could be relaxed. Secondly, where the FDP does not overlap the hours

02:00-05:59, and dependent upon flying hours, there is an argument for permitting a one hour extension to the maximum FDP as standard. Finally, where the work rate is low and the rest period includes a local night, there is a case for removing the current requirement for minimum rest being dependent upon the length of the previous FDP.
Learning Objectives:
1. The participant will be able to understand the differences in the patterns of work and fatigue between Air Taxi and Emergency Medical Services pilots compared with Commercial Air Transport pilots.

[449] STUDYING THE CONTEXT IN ORDER TO OPTIMISE FATIGUE AND PERFORMANCE

M.A. Corbett
Human Systems Integration, RAAF Institute of Aviation Medicine, Walkerville, Australia

MOTIVATION: Strict adherence to a prescriptive rule-set does not guarantee that one is free from fatigue-related risk. Although many extant work and rest regimes have a long history, the operational context may now differ greatly from the historical benchmark. In order to achieve optimum operational effectiveness it is prudent to reinvestigate the often forgotten basics of fatigue management, prior to the application of modern management and mitigation strategies. **OVERVIEW:** The development of crew duty and rest requirements should take into account the whole of the context within which the work group is operating. The basics of fatigue management will be discussed, by utilizing a de-identified modern military operation to illustrate the enhancement of human performance that can be achieved. The utilization of multiple data collection and analysis methodologies increases the likelihood of fatigue issue detection, whilst reducing the likelihood of an adverse outcome. Tools for achieving this may include diaries, interviews, actigraphy, surveys, biomathematical modelling, and event analysis. Optimization of the work group does not necessarily mean a reduction in work and/or an increase in rest. Occasionally, the investigative strategies discussed can result in recommendations for increased working hours. An example will be used to demonstrate how the basic concepts of fatigue risk management can be used to optimize the effective operational employment of personnel. **SIGNIFICANCE:** Suitable consideration of fatigue factors is operationally significant in order to ensure that the workforce is appropriately rested for the planned tasks ahead. Utilization of tools, such as those discussed, will advance human performance employment in the demanding socio-technical aviation environment, to enable the optimum work effort to be achieved. The considerations and methodologies discussed can be employed across Services and across international boundaries. Although focused on military operations, the same constructs can equally support operations in the civilian sphere.
Learning Objectives:
1. Be able to identify basic fatigue-related considerations in the development of duty and rest practices.
2. Be able to identify appropriate tools for fatigue-related data collection and analysis.

Thursday, April 28 ***1:30 PM***
Avalon 13-14

S-86:C SLIDE: NEW PERSPECTIVES FOR PATIENT MOVEMENT

Chair: Elizabeth Anderson-Doze
Wright-Patterson AFB, OH

Chair: Karen Klingenberger
Williamsburg, VA

[450] AEROMEDICAL EVACUATION REGISTRY

E. Bridges, D. Mortimer and S.F. Dukes
USAF School of Aerospace Medicine/FH, 711 Human Performance Wing, Wright-Patterson AFB, OH

INTRODUCTION: Since the start of medical operations in 2001 in support of Operations Iraqi and Enduring Freedom, over 96,700 patients have been evacuated in Central Command (CENTCOM) and worldwide there have been over 303,000 patient movement requests, with 162,000 from CENTCOM/European Command. The purpose of this project is to create the Aeromedical Evacuation Registry (AER), which integrates data from all patients who underwent regulated AE transport (Sept 2001-present). **METHODS**: Data are being abstracted from the Transportation Command Regulating and Command & Control Evacuation System (TRAC^{2}ES) and Air Force Form 3899s from pre- to post-flight. The AER will link to the Department of Defense Trauma Registry. **RESULTS:** Data abstraction from TRAC^{2}ES is complete for general flight information (2001-2014), with ongoing abstraction of patient-specific information. As an example of the use of the AER, data were abstracted to create AE mission profiles based on operational tempo. In November 2004 (2nd Battle of Fallujah), there were 218 flights (1,199 patient moves). On the 45 CENTCOM-Germany missions, there were a median of 13 patients/flight (range 1-64). General surgery (20%), orthopedic surgery (18%), neurosurgery (6%), and psychiatry (4%) the most common specialties, with 39% of patients with battle injuries. In September 2005, AE missions were flown in response to Hurricane Katrina and Rita. From 1-5 September, 1,915 patients were evacuated after Hurricane Katrina, and on 23 September 2005, 1,169 patients/attendants were evacuated on 17 flights in anticipation of landfall of Hurricane Rita (61 ± 27 patients/flight; range 42-123). For these disaster response missions, TRAC^{2}ES includes only name, gender, identification number, movement class, and mission identifier, but no medical data. **DISCUSSION:** The AER will allow for the creation of mission profiles (number of patients, diagnosis, movement classification, en route care requirements) and will facilitate the description of en route events (e.g., pain, oxygen requirements, and safety) for targeted operational events. Potential uses include modeling future en route care requirements and analysis of relationships between en route events and outcomes.
Learning Objectives:
1. Describe patient/flight profiles for Aeromedical Evacuation from selected operational periods.
2. Outline purpose and data available in the Aeromedical Evacuation Registry.
3. Describe gaps in documentation related to AE patient care identified during creation of the AER.

[451] AEROMEDICAL EVACUATION OF MILITARY WORKING DOGS

L.A. McGinley[2], W.P. Butler[1], D.E. Smith[1], B.L. Fouts[1] and J.L. Serres[1]
[1]Aerospace Research, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH; [2]711th Human Performance Wing, Wright-Patterson AFB, OH

INTRODUCTION: At any given time over 500 military working dogs (MWDs) are deployed worldwide. These dogs are subject to a number of maladies; most prevalent are trauma, heat stress, and gastric dilatation and volvulus. Veterinarians are not always readily available, mandating the evacuation of an ailing or emergently treated animal. Very little MWD research exists, especially looking at aeromedical evacuation. **METHODS:** This study is a retrospective records review from the U.S. Transportation Command Regulating and Command & Control Evacuation System for any MWD transported from January 2001 through December 2014. Descriptive analytics characterized the dogs. **RESULTS:** Over 14 yr, there were 161 transports of 139 dogs; 81% were males (mean 6.0 yr, 72 lb) and 17% were females (mean 6.2 yr, 65 lb). C-17 missions dwarfed (45%) those of the C-130 (14%) and KC-135 (12%), mostly moving MWDs from the Middle East to Germany. Disease, Non-Battle Injury made up 52%, while Battle Injury contributed 21%. The majority was Not Seriously Ill (31%); however, 18% were Seriously/Very Seriously Ill. Interestingly, while 45% were Conscious, 6% were Semi-Conscious/Unconscious. Orthopedics predominated (27%; e.g., fractured ulna), followed by Surgical (16%; e.g., gunshot wound), Medical (10%; e.g., cardiomyopathy), and Gastroenterological (6%; e.g., hepatosplenomegaly). Medical equipment included oxygen paraphernalia (7%), intravenous pumps (7%), pulse oximetry (5%), cardiac monitor (1%), and suction (1%). **DISCUSSION:** This is a first look study of MWD aeromedical evacuation experience. It offers a 14-yr snapshot of dogs flown, aircraft used, reasons for transport, and resources required. It is a jumping point for future guidance and research.

Learning Objectives:
1. To understand the spectrum of maladies encountered during the aeromedical transport of military working dogs.
2. To understand the medical support equipment requistite for transport of military working dogs.
3. To understand the logistics required to transport a militry working dog.

[452] DESIGN, DEVELOPMENT AND FIELDING OF THE TRANSPORT ISOLATION SYSTEM (TIS) FOR AEROMEDICAL EVACUATION OF EBOLA AND OTHER INFECTIOUS PATIENTS

D.M. O'Brien
TCSG, U.S. Transportation Command, Scott AFB, IL

MOTIVATION: Aeromedical Evacuation of patients infected with Ebola virus and other high consequence pathogens presents unique and profound occupational and public health hazards. To protect public health, public policy has historically prohibited the transport of patients infected with high consequence pathogens into the United States. The necessity to contain high consequence pathogens became a real world issue in September 2014 when the Department of Defense directed the deployment of U.S. forces to Liberia and tasked USTRANSCOM to develop a patient evacuation capability to safely transport Ebola exposed and infected personnel. **OVERVIEW:** USTRANSCOM and its air component Air Mobility Command partnered with the Defense Threat Reduction Agency and private industry to rapidly develop a Transport Isolation System (TIS). This system would facilitate inflight patient care of Ebola patients while protecting aircrew, ground crew and airframe from contact with the infectious agent. Initial development was based on the previously produced Airborne Containment System (ABCS) utilized by the Phoenix Air Group. During the next three months, a prototype was developed consisting of 3 modules: an antechamber for doffing/donning PPE and 2 patient care modules, mounted on 3 NATO pallets and utilizing the Patient Support Pallet for seat/litter anchoring. The TIS incorporated a high strength clear exterior lining over an aluminum frame, a negative pressure containment with system with HEPA filtering, and a fluid containment system. Access conduits facilitate the use of typical ICU type patient equipment. CONOPS development and aircrew training were conducted concurrently. **SIGNIFICANCE:** The TIS successfully passed initial operational testing in December 2014 and was certified for operation on C-17 and C-130 aircraft. Three units were positioned at Charleston AFB to support Operation United Assistance. Follow on development led to the fielding of the TIS Generation II. This updated TIS includes enhanced frame stability, easy to use bump doors and improved leak resistance. Future decontamination of the TIS will be conducted with hot humid air purification. The TIS remains on call for potential use with EVD cases in W Africa and could be adapted for transporting other high consequence pathogens if/when public policy and defense activities identify a requirement.
Learning Objectives:
1. Transport of patients infected with high consequence pathogens requires prior approval and coordination with the Centers for Disease Control.
2. Ebola virus is not highly contagious, but is does result in a very serious contagious disease that is highly lethal if untreated. Ebola virus requires strict contact isolation.
3. Ebola infection can result in up to 10 liters of body fluid waste per day during the fully symptomatic phase. This body fluid has a high virus count and is highly infectious.

[453] AN OVERVIEW OF NOVEL C-12J AEROMEDICAL EVACUATION MISSION: A RETURN TO OPERATIONAL SUPPORT AIRLIFT AS AN AEROMEDICAL EVACUATION ENABLER IN THE PACIFIC

T. Powell
Class of 2019, Uniformed Services University, North Bethesda, MD

MOTIVATION: since the departure of the C-9A Nightingale in 2003, the U.S. Air Force has not had a dedicated aeromedical evacuation (AE) platform in the area. This mission has been delegated to C-130, KC-135, and C-17 type aircraft. These aircraft are already over expended and expensive to operate, especially for small AE movements. The C-12J, an efficient operational support aircraft, has recently been outfitted to perform these missions. We describe here the process and mission impacts of creating a novel AE mission in the Pacific. **OVERVIEW:** The C-12J is based on the Beechcraft 1900C aircraft, a regional airliner already in use as an AE platform around the world. The Air Force utilizes it for executive and priority cargo movement. The three aircraft based at Yokota Air Base fly routes around the northwest Pacific, supporting the numerous US, Japanese, and Korean bases in the area. AE missions in the region bolster the military healthcare system by flying small numbers of patients to facilities in Okinawa or Hawaii. With the low volume of patients and frequent movement requests as well as the civilian precedent, incorporating an AE mission into the C-12J's mission set was natural fit. The C-12J now operates as a routine AE asset, moving patients from Korea and Mainland Japan to Okinawa with two different patient configurations. **SIGNIFICANCE:** The C-12J is the newest AE platform in the Air Force inventory. It is also a model for future economical AE airlift. It currently operates with two approved configurations; a NATO litter ambulatory patient model, and a Spectrum Aerobed for higher level patient movements. In addition to providing some relief to the other cargo aircraft in the area, the C-12J crews have diligently deployed their aircraft for training U.S. personnel as well as foreign aeromedical technicians. This outreach occurs every few months between the U.S. And Japanese partners, creating a fertile training environment for bilateral AE training and sharing of techniques. The C-12J also participates in multi-lateral exercises, serving regional partners as an economical and unique training platform. The C-12J represents a success story for U.S. Air Force AE and we hope this information informs and inspires future work.
Learning Objectives:
1. To give an overview of the C-12J aircraft, its AE capabilities, and the lessons learned developing the AE mission for this aircraft.
2. To inspire future work on more efficient aeromedical evacuation platforms.

[454] A SURVEY EXAMINING POTENTIAL LIMITATIONS IN ROTARY-WING AIRCRAFT DUE TO SPACE CONSTRAINTS

R. Khouri[1,2], R. Kinsler[2], K. Barazanji[2] and L. Fulton[3,4]
[1]NorthTide, Fort Rucker, AL; [2]U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL; [3]Texas Tech University, Lubbock, TX; [4]Navigator Development Group, Enterprise , AL

INTRODUCTION: The U.S. Army Aeromedical Research Laboratory (USAARL) and the U.S. Army Medical Evacuation Proponency Directorate (MEPD) performed test and evaluation of the UH-60 and HH-60 helicopter medical interiors. In order to assess potential limitations while providing critical care due to space constraints, en route care providers were surveyed on medical interior space and equipment constraints. **METHODS:** The Navigator Development Group, under the direction of USAARL and MEPD, presented a web-based survey to 537 aeromedical evacuation medics, paramedics, and licensed practical nurses. There were 106 valid responses assessing rotary-wing medical design and equipment. **RESULTS:** The survey revealed respondents preferred slick aircraft over current medical interiors. Based on frequency of use and risk to the patient if unavailable, respondents rated small Medical Equipment Set (MES) items as more important. Large, bulky MES items were rated with low importance. However, tasks rated by respondents as high risk require MES items that were seen as not important. Additionally, more than 60% of respondents revealed that a paramedic should be able to effectively treat two trauma patients, and 45% of respondents preferred two litters in each aircraft. When asked to consider 12 possible aircraft configurations, ranging from 1 to 6 litters, respondents preferred configurations with 1 or 2 litters. **DISCUSSION:** The responses suggest that care providers perceive the treatment space in the aircraft to be insufficient. Respondents rated smaller MES items as more important even though crucial, high risk medical tasks require larger MES items. Respondents also felt that a paramedic should be responsible for two trauma patients at a maximum and supported this opinion when selecting possible litter configurations within the aircraft. Areas for improvement are identified with the space and equipment available in the aircraft.
Learning Objectives:
1. The participant will be able to understand the challenges and limitations of providing care to patients in rotary-wing aircraft.

[455] ALLIANCE AEROMEDICAL EVACUATION: IS IT ACCEPTABLE TO THE UK MILITARY?

K. Mears[1,2]
[1]Centre of Aviation Medicine, Royal Air Force, RAF Henlow, United Kingdom; [2]Defence Studies, Kings College, London, United Kingdom

INTRODUCTION: Political alliances are the cornerstone of international relations and are key in the UK defense strategy. This research utilizes a case study of Aeromedical Evacuation to explore this tenet of UK policy, and indicates how acceptable the integration of this particular capability is. **METHODS:** Not everything that can be counted counts, and not everything that counts can be counted, this fact led to diverse methods of primary data capture being undertaken, with a mixed methodology approach used to collect primary evidence. Ten stimulated interviews with key political and military personnel were conducted, coupled to a questionnaire of students on the Advanced Command and Staff course at the UK Defence Academy. The results were coalesced using the Framework Approach to develop a Thematic Index. **RESULTS:** The emerging themes with regard to Alliance Aeromedical capability resolved into two main leitmotifs: sovereignty and resource, with sub themes of command, ethos, preparedness and understanding. The evidence demonstrated that whilst alliance Aeromedical Evacuation is acceptable and imperative for the moral component of war fighting, the dilemma of political alliances overshadows even this key enabler. **DISCUSSION:** The paper concludes that for multinational aeromedical evacuation to progress, further research, to center alliance dialogue upon, is required to engender trust, toward an intensification of pooling and sharing of this capability.

Learning Objectives:

1. Participants will be better placed to analyze and evaluate the politics of alliances on military aviation medicine capabilities.
2. Participants will have gained comprehension of how the pooling and sharing of aeromedical evacuation capability can foster better relations, and will gain insight to the UK context in regard toward NATO.

Thursday, April 28 ***1:30 PM***

Avalon 15-16

S-87: SLIDE: NECK AND BACK: CHARACTERIZATION, PREVENTION, AND INJURY

Chair: Judith Hayes
Friendswood, TX

Chair: Takashi Nagai
Pittsburgh, PA

[456] ASSESSMENT OF THE FUNCTIONAL INJURY REDUCTION STRENGTH TRAINING PROGRAM AMONG U.S.AIR FORCE AERIAL PORTERS

M.R. Coakwell and I.F. Farlik
Aerospace and Occupational Medicine, David Grant Medical Center, Travis AFB, CA

INTRODUCTION: Typical duties of aerial porters involve a great deal of lifting, handling and carrying (LHC). These flight line workers at Travis Air Force Base (AFB) were observed to have a significant number of duty-limiting restrictions, 40% of which were musculoskeletal (MSK) in nature. To help mitigate these findings, a work-hardening intervention called the Functional Injury Reduction Strength Training (FIRST) program was developed. The purpose of this study is to evaluate the effect of this program on injury rates among aerial porters at Travis AFB. **METHODS:** The FIRST program is an ongoing, multi-phase, 6-week-long, 3-days-a-week intervention involving 1-1.5 hours/session of physical training in functional movement that focuses on multi-directional mechanics, rotational mobility, core stability/control and muscular strengthening, coupled with a linear run progression. A cohort of 358 aerial porters is participating. Each person is being assessed at baseline, 6 weeks, and at 3, 6, and 12 months post-intervention with the Functional Movement Screen (FMS), Y-Balance Test (YBT), and Sorensen Test (ST). These interval results are being compared to baseline via the McNemar Chi Square Test (FMS and YBT) and a Paired t-test (ST). Each participant's responses on the RAND Short Form 36 survey (evaluates health and health effects) and an exercise motivation survey are being compared at these same intervals using the Wilcoxon Signed Rank Test. In addition, reported injury rates and duty-limiting restriction rates among the participants are being compared with historical data using calculated odds ratios. This study was approved by the David Grant Medical Center, Clinical Investigational Facility, Institutional Review Board. **RESULTS:** Participants in the initial phases of this study have shown significant improvements in their FMS, YBT, and ST objective scores and their RAND Short Form 36 and exercise motivation survey scores. Due to the limited timeframe of the study's initial phases, we are not yet able to accurately compare injury and duty-limiting restriction rates. **DISCUSSION:** Results from the initial phases of this study indicate a significant improvement in objective measures predictive of MSK injury risk reduction. Subsequent phases will compare reported injury and duty-limiting restriction rates. If reductions are validated in later phases of the study, the program could be recommended to other workplaces with high LHC demands and associated injury potential.

Learning Objectives:

1. Objectively demonstrate the benefits of a work-hardening, musculoskeletal injury reduction program in a high-risk, U.S.Air Force aerial porter population.

[457] LOW BACK PAIN INJURIES IN MILITARY PILOTS – DO CLINICAL FINDINGS CORRELATE WITH CORE PERFORMANCE?

S.H. Rochelt[1], J. Schnaidt[2] and D. Bron[1]
[1]Aeromedical Centre, Duebendorf, Switzerland; [2]Air Force, Fliegerärztliches Institut, Dübendorf, Switzerland

INTRODUCTION: Inactivity, and too much sitting combined with long work days leads to lower back pain (LBP) in a majority of people who live in industrialized countries. Those risk factors joined with high G-forces and vibrations, heavy equipment and asymmetric sitting position expose military pilots to an even higher risk of developing LBP. Many air force personnel report a high prevalence ranging from 50 to 92 % of LBP in military pilots. Several studies report positive effects on core strengthening in alleviating LBP. Pilots of the Swiss Air Force have to complete core stabilization tests periodically. This study aims to investigate a possible correlation between the core strengthening fitness levels and clinical findings as well as outline imaging techniques. **METHODS:** Forty military pilots from the Swiss Air Force who have a history of LBP have been analyzed. Included are pilots who have had at least one episode of LBP in the last 4 years. The clinical risk factors for radiculopathy, scoliosis and magnetic resonance imaging (MRI) screening were evaluated and compared to the level of core performance. Improvement or degradation of the trunk stability test results and the actual level of strength are the rating parameters of the performance skills. A correlation analysis has yet to be carried out. **RESULTS AND DISCUSSION:** Preliminary study results suggest that insufficient results of the core stability test might correlate with radiculopathy, a herniated disk or protrusion. Conversely, an increase of core strength test performance is an effective instrument to avoid diseases of the spine or to enhance existing dorsalgia. With the implementation of a trunk stability test the Swiss Air Force has an effective tool to predict disabilities of the spine in development. What can be clearly deduced from the results thus far is that individual training programs, especially Segmental Stabilization Exercise (SSE) can improve the capacity of the trunk muscles and reduce LBP injuries. This is significant because currently the role of exercise therapy for lessening LBP and its evidence is ambiguous, and that affirmation for prevention might be the most effective way to avoid LBP injuries in military pilots.

Learning Objectives:

1. Physical conditioning and regular physical exercises may minimize spinal disabilities in susceptible aircrews.
2. Due to correlations between the core strengthening fitness levels and clinical findings, a trunk stability test is an effective tool to predict disabilities of the spine in development.

[458] NECK EXTENSION/FLEXION MVC-RATIO AND ASSOCIATION WITH NECK PAIN AMONG F-16 PILOTS

B. Lange[1], P. Toft[1] and G. Sjøgaard[2]
[1]Department of Anesthesia and Intensive Care Medicine, Odense University Hospital, Odense, Denmark; [2]Department of Sports Science and Clinical Biomechanics, University of Southern Denmark, Odense, Denmark

INTRODUCTION: Neck pain is common among fighter pilots. The average neck extension/flexion strength ratio among humans is around 1.7. It has been suggested that a ratio that diverge significantly from 1.7 may course increased neck problems. **METHODS:** Maximum voluntary contraction (MVC) for neck flexion and extension was measured by a force dynamometer. Fifty-five operational F-16 pilots volunteered to participate and 52 (51 male, 1 female) were successfully tested. Neck pain was assessed using the 'Standardised Nordic Questionnaire for the Analysis of Musculoskeletal Symptoms'. Flying hours in the F-16, flying hours with NVG and the JHMCS helmet was incorporated in the explorative analyses. The study was approved by the Ethics Committee of Southern Denmark. **RESULTS:** The mean extension MVC was 28N and the mean flexion MVC was 17N. The mean extension/flexion MVC-ratio was 1.7 with a range from 1.0-3.1. Median, 25% percentile and 75% percentile were: 1.6, 1.4, and 2.0. In the neck pain group (pain score>1 on an 11-point numeric box scale) 46% of the pilots had an E/F ratio between 1.4 and 2.0. In the no neck pain group (score<2) 58% had an E/F ratio between 1.4 and 2.0. The chi-squared test showed no significant difference between the two groups. Neither did we find a proportional association between E/F ratio and neck pain by regression. **DISCUSSION:** With the introduction of helmet mounted cueing systems fighter pilots are encouraged to move their heads further away from the anatomical neutral position while exposed to increased G-forces. In a fifth generation HPJA as the JSF (F-35) with its advanced cameras around the aircraft pilots will even be able to look down through the aircraft. There might be an optimal E/F ratio with regard to minimizing the risk of neck pain among HPJA pilots. Approaching such optimal E/F ratio may be achieved via targeted training.

Learning Objectives:

1. The participant will learn about the human extension/flexion strength rate and get a picture of the range in this parameter in operational F-16 pilots.

[459] PREVENTING NECK PAIN IN FIGHTER PILOTS - HIGH RETURN BUT POOR INVESTMENT

J.B. Wallace
Physiotherapy, RAAF Base Williamtown, Williamtown, Australia

INTRODUCTION: Fighter pilots work in a unique environment with significant physical and psychological demands. As a result, neck pain is highly prevalent in this population, carrying substantial cost and significant detriment to workforce health and operational capability. This systematic review attempts to synthesize the results of studies investigating potential risk factors, which will help shape further research and preventative programs. **METHODS:** Scopus, Web of Science, Medline, SPORTDiscus and CINAHL databases were searched in October 2015, using the maximum date ranges. Eligible studies were limited to those using an appropriate methodological design, and compared a population of fighter pilots who experienced neck pain in a specified period compared with those who had not. Studies were categorized according to a hierarchy of evidence, appraised for quality with a standardized critical appraisal tool, and relevant data was extracted. **RESULTS:** 245 studies were identified, of which 13 were eligible for the final review. Only 1 study was of prospective design, while the remainder were cross sectional. Methodological rigor was generally poor, ranging from 3-9/15 (mean 5.23/15). Common methodological limitations included recall/sampling biases, failure to report validity/reliability of outcome measures, inadequate statistical methods, insufficient justification of sample size, non-reporting of clinical importance of results, and failure to acknowledge study limitations. Risk factors assessed included demographics, physical measures, flight related factors, and work related physical and psychological demands. A number of statistically significant associations were identified; however, there was distinct heterogeneity across studies and no consensus between authors. **DISCUSSION:** Despite a number of studies investigating risk factors associated with neck pain among fighter pilots, poor methodology, significant heterogeneity, and a lack of consensus precludes the ability to draw firm conclusions. High quality prospective studies are required before we can implement evidence based prevention programs targeted at reducing the prevalent and costly issue of neck pain amongst this population.

Learning Objectives:

1. The participant will be able to describe the importance of preventing neck pain among Fighter Pilots.
2. The participant will be able to identify possible risk factors contributing to neck pain in Fighter Pilots.
3. The participant will be able to summarize why the current evidence does not allow us to identify which Fighter Pilots are at greater risk of developing neck pain.

[460] CHARACTERIZATION AND ASSESSMENT OF AIRCREW VIBRATION EXPOSURE ABOARD THE HH-60M MEDEVAC HELICOPTER

S.D. Smith[1], S. Chervak[2] and B. Steinhauer[1]
[1]711 Human Performance Wing, Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Occupational Health Sciences Portfolio-Industrial Hygiene, U.S. Army Public Health Command-Europe, Vogelbach, Germany

INTRODUCTION: Military aircrew continue to report back discomfort, pain, and even injury associated with flying rotary-wing aircraft. Posture, vibration, and seating are targeted as contributing factors. This study characterized and assessed aircrew vibration during operation of the HH-60M Medevac located at the Vermont Army National Guard. The ISO 2631-1: 1997 was used as the guideline for the assessment. **METHODS:** Battery-powered data acquisition units were used to collect accelerations at the pilot, crew chief, and medic stations. Triaxial accelerometer packs were attached to the seat floor/base. Triaxial acceleration pads were attached to the seat pan and seat back cushions. Data records were collected for 20 s during various aircraft tasks and associated flight test conditions. The acceleration spectra were determined at each station and measurement site. The overall vibration total value (o*VTV)* was calculated for assessing comfort reaction. The point vibration total value (*pVTV*) was calculated for assessing health risk. **RESULTS:** A substantial acceleration peak was observed at ~17-17.5 Hz and associated with the aircraft blade passage frequency. The peak occurred in the horizontal and vertical directions depending on the station, measurement site, and flight test condition. Comfort reactions primarily ranged from "a little uncomfortable" to "uncomfortable". The majority of level flight records showed exposures that would cross into the ISO 2631-1 caution zone, where there is the potential for health risk, in less than eight hours and in as little as one hour. **DISCUSSION:** This study emphasizes that rotary-wing aircraft generate multi-axis higher frequency vibration above 10 Hz that is associated with exposing aircrew to the potential for health risks. The synergies and mechanisms by which posture, seats, and higher frequency vibration contribute to the health symptoms require investigation in order to develop or improve exposure criteria, ergonomic design requirements, and mitigation strategies. It is recommended that discomfort and health surveillance of aircrew be conducted and documented by health professionals and reported to the appropriate military health agencies and research institutes.

Learning Objectives:

1. Participant will learn about the methods, including the international and military guidelines and standards, for assessing military aircrew vibration exposure and health risk.
2. Participant will understand the complex multi-axis characteristics of higher frequency military aircraft vibration that may influence health risk and mitigation strategies.
3. Participant will be made aware of potential contributing factors and mechanisms associated with reported discomfort and health symptoms in military vibration environments.

[461] CUMULATIVE G_z-LOADING AND ITS EFFECT ON FIGHTER PILOTS' MUSCULOSKELETAL DISORDERS

R. Sovelius[2] and T.K. Leino[1]
[1]Air Force Command Finland, Tikkakoski, Finland; [2]Centre For Military Medicine, Finnish Air Force, Pirkkala, Finland

INTRODUCTION: Since 1995 G-loads of jet aircraft are recorded in FINAF due to need to follow-up aircraft's structural fatigue. The number of times the levels of +0.25, +2.5, +3.5, +4.5, +5.5, +7.0 and +8.0 Gz are exceeded during the sorties is recorded by the aircraft's accelerometer and stored by flight data recorder. Fatigue Index (FI) for critical aircraft structures is calculated by these figures. FI is counted up on every flight and in this study it is used also as a determining factor for inflight loading for pilots. The aim of the study was to determine possible differences in occupational loading between those pilots who suffer symptoms and those who don't. **METHODS:** 41 jet pilots who have started their jet training 1995-2010 and who have been waivered with G-limitation during follow-up due to musculoskeletal symptoms were selected for case subjects. All cases were linked with two control subjects from same training syllabus cohort and similar jet flight experience. A waiver datum of case was considered as end-point for survival analysis. Flight recorder's data was analyzed to determine the cumulative exposure in general as well as to identify the effect of flight intensity on musculoskeletal disorders among pilots. **RESULTS:** Survival curve during 19 years was linear; however some notches were seen during high intensity tactical training phases. There were no differences in levels of G-loading and FI between groups. Intensity of Gz exposure varies individually between different phases of career path and its effect on becoming symptoms is discussed. **DISCUSSION:** There is no significant difference in Gz exposure between pilots who will suffer flight related musculoskeletal symptoms and those who do not face disturbing symptoms. Deeper analysis of intensity of high Gz flying and work-rest cycle for pain determinant is warranted to achieve the better understanding also for preventive models.
Learning Objectives:
1. A novel approach for determining the acceleration induced musculoskeletal loading effects on jet pilots is presented.

Thursday, April 28 ***1:30 PM***
Avalon 17

S-88: SLIDE: AEROSPACE MEDICAL STANDARDS

Chair: Andreas Grove
Sinzheim, Germany

Chair: Ray King
Tijeras, NM

[462] THE HISTORY OF USAF VISION STANDARDS: BACK TO THE FUTURE? - PART I

D.J. Ivan[1], A.D. Ivan[2] and T.J. Tredici[3]
[1]ADI Consultants, San Antonio, TX; [2]Social and Behavioral Sciences, Vernon College, Wichita Falls, TX; [3]Ophthalmology, University of Texas Health Sciences Center, San Antonio, TX

In the years following man's first flight in a controlled powered heavier-than-air aircraft, the United States lagged well behind Europe in the development of the airplane as a tool of war. Even as the tempestuous winds of an unavoidable armed conflict erupted, future combatants in the First World War had little experience in the care and medical management of an aviator, let alone a combat pilot. Aviation Medicine as a specialized medical discipline did not yet exist. On the eve of the Great War, the entire library on aviation medicine comprised a handful of published papers and a single French textbook devoted to air sickness. At the start of hostilities, few countries had effective medical directives and what did exist were rudimentary and in many cases theoretical. All lacked the practical medical lessons to be derived from experiencing an armed conflict introducing combat aircraft to the fray. However, as World War I played out, militaries on both sides of the battle began to develop the basic aeromedical principles that would eventually give birth to the concept of a dedicated "flight surgeon" and create the foundation for medical standards and regulations that would guide the aeromedical discipline ever since. This paper constitutes the first of a three part series dedicated to exploring the source waters of those aeromedical principles and their impact on the development of modern military aviation vision requirements. Specifically, it will explore the historical and scientific evolution of United States Air Force (USAF) medical selection and retention vision standards, and where necessary, the influence of any political forces that may have significantly influenced major policy changes along the way. Many of the standards derived during this period remain relevant to this very day. Part one of this paper will cover the period before and during WWI. It will address fundamental vision performance concepts that emerged from that war, such as visual acuity, color vision, contrast sensitivity, stereopsis, and heterophoria, as well as related issues involving vision correction and flying goggles. Part II will span the period from WWI up through the end of WWII, while Part III will address the aftermath of those conflicts up through and including the modern era.
Learning Objectives:
1. The participant will learn the historical and scientific foundations of modern USAF aircrew vision standards.

[463] EXPERIENCE REDEFINING GROUND BASED CONTROLLER MEDICAL STANDARDS AS CASE TO CONSIDER OPTIMUM AEROSPACE MEDICINE PATIENT POPULATION

C.E. Backus
U.S. Air Force, Anchorage, AK

MOTIVATION: The notion of Aerospace Medicine solely supporting the pilot is an outdated model of current mission execution in both military and civilian air and space operations. This process review discusses one example of aerospace medicine support for a non-pilot population and uses this experience to help guide a new definition of "operator". **OVERVIEW:** In order to transition from a legacy model in which United States Air Force (USAF) Aerospace Medicine was designed to support the medical needs of pilots to a future model where Aerospace Medicine harnesses its significant strengths to serve the medical needs of a broader, more inclusive set of "operators", those operators must be defined in advance. USAF Aerospace Medicine patient care is more resource intensive than some other areas of its medical system when measured by patient visit per physician and so blindly expanding the patient population without critical thought could result in inefficiencies in the overall system. The experience of the author at Joint Base Elmendorf Richardson during a period of redefinition of the medical standards for ground based radar controllers allows a look at several cases during this period when the Air Force Medical System realized a patient population did not require Aerospace Medical services. This experience will be used in an attempt to demonstrate and define what populations might benefit most from Aerospace Medicine. **SIGNIFICANCE:** Strategic thinking and decision-making about what subset of the USAF population needs Aerospace Medical management will allow the strengths of aerospace medicine to be expanded beyond the legacy population without overly broad expansion that might dilute or drain resources that might not be required for every patient within the system. This allows the best outcomes per resource invested, insuring value in an environment in which efficiency is increasingly scrutinized. This definition, while oriented towards the USAF, could serve as a basis for generalization to other services, other nations, and the civilian sector.
Learning Objectives:
1. Understand the need for strategic redefinition of the United States Air Force Aerospace Medicine patient population and some issues pertaining to that redefinition.

[464] ANALYSIS OF DUTY LIMITING CONDITION AND PROFILE DISTRIBUTION AT TINKER AFB

J. Zhang and J.L. Boyle
Aerospace Medicine Services, Tinker Air Force Base, Oklahoma City, OK

INTRODUCTION: In this study, we examined the reporting and management of duty-limiting conditions (DLC) at Tinker AFB during the month of Sept 2015. Diseases such as low back pain are known to be prevalent in military service members. Nationwide, it is the number one cause for lost work hours. In fact, it has even been noted that 30% of medical

evacuees during deployments have a musculoskeletal etiology. While another 30% of evacuees suffer from mental health-related concern, the remainder are comprised of miscellaneous disease processes. During peace time, military members are generally healthy enough to meet the vigorous requirement of duty performance. Furthermore, the military system may be one of the only enterprises that require its members to pass a fitness test annually. Despite this increased fitness expectation, injuries sustained while on duty are a significant concern for our troop's well-being, and ultimately affect mission readiness. **METHODS:** The monthly Deployment Availability Working Group report from ASIMS is analyzed for Sept 2015 at Tinker AFB. Disease distribution is sorted by ICD-9 code from all reported diagnoses. Duty squadron is correlated with the disease profile to assess for any potentially contributing ergonomic factors predisposing to illness etiologies. **RESULTS**: Among 391 profiles (with a total of 490 conditions): 284 out of 490 (58%) were for musculoskeletal conditions; 38 (7.8%) for Mental health concerns; 34 (6.9%) for respiratory conditions including asthma; 32 (6.5%) for surgical after care; 26 (5.3%) for dental; 19 (3.9%) for OSA; 13 (2.7%) dermatological; 11 (2.2%) cardiovascular; 9 (1.8%) for neurological conditions; with the remaining 17 (3.5%) for miscellaneous issues. Among the profile distribution, maintenance personnel accounted for 139 (35.5%) profiles; air crews 109 (27.8%); support staff 106 (27.1%); and security forces 37 (9.5%). **CONCLUSION:** Musculoskeletal injuries are by far the number one condition receiving a profile at Tinker AFB, followed by mental health and then respiratory-related concerns. Maintenance personnel were the most likely population studied to report and receive a duty-limiting profile.

Learning Objectives:

1. To understand the most prevalent duty limiting condition at Tinker AFB.

[465] THE HISTORY OF MEDICAL CLEARANCE FOR COMMERCIAL SPACE OPERATIONS AND RECOMMENDATIONS FOR NEXT-GENERATION CLEARANCE AND OCCUPATIONAL SAFETY PRACTICES

D.M. Herrin[2] and K.R. Lehnhardt[1]
[1]Department of Emergency Medicine, George Washington University, Washington, DC; [2]School of Medicine and Health Sciences, George Washington University, Washington, DC

MOTIVATION: The United States Congress recently approved a provision extending the current limitations on the Federal Aviation Administration's (FAA) ability to regulate commercial human spacecraft occupant health and safety issues. As a result, there are currently no federal regulations outlining the medical standards that should be used to evaluate the suitability of crew or passengers for spaceflight. **OVERVIEW**: Space is a promising new frontier for commercial activity. Since the future mission for National Aeronautics and Space Administration (NASA) is likely one of deep space exploration, private companies are focused on the atmospheric, suborbital, and orbital regions. This activity has implications not only for international relations, economic growth, and security but also for space tourism and the inspiration of humankind. These spacecraft will require both crew and passengers, all of whom should be medically cleared for launch into outer space. **SIGNIFICANCE**: This study will review the history of recommendations for medical spaceflight certification (including those from the Aerospace Medical Association and the Commercial Space Transportation Advisory Committee, amongst others), outline the evolution over time of the suggested medical standards for commercial human spaceflight, and provide a discussion of the next-generation medical clearance and occupational safety practices.

Learning Objectives:

1. At the end of this presentation, audience members will be able to outline the history of medical clearance recommendations for commercial human spaceflight and the potential regulations that may result in the future.

[466] EVALUATION OF THE MILITARY FUNCTIONAL ASSESSMENT PROGRAM: A PROSPECTIVE, LONGITUDINAL STUDY OF THE PREDICTIVE VALIDITY OF THE MFAP FOR RETURN-TO-DUTY

C.A. Thornson[1], A. Estrada[1] and M. Showers[2]
[1]U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL; [2]Fort Campbell National Intrepid Center of Excellence Intrepid Satellite-III, Fort Campbell, KY

INTRODUCTION: High rates of neurosensory injury from combat operations directly impact the health and well-being of both individual Soldiers and troop readiness; thus, it is imperative to evaluate the psychometrics of assessments guiding return-to-duty (RTD) decisions. The MFAP is a military-relevant assessment using multidisciplinary sources to verify Soldier cognitive and physical fitness. This study evaluates the relationship between clinical assessments and MFAP scores, and the predictive validity of MFAP scores on successful RTD (or reintegration to civilian life). **METHODS:** Active duty male and female Soldiers (18-45) with a history of at least one concussive event were administered a clinical screening battery prior to treatment and rehabilitation. This battery includes core cognitive, psychological, vestibular, and occupational assessments. Other data include demographics, MFAP scores, and RTD determinations. Follow-up data were collected at 6 and 12 months post-MFAP to include online self-report clinical assessments and structured phone interviews of occupational/cognitive performance. Study is ongoing since 2014 with 38 Soldiers (36 males, 2 females) consented. Data were analyzed using correlation matrices and multiple regression analysis. **RESULTS:** Preliminary correlational analyses revealed that the six MFAP military exercises most highly correlated with the global MFAP performance score ($p < .01$) were Virtual Convoy Operator Trainer ($r = .66$); Land Navigation Prep Class ($r = .65$); Land Navigation ($r = .70$); Engagement Skills Trainer: Judgment-Based Scenarios ($r = .74$); Mass Casualty Medical Trainer ($r = .74$); and Mass Casualty Tactical Mission Scenarios ($r = .69$). **DISCUSSION:** The six tasks most highly related to MFAP performance required judgment and decision making skills as well as the ability to work well under pressure. Accordingly, the screening qualifications listed on the U.S. Army careers site as critical to becoming an Army Aviator include the "ability to perform under pressure" and "to make quick decisions." Therefore, this study is instrumental not only in evaluating the usefulness of the MFAP in guiding policymakers on issues of Soldier readiness to RTD after mTBI, but in its broader applicability to Army aviation as well.

Learning Objectives:

1. Understand to what extent and in what ways traditional clinical tests and self-report assessments are related to MFAP task performance (and on which tasks).
2. Understand to what extent and in what ways MFAP scores predict Soldier performance six and 12 months following return-to-duty, as measured by military performance evaluations, self-report assessments, and structured interview questions.
3. Be able to make the critical distinction between neurosensory research that is focused on rehabilitation vs. neurosensory research that is focused on return-to-duty.

[467] RISK FACTOR DISCOVERY FOR CAUSE-SPECIFIC FLIGHT STATUS REMOVAL AMONG UNITED STATES AIR FORCE AIRCREW

A.P. Tvaryanas[1], B. Greenwell[2] and G. Maupin[2]
[1]Human Systems Integration Directorate, Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: This study reused available data to conduct a survival analysis of aircrew to identify predictors of time until development of a disqualifying condition. The objective was to determine the feasibility of tailoring and/or risk-adjusting medical surveillance intervals for individuals and/or cohorts. **METHODS:** A prospective cohort analysis of Air Force aircrew with an initial fly date between 2001 and 2012 was analyzed for factors associated with development of a disqualifying medical condition. Specifically, a competing risk forest was used to uncover potential cause-specific risk factors of flight status removal. Potential risk factors are further investigated through marginal effects and partial dependence plots. Competing risk forest is a machine learning algorithm inspired by Leo Breiman's original random forest and is free of model assumptions. **RESULTS:** Of 15,560 aircrew, 8,529 (54.8%) developed a disqualifying condition. The most common reasons for removal were problems with vision, hearing, medical waivers, or hypertension – vision problems were the majority. Moreover, the specific factors associated with each differed. For example, increasing age and male gender were risk factors for flight status removal due to hypertension or changes in hearing. **DISCUSSION:** While this analysis brings to light potential risk factors, a more thorough investigation is required to determine which risk factors are practically significant.

Thursday, April 28 ***3:30 PM***
Avalon 1-3

S-89: SLIDE: ACCELERATION TRAINING AND TOLERANCE

Chair: Mary Brueggemeyer
Bethesda, MD

Chair: Kai-Wood Ma
Lackland AFB, TX

[468] 2014 AIR FORCE ACCELERATION TRAINING PROGRAM STATISTICS REVIEW

E. Combs, R. Sumrall and S. Sarsfield
USAF School of Aerospace Medicine, U.S. Air Force, San Antonio, TX

MOTIVATION: The centrifuge in San Antonio currently runs the USAF acceleration training program. A full disclosure of student data has not been disclosed in several years and there have been misconceptions regarding pipeline and qualification training. This presentation is to alleviate further researcher confusion. **OVERVIEW:** Every student pilot transitioning to the T-38 from Undergraduate Pilot Training (UPT) must sufficiently complete centrifuge training. Additionally, any student who is assigned to a higher Gz aircraft, or, returning to the aircraft after three years of inactive flying, must again successfully complete centrifuge training. **SIGNIFICANCE:** In CY14 there were a total of 894 students trained at the centrifuge. Of those, 390 were student pilots who successfully complete centrifuge training prior to transitioning to T-38s. There were two pilots and one physiologist that completed Initial training but were not pipeline students. There were 381 Qualification students, 222 of which were pilots, 52 which were Combat System Officers (CSO), 68 which were Flight Surgeons (FS), 30 of which were Flight Test Engineers (FTE), and 9 of which were Aerospace Physiologist/Technicians. There were a total of 120 Refresher students who were returning to the aircraft after three years on non-flying. Of the 120, 113 were pilots, 1 CSO, and 6 FS. There were 5 centrifuge training failures (one student failed twice). Two failures were Romanian AF pilots transitioning to the F-16 who were unable to return for a second attempt until CY15 (both successfully passed). One FS and one FTE did not return for a second attempt at completing the centrifuge profiles. This is an overall failure rate of 0.5%. Previous year failure rates were 2.6% (CY13), 1.3% (CY12), and 1.4% (CY11) respectively. Failures were attributed to respiratory errors (20%), insufficient lower body component (40%), or a combination of both (40%). There were a total of seven training sessions that were stopped for injuries. Five terminated training for lower back pain, one for pain in the abdomen and one for pain in leg from a pre-existing injury.
Learning Objectives:
1. To review the centrifuge program and reason for failure in centrifuge training.

[469] MEDICAL REASONS FOR STOPPING CENTRIFUGE TRAINING, NINE YEAR REVIEW

S. Sarsfield, E. Combs and R. Sumrall
Acceleration Training, U.S. Air Force, San Antonio, TX

MOTIVATION: High-Gz training in the human centrifuge is very safe, but a small number of students do experience physical symptoms during centrifuge exposure requiring cessation of training. **OVERVIEW:** From 2006 through the present, 8756 aircrew have presented for high-Gz centrifuge training at Brooks City-Base in the USAF training program. Only 36 student training sessions (0.41%) were stopped due to a physical symptom or condition experienced while in the centrifuge that precluded successful completion of the training. Low back pain was the most common reason (10); other musculoskeletal conditions included leg pain (5), neck pain (4), and arm pain (2). Two students experienced the same limiting symptoms at two subsequent training sessions (back, leg). One student experienced neck pain to stop training both at initial training session and refresher session 6 years later. Five students had exacerbation of an acute illness; the particular syndrome was not recorded. Three students reported abdominal pain and two reported chest pain. Three students had excessive Coriolis motion effect that required stopping training. And two students were stopped for poor anti-G straining maneuver for medical reasons. All cases were seen by the on-site flight surgeon and found to have non-immediate conditions. A specific diagnosis was not made for these cases, but they were given self-care recommendations and told to follow-up with their local flight surgeon. After evaluation by their flight surgeon, the student returned when the condition was resolved to complete training. Of these 33 students, 19 eventually passed the training. The highest rate of not returning to complete training was in those with neck pain; 3 of the 4 did not return. Half of the 10 students with low back pain did not return. The other categories had more than half return for training. This report does not include the many students that may have experienced physical symptoms while in centrifuge training, but completed the training. **SIGNIFICANCE:** Stopping centrifuge training for a medical reason or condition during centrifuge exposure accounted for a very small number of cases. None of these cases caused a permanent or waiverable condition, and more than half later completed the training.
Learning Objectives:
1. Centrifuge training is rarely halted due to a medical symptom or condition, and more than half later return to complete centrifuge training.
2. Experiencing neck pain during centrifuge training causing cessation has a high rate of not later completing centrifuge training.

[470] ASSOCIATIONS BETWEEN G TOLERANCE AND CHANGES OF STROKE VOLUME, HEART RATE, AND CARDIAC OUTPUT IN OPERATING ANTI-G STRAINING MANEUVER

C. Lai[1], W. Chang[1], K. Chiang[2] and H. Chu[1,3]
[1]Aviation Physiology Research Laboratory, Kaohsiung Armed Force General Hospital Gangshan Branch, Kaohsiung, Taiwan; [2]Kaohsiung Armed Force General Hospital Gangshan Branch, Kaohsiung, Taiwan; [3]Institute of Aerospace and Undersea Medicine, National Defense Medical Center, Taipei, Taiwan

INTRODUCTION: The purpose of performing anti-G straining maneuver (AGSM) is to increase cardiac output (CO) and ultimately, blood supply to the brain, to avoid black out and G-induced loss of consciousness (G-LOC) during high G air combat maneuvers. Until now, the effectiveness of AGSM performed by trainees in Taiwan is evaluated subjectively. **AIMS:** To investigate the association between G tolerance and cardiac performance parameters while performing AGSM on the ground and during high G endurance training. **METHODS:** This is a longitudinal study design. Young male volunteers were randomly recruited from 2015 flights surgeon/aviation physiologist training program. Cardiac performance parameters (cardiac output, CO; stroke volume, SV and heart rate, HR) were evaluated using non-invasive instrumentation (PhysioFlow® Enduro™ Manatec Biomedical, Paris, France) on the ground at 1G and during high G endurance training in a human centrifuge (Latécoère, France).Data were analyzed using SPSS 18.0 software. **RESULTS AND CONCLUSIONS:** Five young male (age, 27.8±2.8 years; body mass index, 23.8 ± 3.3) participated in the study. Their mean relaxed and straining G tolerance were 4.7 G and 8.6 G, respectively. The effectiveness of AGSM (G increment or gain) was 3.9 G. Ratios of SV, HR, CO between high G training and ground training while performing AGSM were 1.09, 0.94 and 0.95, respectively. During training, three subjects suffered G-induced loss of consciousness. Ratios of SV, HR, CO in non-G-LOC group (n=3) were 1.2, 0.92 and 0.98, respectively while those in the G-LOC group (n=2) were 0.93, 0.97 and 0.89, respectively. When comparing AGSM effectiveness, ratios of SV, HR, CO in G increment ≧4 G group (n=3) were 1.19, 0.98 and 1.08, respectively while those in G increment <4 G group (n=2) were, 0.94, 0.88 and 0.75, respectively. We were able to measure cardiac performance during centrifuge training with non-invasive methodology. In the future, we will recruit Air Force cadets into our study to pursue our final aim.
Learning Objectives:
1. To assess the changes of cardiac performance parameters in operating AGSM.
2. To establish the associations between cardiac performance parameters and G tolerance.
3. To predict the effectiveness of AGSM by cardiac performance parameters.

[471] PHYSIOLOGICAL INTERPRETATION OF A-LOC INCIDENTS

S.S. Khatua[1], M. Dahiya[2], A.B. Krishnegowda[1] and P. Sannigrahi[1]
[1]Indian Air Force, Near Alipurduar, India; [2]Acceleration Physiology & Spatial Disorientation, Indian Air Force Institute of Aerospace Medicine, Bangalore, India

INTRODUCTION: The phenomenon of Almost Loss of Consciousness (A-LOC) is although known to the Aviation Fraternity since 1980's, is not well researched. Very few studies have attempted to elaborate the characteristics of A-LOC. However the explanations are not conclusive. The present study is a retrospective analysis of 71 A-LOC incidents recorded in the High Performance Human Centrifuge in India. The study also endeavors to address the lacunae in the literature. **METHODS:** The study was conducted in the department of Acceleration Physiology and Spatial Orientation, IAM IAF, Bangalore. A retrospective analysis of the G training data in High Performance Human Centrifuge for a time span of 4yrs (2009 to 2013) was carried out. In total 8093 videos were analyzed and 71 A-LOC incidents were reported. The videos were evaluated for the characteristics of A-LOC. **RESULTS:** Convulsions and involuntary body movements were observed in 36 pilots, whereas nystagmus was observed in 43 pilots. Of the 71 pilots who had A-LOC, 30 were interviewed about the event. Amnesia and dreams were reported by 11 and 02 pilots respectively. The average incapacitation period was noted to be 10.14 ± 3.26 s during A-LOC episodes. **DISCUSSION:** On the basis of findings like nystagmus, maintenance of postural tone, convulsions, amnesia, dreams during A-LOC, Neuro-physiology of A-LOC has been hypothesized. Presence of nystagmus, maintenance of posture suggests intact vestibulo-ocular reflex and intact sensory motor tract respectively. Non-recollection of dreams, amnesia suggests breach in memory and/or information processing for higher functions. The mechanism in toto can be explained by regional difference in blood flow and vulnerability of cerebral centers like (Memory and information processing) to ischemic hypoxia more than other centers. In contrast to differential perfusion theory of G-LOC by Whinnery, convulsions in A-LOC could be attributed to hyperexcitability of nerve fibers due to hypoxia.

Learning Objectives:

1. The analysis of the neuro-physiology of A-LOC will help in better understanding A-LOC and G-LOC.
2. The analysis of the neuro-physiology of A-LOC will help in accident investigations to find out the cause of accident by studying the Histopathology.
3. The analysis of the neuro-physiology of A-LOC will help in training pilots in a better manner.

[472] INNATE +GZ TOLERANCE AND BODY COMPOSITION

A.B. Krishnegowda[1], S. Sampath[2], M. Dahiya[1] and P. Rastogi[1]
[1]Department of Acceleration, Physiology and Spatial Orientation, Institute of Aerospace Medicine, Indian Air Force, Bangalore, Karnataka, India; [2]Biochemistry, Armed Forces Medical College, Pune, India

INTRODUCTION: +Gz tolerance, is determined by many factors. One such factor is Weight, however Weight is itself a composite of Fat Mass (FM) and Fat Free Mass (FFM). Both FM and FFM can contribute differently to relaxed +Gz tolerance. **METHODS:** The body FM, FFM and Total Body Water (TBW) of 75 volunteers were calculated by Bioelectrical Impedance Analysis and Relaxed +Gz tolerance was assessed using High Performance Human Centrifuge at IAM IAF. The data was evaluated using Pearson Product Moment Correlation. Further, the pooled data was divided into two groups, Above-Average Tolerance (AATG) and Below-Average Tolerance (BATG) with mean +Gz value as a cut-off and physical parameters of these groups were compared**. RESULTS:** The mean ± SD of relaxed +Gz tolerance was 4.35 ± 0.55G. The mean, FM, FFM and TBW were, 12.08 ± 3.81 kg, 59.51 ± 5.40 kg and 41.12 ± 3.05 L, respectively. The result indicated that relaxed +Gz tolerance showed significant moderate level positive correlation with FM (r = 0.498). Low positive correlation was observed between FFM (r = 0.254) and TBW (r = 0.291). In addition, it was noted that the AATG had significant higher levels of, FM, and MAP than the BATG. **DISCUSSION:** High Fat Mass is associated with increased sympathetic nervous system activity in the body and over time alters the baroreceptor responses to sympathetic activity. Hence individuals with excess Fat mass even though they are normotensive have high resting BP than others and this high resting BP has positive correlation with resting relaxed +Gz tolerance**. CONCLUSION:** The results obtained in this study indicate that an individual with higher fat content within the permissible range will have higher relaxed +Gz tolerance. The relationship of Straining +Gz tolerance and +Gz Duration tolerance with body composition also needs to be explored**.**

Learning Objectives:

1. A participant will be able to understand the relationship between innate +Gz tolerance and specific body components such as water, fat, and fat free mass. Participant will appreciate the role of these components in providing protection to acceleration stress. An intuiting hypothesis of these components regulating the autonomic nervous system is also projected.
2. Participant will review different methods of assessment of body composition. An essence of inefficiency of using BMI for predicting physical health will also be introduced.

[473] MEDICAL EVALUATION OF AIRCREW IN THE CENTRIFUGE, FIVE YEAR REVIEW

R. Sumrall
Acceleration Training, U.S. Air Force, San Antonio, TX

MOTIVATION: High Gz acceleration forces encountered in high-performance aircraft may be not appropriate in aircrew with certain medical conditions or history, but medically monitored Gz exposure in the centrifuge can validate that these aircrew to be safe to return to high-performance aircraft. **OVERVIEW:** In the last 5 years, 8 aircrew underwent medical evaluation in the centrifuge at Brooks City-Base. The conditions being evaluated were varied: recurrent vasovagal syncope, vertigo, Peyronie's disease treated with pentoxifylline, supraventricular tachycardia, ventricular tachycardia, mitral stenosis treated with annuloplasty, chronic lymphocytic leukemia (CLL) after treatment, and head and neck cancer after treatment with radiation, chemotherapy, and surgery. All centrifuge sessions were observed by a flight surgeon with video and 2-lead electrocardiographic monitoring. The exposure protocols were similar to the training protocols they would need to pass to return to their aircraft. Six patients had normal centrifuge exposures and were given unrestricted aeromedical waivers. One pilot with recurrent vasovagal syncope continued to have symptoms in and outside of the centrifuge and was given a waiver for no high-G aircraft with another pilot at the controls. One flight surgeon with CLL did not apply for a waiver, even thought he had a normal centrifuge medical evaluation. **SIGNIFICANCE:** Testing aircrew with medical conditions in the environment they will be exposed to operationally, such as high-Gs, can give reassuring information to certifying authorities that the aircrew's medical condition in compatible with the high-Gz environment. Cardiac rhythm and valve disorders, otolaryngologic disorders, and vasoactive medication use are conditions that can be tested for compatibility in the high-Gz environment.

Learning Objectives:

1. Review the indications and recent history and outcomes of medical evaluation of aircrew in the centrifuge.

Thursday, April 28 ***3:30 PM***
Avalon 7-9

S-90: SLIDE: WOMEN'S HEALTH ISSUES IN AVIATION

Chair: Jennifer Fogarty
Houston, TX

Chair: Bill Tarver
Houston, TX

[474] PRACTICAL CONSIDERATIONS FOR THE CARE OF FEMALE ASTRONAUTS ON THE INTERNATIONAL SPACE STATION

S. Moynihan, S. Auñón and J. Law
NASA Johnson Space Center, Houston, TX

MOTIVATION: Women have been and will continue to be active participants in spaceflight. Practical considerations specific to women's health need to be further refined and emphasized. **OVERVIEW:** Since the Female Astronaut Health Standards Summit in 2014, NASA has been working to strengthen our approach to women's health care in the Astronaut Corps. This includes screening, preventive care, and operational

constraints faced on the International Space Station with respect to menstruation, nutritional concerns, and reproductive viability. Other issues include bone health, menopausal status, and unique operational considerations such as radiation exposure. **SIGNIFICANCE:** Practitioners will have a better understanding of the unique issues involved with health care in the female Astronaut Corps. These advances should benefit other operational venues such as the military, extreme environments, and future exploration class missions.

Learning Objectives:

1. The participant will gain a better understanding of the unique issues involved with health care in the female Astronaut Corps.

[475] REMOTELY GUIDED BREAST SONOGRAPHY FOR LONG-TERM MISSIONS

A.F. Sorice Genaro[1], T. Russomano[2], N. Glauber[3], H. Wen[4] and J. Silva-Martinez[5]

[1]Engineering Directorate, INPE - Instituto Nacional de Pesquisas Espaciais, São José dos Campos, Brazil; [2]Micro-G, PUC-RS, Porto Alegre, Brazil; [3]Omnisys Aerospace, Rosh Ha'ayin, Israel; [4]École de technologie supérieure , Montreal, Quebec, Canada; [5]NASA Johnson Space Center, Houston, TX

INTRODUCTION: The performance of breast sonography is essential for long-term ISS or deep-space missions, as astronauts will be exposed to space radiation. Based on the NASA ISS Ultrasound Imaging Capability Overview for Prospective Users (NASA/TP–2006–213731), no complete bilateral breast sonography has been performed with either remote guidance or on the ISS. **OBJECTIVE:** To validate a method to detect possible signs of breast cancer using real-time remotely guided sonography during a space mission, decreasing the time for diagnosis, providing early treatment and increasing the chance of cure. A secondary goal is to help determine the necessary onboard equipment to be used for breast exams in space missions. **METHODS:** The experiment was divided into two phases: first or test phase consisted of a remotely guided breast sonography exam, with the subject and sonographer located in two different sites on the ground. The test included an ultrasound machine with linear array transducer (at 6-16 MHz), acoustic gel, and an inclining bed to simulate microgravity. The sonographer guided the subject through each step of the breast exam; second or validation phase will be based on the procedures performed in the ground study and conducted on the ISS, having the sonographer on the ground. **RESULTS:** With no prior training, the test subject was able to follow the exam while being instructed remotely by an expert. However, the subject found that the amount of pressure needed during the exam was unclear. **DISCUSSION:** The real-time remotely guided sonography exam is expected to be performed in space and to yield important clinical results that could positively affect the diagnosis and treatment of astronauts suffering from breast cancer. These findings may allow us to propose a breast exam procedure in space. For long-term mission, this technique should be conducted on both male and female astronauts, as a preventative measure. Before this technique can be implemented, further testing on earth and on parabolic flights will be required to fine tune the test procedures.

Learning Objectives:

1. To discuss the use of telemedicine in space missions.
2. To study image transmission from space.
3. To investigate diagnostic methods of cancer in space missions.

[476] A NOVEL PERSONALIZED APPROACH TO HEALTHCARE FOR FEMALE ASTRONAUTS

V. Jain[1,2] and V.E. Wotring[2,3]

[1]Obstetrics and Gynecology, Barts Health Trust, Walsall, United Kingdom; [2]Center for Space Medicine, Baylor College of Medicine, Houston, TX; [3]Department of Pharmacology, Baylor College of Medicine, Houston, TX

MOTIVATION: A known risk factor for venous thromboembolism (VTE) is combined oral contraceptive (COC) use proportional to estrogen dosage. Immobility, experienced through prolonged sitting, more than doubles the risk of VTE. When combining these with travel of more than four hours, the effect is additive. Finally, age impacts this risk synergistically with every decade ≥30 years. **OVERVIEW:** There have been no reported cases of VTE pre, during or post spaceflight. We have demonstrated that spaceflight does not increase the risk of VTE for astronauts using COCs. However, the above variables are unavoidable during an astronaut's career and applicable in pre and post-flight phases. Advancing age, combined with relatively high doses of estrogen, topped with multiple long haul flights and prolonged confined immobility during Soyuz training, create a risk profile whereby VTE is a distinct pre-flight possibility. The implications of an event could not only ground a crewmember during training but also have an immeasurable impact on the entire mission. **SIGNIFICANCE:** The relatively high doses of estrogen (30-35 micrograms) prescribed are thought to protect against spaceflight osteopenia. However, this is irrelevant for an otherwise active population in 1Gz. We propose a new model of offering personalized healthcare to female astronauts. Considering the individuals' health risks, age, family history, work environment and training schedule, we suggest reducing or even eliminating this estrogen component and adopting either a progester-one-only pill or a progesterone based long acting reversible contraceptive for example, an intrauterine device. Estrogen could be reintroduced temporarily during spaceflight in order to maximize osteoprotective benefits.

Learning Objectives:

1. To gain an understanding of the pathogenesis of venous thromboembolism.
2. To understand the spaceflight specific risk factors for venous thromboembolism.

[477] NASA ASTRONAUT URINARY CONDITIONS ASSOCIATED WITH SPACEFLIGHT

R. Cole[2,3], J. Law[1], S. Mason[4] and M. Young[4]

[1]NASA Johnson Space Center, Houston, TX; [2]Preventive Medicine, University of Texas Medical Branch, Galveston, TX; [3]Emergency Medicine, University of Texas Health Science Center at Houston, Houston, TX; [4]Wyle, Houston, TX

INTRODUCTION: Spaceflight is associated with many factors which may promote kidney stone (KS) formation, urinary retention (UR), and/or Urinary Tract Infection (UTI). According to International Space Station (ISS) mission predictions supplied by NASA's Integrated Medical Model, KS is the second and sepsis (urosepsis primary driver) the third most likely reason for emergent medical evacuation from ISS. **METHODS:** In-flight and postflight medical records of NASA astronauts were reviewed for UR, UTI and KS during Mercury, Gemini, Apollo, Mir, Shuttle, and ISS expeditions 1-38. **RESULTS**: NASA astronauts have had 7 cases of KS in the 12 months after flight. Three of these cases occurred within 90 to 180 days after landing and one of the seven cases occurred in the first 90 days after flight. There have been a total of 16 cases (0.018 events per person-flights) of UR during flight. The event rates per mission are nearly identical between Shuttle and ISS flights (0.019 vs 0.021 events per person-flights). In 12 of the 16 cases, astronauts had taken at least one space motion sickness medication. Upon further analysis, it was determined that the odds of developing UR in space-flight is 3 times higher among astronauts who took promethazine. The female to male odds ratio for inflight UR is 11:14. An astronaut with UR is 25 times more likely to have a UTI with a 17% infection rate per mission. There have been 9 reported UTIs during spaceflight. **DISCUSSION:** It is unclear if spaceflight carries an increased post-flight risk of KS. Regarding UR, the female to male odds ratio is higher during flight compared to the general population where older males comprise almost all cases due to prostatic hypertrophy. This female prevalence in spaceflight is even more concerning given the fact that there have been many more males in space than females. Terrestrial medications with a known side effect of UR are also associated with UR during flight. However, not all cases of UR surrounded medication use inflight. UTI is a known terrestrial cause of UR. Furthermore, the treatment of UR with a urinary catheter may be more likely to initiate a UTI in space than on the ground, as aseptic techniques can be particularly challenging with an inexperienced provider in a free-floating environment. Inflight UR and

UTI have proven to be highly associated and urinary risks should be considered collectively when planning for space flight.
Learning Objectives:
1. Kidney stones have occurred within months of NASA astronauts return to Earth.
2. Urinary retention has occurred during space flight with a risk of over 1% events per person flight. The female to male odds ratio is higher in spaceflight compared to the general ground population. Some urinary retention cases during spaceflight were not associated with medication.
3. Urinary retention and UTI are highly associated during spaceflight. Both kidney stones and UTI have a risk for medical evacuation from the ISS.Therefore, comprehensive urinary risks should be considered collectively when planning for spaceflight.

[478] THE MEDICAL ISSUES OF THE WOMEN AIRFORCE SERVICE PILOTS

D. Kazdan[1,2]
[1]Electrical Engineering and Computer Science, Case Western Reserve University, Cleveland, OH; [2]Anesthesiology, Case Western Reserve University, Cleveland, OH

PROBLEM STATEMENT: The Women Airforce Service Pilots (WASPs) of World War II comprised over 1000 female civilian pilots under military discipline. They were the first women to fly U.S. military aircraft. Their medical intake criteria, medical care while in training and in service, and accumulated medical record is a little-known chapter of aviation medicine. Further discussed will be the extent that the WASP experience advised the flight medicine of later female aircrew and that of the female Mercury astronaut examinees of the Lovelace Clinic. **TOPIC:** The WASP program began in September 1942 as the Women's Flying Training Detachment (WFTD) and the Women's Auxiliary Ferrying Squadron (WAFS) of the Air Transport Command, organized separately in September 1942. The groups merged into the WASP program in August 1943. 25,000 already-licensed female pilots applied; ultimately, 1,074 finished the program, mostly at Avenger Field, Sweetwater, Texas. The intake physical examination system mirrored that of the Army Air Force and most exams were performed locally, some by private physicians. Avenger field had a dispensary staffed with at least one flight surgeon and ancillary staff with responsibility for counseling, medical training, and day-to-day, and emergency care of the pilots. The group prepared a comprehensive report after the WASP unit was disbanded in December, 1944. **APPLICATIONS:** Discussion will include the slow organization of the women's medical intake, the evolved changes in medical and experience requirements for entry, and the medical care the aircrew received, and the medical problems encountered during training and service. A review of known literature from reports, memoirs, and published papers will be presented. Physical and mental health issues, performance reviews of the pilots, and women's health issues will be discussed. The dispensary installation will be reviewed, including its diagnostic abilities and its pharmacy. Discussion of this history should help inform understanding of early issues and policy patterns in women aircrew's medical policy.
Learning Objectives:
1. The participant will be able to discuss and further explore the medical issues of the Women Airforce Service Pilots, the first female pilots to fly U.S. military aircraft.

Thursday, April 28 ***3:30 PM***
Avalon 10-12

S-91: SLIDE: RESEARCH & REVIEW OF STIMULANTS AND FATIGUE COUNTERMEASURES

Chair: Arpan Kothari
Kettering, OH

Chair: William Porter
Pensacola, FL

[479] AN INDIVIDUALIZABLE MODEL TO PREDICT SLEEP/WAKE, CIRCADIAN, AND CAFFEINE EFFECTS ON COGNITIVE PERFORMANCE

S. Ramakrishnan[1], J. Liu[1], M. Khitrov[1], N. Wesensten[2], T. Balkin[3] and J. Reifman[1]
[1]U.S. Army Medical Research and Materiel Command, DoD Biotechnology HPC Software Applications Institute, Fort Detrick, MD; [2]Air Traffic Organization, Federal Aviation Administration, Washington, DC; [3]Department of Behavioral Biology, Walter Reed Army Institute of Research, Silver Spring, MD

INTRODUCTION: Biomathematical modeling of sleep/wake and circadian rhythm effects on mental performance comprises a critical component of most fatigue risk management systems (FRMS), allowing for identification of periods during which individuals are at increased risk for committing fatigue-related errors. However, most models are not individualizable nor do they account for the effects of caffeine (one of the most widely used fatigue countermeasures). Here we describe a unified mathematical model of performance (UMP) that not only predicts sleep/wake and circadian rhythm effects on cognitive performance but also (1) predicts intra-individual or "trait-like" responsivity to sleep/wake (i.e., model can be tailored to the individual), and (2) predicts the temporary performance-restoring effects of caffeine. **METHODS:** To determine UMP accuracy for predicting intra-individual (trait-like) responsivity to sleep/wake, we utilized data from a study in which 15 subjects underwent both a 64 h total sleep deprivation (TSD) challenge and a chronic sleep restriction challenge [3 h time in bed (TIB) per night for 7 consecutive nights]. To determine UMP accuracy for predicting caffeine effects, we utilized data from a 29-h TSD study in which 48 subjects were administered three repeated doses (separated by 2 h) of 0, 50, 100, or 200 mg of caffeine (n = 12 per caffeine group). **RESULTS:** Trait-like prediction accuracy. The UMP customized to an individual under one sleep/wake condition (either 64 h TSD or 3 h TIB/night for 7 nights) predicted performance of the same individual under the other condition up to 50% more accurately than a non-individualized (i.e., group-average) model. Caffeine affects prediction accuracy. The UMP predicted the effects of the range of caffeine doses, yielding up to 90% improvement over the standard two-process model. **DISCUSSION:** The UMP accurately predicts an individual's (trait-like) response to sleep/wake and caffeine effects on cognitive performance. The UMP can be used to determine individual-specific responsivity to any given sleep/wake schedule and to appropriately time caffeine to optimize cognitive performance at critical mission times.
Learning Objectives:
1. Describe the role of biomathematical modeling in FRMS.
2. Describe how the UMP can be utilized to predict the impact of a given sleep/wake schedule on an individual's cognitive performance.
3. Describe how the UMP can be utilized to determine the appropriately timed dosage of caffeine to optimize cognitive performance during critical periods.

[480] COMBINING MODAFINIL AND CAFFEINE: EFFECTS ON COGNITIVE PERFORMANCE DURING 35 HOURS OF CONTINUOUS WAKEFULNESS

J.L. Caldwell, B. Hartzler, C.L. Kunkle, C.B. Levin, M.Y. Hayes and F.E. Robinson
Aeromedical Directorate, Naval Medical Research Unit - Dayton, Yellow Springs, OH

INTRODUCTION: Performance effects due to insufficient sleep have been documented for decades. Given the prevalence of caffeine as a fatigue countermeasure among military personnel, and the availability of prescription medications such as modafinil to select populations, commanders and medical staff have expressed concern over the safety of potentially combining the two alertness aids. The present study addressed this issue in a laboratory investigation comparing the combined effects of modafinil and caffeine with those of either substance alone during 35 h of continuous wakefulness. This study was reviewed and approved by the Naval Medical Research Unit Dayton Institutional Review Board. **METHODS:** To determine the effects of the combined alertness aids on cognitive performance, participants were randomly assigned to one of four groups: modafinil - MO (200mg),

caffeine - CA (200mg), modafinil-caffeine - MC (200mg each), or placebo - PL. Following training and baseline, participants received their respective treatment at 2300 (18 h awake). Cognitive performance, subjective mood, and vital signs were measured every 3 h starting at 0200 for a total of 5 test sessions. **RESULTS:** Participants in the MC group had fewer lapses on the PVT than those in the CA and PL groups, and faster reaction times than those in the PL group. Changes in performance did not differ among the groups across time. Mood disturbance scores were significantly worse in the PL group at 0500 than all other groups. The PL group's mood disturbance score was also worse than the MO group at 0200, but only tended to be worse than the MC group at 0800. Vital signs did not differ among the groups. **DISCUSSION:** These results suggest the MC was more effective than either CA or MO alone, and that this benefit was not accompanied by problematic changes in vital signs. Since modafinil has a longer half-life, but produces fewer subjectively noticeable signs than caffeine (perhaps leading people to underestimate the benefits of modafinil), it may be that combining the two compounds is actually desirable. Further analyses of other cognitive tests will determine whether similar results are evident across measures.

Learning Objectives:

1. Individuals who consume both modafinil and caffeine may experience a slight improvement in alertness and performance compared to either substance alone without an increase in side effects.

[481] EFFECT OF ADMINISTRATION OF MODAFINIL DURING EXTENDED WAKEFULNESS ON SUBSEQUENT SLEEP QUALITY, SLEEPINESS AND FATIGUE

H. Singh, K.K. Tripathi, N. Tripathy And S. Chowdhary
Institute of Aerospace Medicine, Bangalore, India

INTRODUCTION: Modafinil, an analeptic is under investigation for its value in mitigating effects of sleep & fatigue. Its effects on subsequent quality of sleep and restorative value have not been explored adequately. This study examined if administration of modafinil during extended wakefulness (EW) of 24-32 hours significantly modulates the quality & restorative value of subsequent induced sleep (IS). **METHODS**: In a placebo controlled, double blind, mixed design, sleep was induced with Zolpidem (10 mg)/Placebo after an EW for 24 to 32 hours. Two doses of modafinil (200 mg)/ Placebo were administered at 17th & 24th hour of EW. Subjects were woken up 6 hours after administration of Zolpidem and were evaluated for quality of the IS (Groningen Sleep Quality Scale), Sleepiness (Stanford Sleepiness Scale) and Fatigue (Chalder Fatigue Questionnaire) after a given task. These indices were compared amongst the four groups viz, 'M-Z' (modafinil during EW, zolpidem before IS), 'M-P' (modafinil during EW, placebo before IS),'P-P'(placebo during EW and before IS) and 'P-Z'(placebo during EW, zolpidem before IS) and also with baseline values. Heart rate, Oral Temperature and Mean Arterial Pressure (MAP) were also measured in this timeframe. **RESULTS**: In the groups M-P and M-Z, MAP after induced sleep was significantly higher than baseline. In all the groups except P-P, quality of induced sleep was significantly inferior to that in the night prior to the study. Sleepiness and Fatigue scores after induced sleep were significantly higher than their base line values in all the groups except P-P. **DISCUSSION**: Increase in MAP induced by modafinil persists for an appreciable time. The quality of induced sleep after a period of extended wakefulness and administration of a total of 400 mg of modafinil was significantly inferior to that in the night prior to the commencement of the study. It was also less refreshing and restorative; participants were more sleepy and fatigued after they were woken up after induced sleep compared to when they woke up on their own after a restful sleep in the night prior to the study. The detrimental effects of modafinil on both quality and restorative value of sleep were not attenuated with the pharmacological assistance of Zolpidem.

Learning Objectives:

1. Quality of induced sleep after a period of extended wakefulness and administration of a total of 400 mg of modafinil was significantly inferior.
2. The detrimental effects of modafinil on quality and restorative value of sleep were not attenuated with the pharmacological assistance of zolpidem.

[482] TIME DEPENDENT EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION AND CAFFEINE ON PERFORMANCE DURING EXTENDED WAKEFULNESS

L.K. McIntire[1], A. McKinley[2], J. Nelson[1] and C. Goodyear[1]
[1]Infoscitex, Inc., Dayton, OH; [2]711th Human Performance Wing/ RHCP, Wright-Patterson AFB, OH

INTRODUCTION: Extended wakefulness is a common complaint in military operations due to extended duty hours. Caffeine is a common countermeasure used to combat these complaints but the effects decline rapidly. Previously, we found that transcranial direct current stimulation (tDCS) in the middle of the night (0400) could combat the negative performance and mood effects as a result of sleep deprivation as well as and in some instances better than caffeine and that this effect lasted at least 6 hours. Therefore, this study proposed to see how long the effect of tDCS as a fatigue countermeasure lasts and if there is a difference between stimulating at the beginning of the night (1800) versus in the middle of the night (0400). We also compared these results to caffeine. **METHODS:** Five groups of ten participants in each group received either active tDCS and placebo gum at 1800, caffeine gum with sham tDCS at 1800, active tDCS and placebo gum at 0400, caffeine gum with shave tDCS at 0400, or sham tDCS with placebo gum at 1800 and 0400 during 36-hours of sustained wakefulness. Participants completed a 30 minute vigilance task, 10 minute working memory task, 10 minute psychomotor vigilance task (PVT), and 10 minute warship commander task beginning at 1800 hours and continued every two hours throughout the night until 1900 the next day for a total of 13 sessions. At the end of each session participants also filled out 4 subjective mood questionnaires. **RESULTS:** Our results show that tDCS intervention given at 1800 provided a sustained attention performance benefit that lasted until the conclusion of the study (24 hours) compared to control. Comparatively, the caffeine group only had a benefit at until 0800 (14 hours) before returning to levels comparable to our control group for the duration of testing. Both tDCS groups also reported higher subjective mood ratings when compared to the control group and caffeine groups. **DISCUSSION:** Our results suggest that tDCS could be a powerful fatigue countermeasure. The effects appear to be more beneficial than caffeine because they are longer lasting and subjective mood remains more positive.

Learning Objectives:

1. tDCS could be used as a fatigue could be used as a fatigue countermeasure.
2. Differences between giving the intervention early in the night versus during a circadian trough.
3. Improved subjective mood ratings for tDCS groups compared to caffeine and placebo groups.

[483] COMBATTING SHIFTWORKER FATIGUE FOR SPACE OPERATORS AT VANDENBERG AFB

N. Maertens, B. Eovaldi, S. Edstrom and P. Manzur-Ballard
U.S. Air Force, Colorado Springs, CO

Manipulating the space environment for strategic advantage and to enjoy the amenities of modern life necessitates 24/7 operations from a select crew of space operators. This article will discuss how we worked with these operators to rebuild their shift schedule system, mission, environment and education to provide a well-rounded and informed approach to optimize health and happiness. Our method of interaction was: 1) define the current state via interviews and surveys; 2) review the literature for evidence-based interventions and to capture the scope of the problem and risks being accepted under the current state; 3) provide shift scheduling modification and intervention recommendations to leadership based on the literature and circadian rhythm models we built off of survey results; 4) execute approved interventions and implement an education campaign; and 5) assess effectiveness of interventions. This presentation will discuss each of these components but will focus on information found during the literature review that drove recommended interventions, how well those recommendations were accepted by leadership and shift workers and the noted effectiveness of said interventions. The project was executed at the Joint Space Operations

Center at Vandenberg AFB but has since branched out to several other AFSPC bases and may likely be the model under which all space operators work in the future.

Learning Objectives:

1. Members will learn how our team of aerospace medicine professionals addressed shift worker fatigue for 24/7 operations.
2. Members will understand several shiftwork interventions discussed in the literature.
3. Members will gain an appreciation for the complexity of balancing mission/life demands with a sound physiological approach.

Thursday, April 28 ***3:30 PM***
Avalon 13-14

S-92: PANEL: USING GAP ANALYSIS TO GUIDE HUMAN PERFORMANCE RESEARCH

Sponsored by Aerospace Human Performance

Chair: Joseph Cohn
Washington, DC

Chair: Keith Ruskin
Chicago, IL

PANEL OVERVIEW: PROBLEM STATEMENT: Aerospace medicine and affiliated fields draw from knowledge bases in medicine, engineering, and psychology, with data relevant to the practice of the specialty being published in a wide-variety of sources including journals and government publications. This may result in difficulty accessing the full range of data, difficulty in systematically identifying gaps in knowledge, and challenges in doing systematic reviews to guide the practice of aerospace medicine. **TOPIC**: The traditional medical literature reports on information obtained from basic science experiments and clinical trials. Systematic reviews are frequently employed to organize and synthesize data from multiple sources to guide clinical practice. While systematic reviews are excellent for the critical evaluation of literature around a very specific question, they are not geared to conducting broad surveys of medical fields and mapping current knowledge and identifying gaps in knowledge that need to be filled in order to improve evidence-based care. Fortunately, the information sciences have recently developed an approach for identifying and prioritizing gaps in knowledge called evidence-based mapping. Both evidence-based mapping and systematic reviews are complementary approaches for ensuring that the practice of aerospace medicine has a solid and up-to-date scientific foundation. **APPLICATIONS**: This panel will provide an overview of how both evidence-based maps and systematic reviews can be undertaken, with the goal of better informing researchers, funding agencies, and the public about strengths and gaps in knowledge in the field. Successfully doing this will increase the visibility of aerospace medicine, improve our ability to attract top researchers and clinicians to the highest need areas, and convince funding agencies that aerospace medical research activities are critical to safe and cost-effective operations in the aerospace and other extreme environments.

[484] WHY IS EVIDENCE GAP RESEARCH IMPORTANT?

K. Ruskin
Anesthesia and Critical Care, University of Chicago, Chicago, IL

MOTIVATION: The United States spent over $240 billion in 2010 to fund biomedical research. Although many of these studies offer significant improvements in the quality of life for patients and the public, some research studies are designed to answer questions for which ample evidence already exists. Although this problem is multifactorial, contributing factors may include the fact that funding proposals are submitted to peer review groups who might resist ideas that do not conform to mainstream thought. Moreover, some studies suggest that peer reviewers tend to have a favorable bias towards research that supports their own interests. A method of identifying new research topics has the potential to improve research efficiency and ultimately expand the body of biomedical knowledge. **OVERVIEW:** Evidence-based practice provides solutions that address a unique set of challenges in a manner that is compatible with its properties, needs and limitations. Researchers designing new trials can use current systematic reviews to develop questions, define sample size, and justify grant applications. The systematic review techniques used to develop a level of evidence can also be used to identify *evidence gaps*, areas in which knowledge is lacking. Systematic reviews can also help to prevent unnecessary studies. For example, a systematic review of 28 trials found that calcium channel antagonists had no benefit in patients with ischemic stroke. A subsequent review of 20 animal studies provided no evidence to justify the human trials. Evidence gaps identify areas in which additional research will add knowledge, and may increase the likelihood of obtaining funding for an important study. **SIGNIFICANCE:** In an era of increasingly fiscally constrained research, evidence gaps represent a new and potentially cost effective way to identify and validate new research opportunities, allowing researchers to cost effectively identify areas of research in which to invest. This panel will define an evidence gap, discuss the process of identifying potential research opportunities, and explain how to construct the literature search. Finally, an example of gap research from another specialty will be presented.

Learning Objectives:

1. Participants will learn how evidence gaps can be used to guide research and funding opportunities.
2. Participants will understand how to conduct systematic literature reviews in order to find evidence gaps.
3. Learners will be able to interpret evidence gap maps.

[485] FORMULATING AND CONSTRUCTING A SYSTEMATIC SEARCH METHODOLOGY TO IDENTIFY EVIDENCE GAPS FOR FURTHER RESEARCH

D.P. Hersey
Cushing/Whitney Medical Library, Yale University, New Haven, CT

PROBLEM STATEMENT: Identifying gaps in research can be an important method for researchers to determine necessary and important areas to study. It is essential that all relevant literature on an article be identified in order to ensure that a gap truly exists. As a result, researchers, or their library colleagues, must conduct a systematic search within all relevant databases. **TOPIC:** Systematic searches entail searches that are comprehensive, methodical, transparent and reproducible. A number of search strategies are employed including the use of controlled vocabularies, free-text (natural language) searching, truncation, Boolean logic, and limits applicable to specific databases. Ultimately search results will need to be validated and verified. The result is a set of references that should encompass the breadth of material available on the researchers' topic of interest. **APPLICATIONS:** A comprehensive, systematic search of the literature on a topic needs to be conducted in order to perform an accurate gap analysis. Having a librarian assist in formulating and conducting the searches can help ensure a thorough set of results on all topics of interest to aerospace medicine and human performance interested in evidence-based research.

Learning Objectives:

1. Participants will be able to identify the steps necessary to conduct a systematic search of the literature.

[486] EVIDENCE MAPPING IN AEROSPACE NEUROLOGY

E. Boudreau[1,2]
[1]Neurology, Oregon Health & Science University, Portland, OR; [2]Medical Informatics & Clinical Epidemiology, Oregon Health & Science University, Portland, OR

PROBLEM STATEMENT: Experience is a critical component of successful clinical practice. However, this experience needs to be supported by a strong evidence-based foundation. Neurologic problems significantly contribute to loss of medical certification. While good data is available to support routine neurologic care, much less systematic data is available to support decisions regarding the medical certification of flight personnel with neurological problems. **TOPIC:** Using the field of aerospace neurology as an example, we plan to discuss how a modified version of the Global Evidence Mapping Initiative (see "Resources" below) can be used to do a broad survey of aerospace neurology. Key steps in this process include choosing and refining an appropriate scope for the evidence-based mapping, systematic literature review with assessment of the quality of the literature available, conducting mapping workshops with experts in the field, and prioritizing the most pressing operational questions.

APPLICATIONS: Once evidence-based mapping in aerospace neurology is completed, there will be a stronger foundation to guide decision-making with regard to neurologic disorders that impact aerospace operations. Furthermore, identification of gaps in knowledge can be used to advocate for funding and stimulate research in the highest need areas. **RESOURCES:** Bragge P, Clavisi O, Turner T, Tavender E, Collie A, Gruen RL (2011) The global evidence mapping initiative: Scoping research in broad topic areas. BMC Med Res Methodol (England) 11:92-2288-11-92.

Learning Objectives:

1. Understand the difference between evidence-based mapping and systematic reviews.
2. Understand the basic steps for completing an evidence-based map.
3. Understand how an evidence-based map could enhance neurologic care in aerospace neurology.

Thursday, April 28 ***3:30 PM***
Avalon 15-16

S-93: SLIDE: ATLANTIC CITY MONOPOLY

Chair: Aubrey Florom-Smith
Cooper City, FL

Chair: Marian Sides
Grayslake, IL

[487] SAFETY CLIIMATE AND MISHAP PROBABLITY

T.S. Strongin, T. Mayfield and L. Jones
Air Force Safety Center, Kirtland AFB, NM

SUMMARY: The Air Force Combined Mishap Reduction System (AFCMRS) includes a safety culture survey that has been administered to Airmen nearly half a million times. Airmen of all ranks provide opinions about their organizations' safety culture, leadership, resources and processes. The survey has a response rate of approximately 75% and results are presented to commanders within a few days of the last survey administration. This study analyzed the correlation of survey responses with the number and severity of subsequent mishaps. Results indicated that organizations with extreme scores (those in the highest and lowest deciles) were most predictive of mishap rates. This presentation provides both a summary of that data and a demonstration of its application to risk management strategies in the U.S. Air Force. **INTRODUCTION:** Human factors cause most Air Force mishaps. The Air Force Safety Center has developed a suite of safety culture surveys and a debriefing technique to assist operational commanders with their risk management programs. **METHODS:** The web-based Air Force Combined Mishap Reduction System survey was administered to flying and their associated maintenance organizations. Responses to each survey item were averaged and correlated to the number of mishaps in the year following the surveys. **RESULTS:** Correlations revealed that extreme survey scores yielded the highest correlation with mishap probabilities. Scores in the mid-range were not as predictive. **DISCUSSION:** Human factors cause most mishaps. Surveys and interviews of the Airmen who accomplish the mission on a daily basis revealed a correlation between several survey items and the probability of subsequent mishaps. Commanders received 1:1 briefings in which the results were analyzed, interpreted and potential courses of action were discussed. These process appear hold promise for commanders of with extreme survey scores. Future developments in the acquisition and communication of safety climate information will be discussed.

Learning Objectives:

1. Understand the potential predictive value of safety climate surveys. Understand some of the limitations of the U.S. Air Force safety climate survey.
2. Relate existing safety climate research to potential future research activities.

[488] ACCIDENT CAUSES AND OCCUPANT INJURY SEVERITY IN HELICOPTER EMERGENCY MEDICAL SERVICES (1983-2014)

D. Boyd[2] and N. Macchiarella[1]
[1]Embry Riddle Aeronautical University, Daytona Beach, FL;
[2]University of Texas, Houston, TX

INTRODUCTION: Helicopter emergency medical services (HEMS) transport critically ill patients to/between emergency care facilities and operate in a hazardous environment: the destination site is often encumbered with obstacles, difficult to visualize at night and lack instrument approaches for degraded visibility. The study objectives were: determine (a) HEMS accident rates and causes (b) occupant injury severity profiles (c) whether accident aircraft were certified to the more stringent crashworthiness standards implemented two decades ago. **METHODS:** The National Transport Safety Board (NTSB) aviation accident database was used to identify HEMS mishaps for the years spanning 1983-2014. Contingency tables were used to determine differences in proportions. A Poisson distribution was used to determine if accident rates differed over time. **RESULTS:** The accident rate for the 1999-2002 period was 28 per million flight hours and decreased by 22 and 29% for the 2003-2006 and 2007-2010 periods respectively ($p=0.04$ and $p=0.05$ respectively) compared with the initial period. There was a further decline to 8 accidents per million flight hours for the most recent time span (2011-2013). However, the fraction of fatal accidents (36-50%) ($p=0.191$) and the injury severity profiles were unchanged ($p=0.701$). None of the accident aircraft fully satisfied the current crashworthiness standards. Failure to clear obstacles and visual-to-instrument flight were the most frequent accident causes. Moreover, the accident cause proportions between the three periods was unchanged ($p=0.409$). **CONCLUSION:** HEMS operators should be encouraged to update their fleet (a) to the current, more stringent crashworthiness standards towards reducing injury severity and (b) for IFR-certified avionics.

Learning Objectives:

1. The participant will gain a further understanding of occupant injury severity in helicopter emergency medical services.

[489] DESCRIPTIVE ANALYSIS OF PATIENT TRANSPORTS WITH A CABIN ALTITUDE RESTRICTION: 2001-2014

G. Maupin, W.P. Butler and D.E. Smith
Aeromedical Research, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: Aeromedical evacuation (AE) has played a major role in the Iraq and Afghanistan wars. AE is not without risk, however, as in-flight stressors may produce a "second hit" causing further injury. Cabin altitude restriction (CAR) is a validating flight surgeon prescription devised to counter this potential hit. To date, data-driven research supporting the use of CAR is parsimonious. **METHODS:** A descriptive study of patient transports from 2001-2014 was performed. Patients were divided into CAR and non-CAR groups. Inclusion criteria included United States Department of Defense service members who were ≤ 18 yr of age and who were transported intra-theater, inter-theater-Europe, and inter-theater-other. **RESULTS:** There were 92,530 transports that met the study criteria; 90,480 (97.78%) were in the non-CAR group and 2,050 (2.22%) were in the CAR group. The highest number of total transports occurred in 2004 (10,831), and the greatest proportion of CAR transports (6.64%) was in 2007. There were 13,464 (14.55%) intra-theater transports, 74,033 (80.01%) inter-theater-Europe transports, and 5,033 (5.44%) inter-theater-other transports. About a third (30,930; 33.43%) of transports were litter-bound. The total number of individual patients transported over the study period was 83,745 for an average of 1.10 transports per person. Most patients transported were male (87.78%), members of the Army (78.50%), and under 30 yr of age (60.26%). Most (78.73%) evacuations were for non-battle injuries. **DISCUSSION:** Once data abstraction is complete, future work will investigate differences between CAR and non-CAR groups, not to mention those non-CAR patients who were flown on a CAR flight.

Learning Objectives:

1. Understand the descriptive epidemiology of patient transports with and without a Cabin Altitude Restriction.

[490] ELECTRO-THERMAL EQUIVALENCES IN MULTI-SCALE MODELING

I. Cinelli
Biomedical Engineering, NUIG, Galway, Ireland

PROBLEM STATEMENT: Modeling of the brain tissue as a multiscale electromechanical modeling is increasingly recognized as a

critical step towards reliable, predictive modeling of neurophysiological function. The integration of the electrical activity within the mechanical structure of brain tissue is a key challenge for the quality of a complex model and real-time simulations. **TOPIC:** Advanced numerical modeling is a well-established tool for better understanding the nature of a complex phenomenon. It has been successfully applied to analyze, predict, assess and mitigate potential hazards to health. The investigation of neurocognitive performance during changed gravity conditions can be enhanced using a fully coupled (equivalent) electromechanical modeling [EEMM], capable of providing insight into the mechanisms by which the behavior arising from the electromechanical coupling contributes to brain plasticity, across temporal and spatial scales. We seek to assess electro-thermal equivalences as an approach for modeling the inter-dependence of electrical and mechanical phenomena in multi-scale models (from micro-structure to tissue scale) of nervous cells. A 3D model of a nerve cell is used to assess thermo-electrical equivalences in finite element analysis [FEA], simulating electrical conduction through heat conduction analysis in Abaqus CAE Software 6.13-3. Instead a model of a nerve bundle is used to assess the fully coupled EEMM. The electric flux in a nerve cell is analyzed under both steady state and transient conditions, and validated with analytical solutions for a range of different boundary conditions and experimental evidence as published in literature. This procedure allows for the reduction in problem complexity and it facilitates the coupling of electrical and mechanical phenomena reducing the computational cost and improving the reliability of the model. **APPLICATIONS**: The influence of changing gravity conditions in long-term mission might permanently alters the signal transmission between nervous cells. Neurophysiological processes, neurocognitive impairment and perception can be alternatively investigated in a 3D environment of the neural-networking using this novel approach. Although the findings of this analysis are mainly addressed towards the electro-mechanics of tissue within the biomedical domain, the same approach could be used in other studies in which a coupled FEA is required.

Learning Objectives:

1. Understand role and nature of changed gravity conditions in the mechanical structure of the brain tissue.
2. Understand role and nature of altered electrical transmission between neurons in the causation of changing neurocognitive performance.
3. This innovative neurophysical modeling technique is addressed to safety enhancement in short-term and long-term missions.

[491] IMPACT OF COMMUNICATION DELAYS ON PERFORMANCE AND WELL-BEING ABOARD THE INTERNATIONAL SPACE STATION: LESSONS LEARNED FOR LONG-DURATION SPACEFLIGHT

N. Kintz[2] and L.A. Palinkas[1]
[1]Children, Youth and Families, University of Southern California, San Diego, CA; [2]School of Social Work, University of Southern California, Los Angeles, CA

INTRODUCTION: The NASA Human Research Program Behavioral Health and Performance Element (BHP) examined the impact of an experimental communication delay to and from the International Space Station (ISS) on performance and well-being. This presentation describes results relating to the feasibility and acceptability of conducting such a study and potential countermeasures to prevent or mitigate adverse impacts. **METHODS:** During a recent increment, 3 astronauts and 18 ground support personnel performed 6 tasks under conditions of no communications delay, and 4 tasks under conditions of a 50-second one-way delay in communications to and from the ISS. After each task, participants answered questions about their ability to communicate with one another, how well they and the team performed, their perceptions of crew morale, how much autonomy was exercised, and how much support was received in completing the task. Individual semi-structured interviews were conducted <21 days post-flight to assess study feasibility and acceptability and to elicit recommendations for countermeasures. **RESULTS:** Delays in communications were technically feasible and audiovisual records of the tasks provided objective measures of performance under conditions of delay or no delay. Obtaining post-task information from participants on mood and performance was also feasible. Study participants were in agreement as to importance of study and there was little difficulty with recruitment. However, concerns were expressed by: Mission Operations about impact of study on certain operations, the Astronaut Office about astronaut willingness to provide certain types of information in standardized formats, and the astronauts about relevance of certain questionnaire items. Finding sufficient number of tasks that meet study criteria is a challenge and data collection will require more increments to achieve adequate sample size. Changes in participant behavior during task performance and post-flight interviews suggested three types of countermeasures; 1) Technology-focused, 2) Training-focused, and 3) Teamwork-focused. **DISCUSSION:** Studies of communication delays on the ISS and their impacts are both feasible and acceptable within constraints imposed by operational needs and astronaut preferences. Results suggest a comprehensive systems approach to development of countermeasures that are operational and behavioral in nature and involve specific technology, training, and team-focused strategies.

Learning Objectives:

1. Understand the feasibility and acceptability of conducting a study examining the impact of experimental delays in communication to and from the International Space Station on performance and well-being.

Thursday, April 28 ***3:30 PM***
Avalon 17

S-94: PANEL: ADVANCED AEROSPACE MEDICINE FOR INTERNATIONAL MEDICAL OFFICERS (AAMIMO) AEROMEDICAL CLINICAL CASE PRESENTATIONS

Chair: Jeffrey Lawson
Wright-Patterson AFB, OH

PANEL OVERVIEW: The Advanced Aerospace Medicine for International Medical Officers (AAMIMO) course is an intensive 6 month long curriculum taught at the USAF School of Aerospace Medicine (USAFSAM), Wright-Patterson AFB, OH. As part of this course, these flight surgeons from around the globe are able to bring aeromedical cases for presentation from either their country's Air Force experience or cases of interest from the USAFSAM Aeromedical Consult Service (ACS). Cases are selected for presentation in accordance with both the clinical learning interests of the student and the topical currency of the diagnosis. Each case presentation will include a PowerPoint presentation with an introduction, case report, discussion, aeromedical disposition implications for their countries as well as that of the USAF, and conclusion. Limited questions will be allowed for each presenter by the panel chair.