lives, most of us would be hard pressed to identify what made that one teacher stand out from the rest as being the "great" teacher in our lives. This presentation will help identify the things that make great teachers great through. This will proceed through a rapid review of learning theory to an exploration of characteristics of great teachers illustrated with examples from popular culture and conclude with a discussion of strategies that we can employ to make ourselves better and more effective teachers.

Learning Objectives:

1. Review the history of learning theory.
2. Identify the value of great teachers.
3. Discuss the characteristics of great teachers and strategies for adopting some of those characteristics for ourselves.

[019] DOES FLIGHT SIMULATION IMPROVE INITIAL INSTRUMENT TRAINING FLIGHT PERFORMANCE?

R. Allnutt
USAFSAM, Beavercreek, OH

INTRODUCTION: It seems intuitively obvious that use of a high fidelity, FAA approved advanced aviation training device (AATD) would be helpful in the early training of aviators in instrument procedures such as scanning of instruments and maintaining altitude while referencing only aircraft instruments. But what seems obvious is not always true. **METHODS:** A group of residents in Aerospace Medicine, all of whom had previously been trained to the level of solo flight in a light civilian aircraft, were divided randomly into two groups. Group 1 residents had four individual 1.25-hour instrument lessons taught by an FAA Certified Flight Instrument Instructor (CFII) on an AATD simulator. Group 2 residents had no instrument simulator training. All residents (Group 1 and Group 2) then underwent four 1.25-hour, in-aircraft, instrument instructional flights. All residents were objectively rated for each flight on their ability to maintain speed, heading, altitude, and bank angle as prescribed with a 5 point scale (0-4) for each variable. **RESULTS:** Five residents were simulator trained (group 1) and eight were not simulator trained (group 2). All 13 residents completed the 4 in-aircraft training flights. Each resident had the potential to achieve up to 16 points on each flight for a total of 64 points for the 4 flights. The range of overall scores for each resident was 4-57 points. The average score for simulator trained residents was 36.7 points as compared to 44.6 points for the residents not exposed to the simulator. This difference was not statistically significant. **DISCUSSION:** Simulator training had no demonstrable effect on in-aircraft performance on the rated aspects of instrument precision. AATD simulator training is an inadequate substitute for in-flight training when introducing the complexities of IFR flight to aerospace medicine residents.

Learning Objectives:

1. Understand the difference between different types of flight simulators.
2. Understand the types of instrument training sorties that might best be enhanced with simulator training.
3. Understand the lack of statistical validation of simulator training in enhancing instrument proficiency early in instrument flight training.

NOTE: AEROSPACE MEDICINE BOARD REVIEW SESSIONS S-005A (Abstracts 020, 021, 022); S-005B (Abstracts 023, 024); and S-005C (Abstracts 025, 026, 027,028) WILL BE HELD ON TUESDAY, MAY 2, IN GOVERNOR'S SQUARE 10.

MONDAY, May 1, 2017

Monday, May 1 ***8:00 AM***
Majestic Ballroom

63rd ANNUAL LOUIS H. BAUER LECTURE

Michael R. Barratt, M.D.
"N=1: Medical Debrief on an ISS Expedition"

Monday, May 01 ***10:30 AM***
Plaza A/B

S-006: PANEL: OCCUPATIONAL INJURIES IN CABIN CREW

Sponsored by the AsMA Air Transport Medicine Committee

Co-Chair: Paulo Alves
Tempe, AZ

Co-Chair: Rui Pombal
Lisbon, Portugal

PANEL OVERVIEW: This panel presents an overview of occupational injuries (OIs) in cabin crew across a range of international airlines. The first presentation will give a general picture of the topic by describing the epidemiology of OIs and their operational impact in terms of days of work lost in a medium-sized airline with a composite route network of medium and long-haul flights. The second presentation will zoom in detail into two specific injuries to the wrist that are often missed at initial medical observation and which have prompted changes to case management. Procedural aspects and the role of occupational medicine in the management of OIs in a major world airline will be discussed in the third presentation. The fourth presentation, from another major world airline, will look at the impact of initiatives aimed at identifying causes of lost time from injuries, reducing time lost following accidents and preventing recurrence. The fifth presentation will further discuss strategies to assist cabin crew in returning to work after prolonged sick leave including for serious OIs. Both variation and common ground in case management across various organizational and cultural settings will be highlighted in this panel. It is expected that the broad range of data and approaches presented will constitute a useful reference for future discussions on the topic.

[029] EPIDEMIOLOGY OF OCCUPATIONAL INJURIES IN CABIN CREW IN AN AIRLINE

M. Lima, R. Pombal, A. Jorge and H. Peixoto
UCS - TAP Portugal Group, Lisbon, Portugal

INTRODUCTION: Cabin crew are exposed to multiple hazards in the workplace which can contribute to the occurrence of occupational injuries with an impact on the wellbeing of crewmembers and on airline productivity. The analysis of occupational injuries is essential to the development of targeted occupational safety programs. **METHODS:** All the occupational injuries sustained by cabin crew in a medium-sized European airline in the period 2011-2015 were studied for incidence, severity, causality nexus and time lost. **RESULTS:** For an average of 2,600 cabin crew, the annual frequency rate varied from 134 to 169 injuries per million hours worked. The overall 5-year incidence rate was 238 per 1,000 persons and the overall 5-year severity rate was 2.417 work days lost per million hours worked. Occupational injuries in cabin crew were account on average for 8,900 days away from work per year. The most frequent occupational injury was ear barotrauma (61%), corresponding to 33% of total time lost and an average of 7 days lost per episode. Musculoskeletal injuries came second, accounting for 37% of all the occupational accidents but 65% of time lost and an average of 24 days lost per episode. From another perspective, 12% of all the accidents and 21% of total time lost were related to cabin trolley handling, whereas 8% of the accidents and 13% of time lost were related to galley work. **DISCUSSION:** Knowing the characteristics of occupational injuries sustained by cabin crew and understanding their causes is essential for designing relevant preventive health and safety interventions in the workplace. This epidemiological study provides baseline data for this type of assessment.

Learning Objectives:

1. To know the most frequent causes of occupational injuries in airline cabin crew.
2. To know the most frequent lesions resulting from cabin crew occupational injuries.
3. To know the impact of cabin crew occupational injuries in terms of time lost to work.

[030] ROLE OF OCCUPATIONAL MEDICINE IN THE MANAGEMENT OF OCCUPATIONAL INJURIES: A FRENCH POINT OF VIEW

M. Klerlein, M. Bouton, C. Cardines and M. Cantegril
Occupational Medicine, Air France, Roissy Charles De Gaulle, France

INTRODUCTION: In France, the Social Security Code defines occupational injuries as any adverse event occurring during the working hours, whether these events link to the work or not. This concept of "presumption of causality" leads our airline to manage as occupational injury minor but very frequent problems such us otalgia during descent or being emotionally hit by an onboard resuscitation. Of course, injuries that are more classical are equally frequent like musculo-skeletal disorders or all kind of contusions that can happen onboard or during the rest at the hotel. A special attention is given to malaria, which in France is considered as an occupational injury for crew, We present hereafter the main figures of our occupational injuries and the main actions the occupational health department do to prevent them. **METHODS:** The figures of occupational accidents and occupational diseases are retrieved from the Air France human resource database name PRATIS, through the Business Object retriever. The role of the occupational health department is simply described. **RESULTS:** For the last ten years, Air France faced an annual mean of 1339 (± 204) occupational injuries with at least one day of sick leave for a mean of 14,153 (± 573) cabin crewmembers. The breakdown shows that the main type of injuries are otalgia (43 %), musculo-skeletal disorders (22 %) and floor level falls (13 %). Psychological injuries represent 3 % and injuries due to mosquitoes 1.4 %. **DISCUSSION:** In France, occupational health services are strictly devoted to prevention. They are allowed to treat injured people only for emergency care. The main actions of prevention are listed below. Modification of work conditions: Information of the cabin crew at the top of descent, redesign of the galley, modification of the upper deck floor of the A380, implementation of a banister to facilitate access to the crew rest. Prevention of psychological stress: Systematic psychological debriefing after any event affecting the crew immediately after disembarkation. Implementation of a no mosquito bite policy in malaria or arboviruses affected country: Supply skin and textile repellent, ensuring cooled air shuttle, forbid evening outdoor activities. Information and training: Collective and individual risk information, briefing before flights, supplying medical information for friends, relatives and health care workers (malaria information card).

Learning Objectives:

1. Understanding the French distinctiveness of occupational medicine regarding management of occupational injuries.
2. To know the main type of occupational injuries of cabin crew in a major airline.

[031] THE EFFECT OF ACTIVE INTERVENTION ON ABSENCE FROM WORK IN CABIN CREW FOLLOWING ACCIDENTS ON DUTY

M. Popplestone
Health Services, British Airways, Wokingham, United Kingdom

INTRODUCTION: Manual handling incidents are a common cause of injuries in cabin crew leading to pain and restriction in capability for the individual affected. In addition in some cases the injury causes time away from work resulting in financial loss to the crew member and the business. This study examines the impact of detailed root cause analysis, early treatment and specific training initiatives. **METHODS:** Cabin crew accident data collected between 2011 and 2015 (including number of incidents, causation and time lost) will be analyzed to identify any impact of accident reduction initiatives. There will be particular focus on trends following changes in annual refresher training subject matter. **RESULTS:** Anecdotal reports from managers and safety professionals suggest that the number of accidents and time lost have reduced, however detailed analysis of the data is required to either substantiate or disprove this assertion. Final analysis and detailed examples of intervention will be presented. **DISCUSSION:** Airlines are required to do what they reasonably can to reduce the number and impact of accidents and injuries at work. Targeted initiative may be helpful in addition to routine retraining however clearly demonstrating benefit may be difficult.

Learning Objectives:

1. The participant will be able to decribe which interventions are most likely to be effective in reducing time off work following accidents at work.

[032] CABIN CREW RETURN TO WORK - OCCUPATIONAL HEALTH PRACTICE IN ONE MEDIUM-SIZED COMMERCIAL AIRLINE

K. Ketola
Finnair, Vantaa, Finland

INTRODUCTION: This presentation describes epidemiology of cabin crew occupational injuries (OI) in a medium-sized European airline in context with the airline's Model For Active Caring with focus on the return to work (RTW) process. Legislative background and some aspects of Finnish Occupational Health Act are also presented. Statistics of cabin crew OIs by diagnostic subgroups are also shown as the presenter considers this collection of data unique for European Occupational Health Services. **METHODS:** The airline has actively utilized its Model For Active Caring since 2010 to the earliest possible recognize lowered ability to work and to proactively co-operate with the airline's Occupational Health Services to improve the workability status of the employee and, in case of sickness absence, to effectively facilitate RTW. The model is discussed briefly. Sickness absence data by diagnostic categories according to ICD-10 have been collected from five consecutive years. This data will also be presented with emphasis on the "Injury, poisoning and certain other consequences of external causes" category. **DISCUSSION:** The airline's Model for Active Caring incorporating a process for RTW has enabled many employees to return to work after prolonged absence and disability. This seems to benefit both the employee, the airline and even the society as a whole. Considerable savings, both financially and in regard to human capital, have been made. In this model the manager's role is of very high importance.

Learning Objectives:

1. The participant will learn how incorporating a process for return to work can enable many cabin crew members to return to work even after a prolonged absence and disability.

[033] MANAGING OCCUPATIONAL INJURIES OF THE WRIST IN CABIN CREW, WITH SPECIFIC ATTENTION TO TFCC AND SCAPHO-LUNATE LIGAMENT INJURIES

R.J. Pieterse
Group Medical, Emirates Airline, Dubai, United Arab Emirates

INTRODUCTION: Flight attendants are exposed to very physical job demands. Work place injuries place a significant burden on the airline as well as the individual. Although small in number, injuries to the wrist in cabin crew lead to great morbidity, are often career ending and result in a high financial burden to the airline. Unfortunately, the majority of these injuries are often miss-diagnosed initially as a sprained wrist by general practitioners. A high index of suspicion and early diagnosis is essential for early appropriate management of these conditions. **METHODS:** I collected all data for injuries sustained at work from the 1st February 2015 till the 31st January 2016. Injured flight attendants complete an accident report and sign consent for the company to utilize this information and investigate the incidents. For the year 3333 reports were completed, 985 were rejected for industrial injury compensation due to various reasons. 2348 cases were approved as "industrial injury" and therefor fully compensated. (Pay, Accommodation, Utilities, Medical Care etc.) Off these 2348 cases, 1969 returned to work ≤ 4 weeks. 379 returned to work > 4 weeks. Off these 379 cases 124 were wrist injuries (33%) with 67% making up the rest. **RESULTS:** Triangular Fibro-Cartilage Complex injuries: 21; Scapho-Lunate Ligament injuries: 8; Injury to both structures: 5; Total of the wrist injuries: 34/124 (27% of all wrist injuries); Minimum time off work: 34 days; Maximum time off work: 477 days; Average time off work: 202 days; Median time off work: 176 days; Average cost to the company:* Still being calculated. Cost to the individual: Career ending for 5 individuals. **DISCUSSION:** These specific injuries were followed all the way through from initial presentation to conclusion. All wrist injuries sustained at work presenting to the walk-in clinic and primary care doctors are referred

to the specialized musculo-skeletal rehabilitation unit for early diagnosis and appropriate management. We have a close working relationship with a number of specialist hand surgeons in the community and focus on the case management as well as doing job specific rehabilitation and strengthening for these individuals. Before resuming normal flying duties, they have to complete a standardized functional assessment that simulates various on-board tasks required to successfully resume flying duties.

Learning Objectives:

1. To have a high index of suspicion for these injuries when the mechanism of injury and signs and symptoms fit.
2 To gain a better understanding of these conditions and the implications to the patient.
3 To be better equipped to make an early diagnosis and therefore initiate early appropriate medical care for these high morbidity conditions and where possible through education reduce the incidence of these injuries.

Monday, May 01 ***10:30 AM***
Plaza D/E

S-007: PANEL: SLEEP ISSUES IN DEMANDING OPERATIONAL CONTEXTS

Chair: J. Lynn Caldwell
Yellow Springs, OH

Chair: John Caldwell
Key West, FL

PANEL OVERVIEW: MOTIVATION: Today's demanding operational environments present a variety of challenges to human physiology. In particular, the ability to obtain restful day-to-day sleep is often compromised by the fast-paced operational tempos, ever-changing work/rest schedules, lengthy duty periods, and poor sleep conditions present in many of today's mission environments. As a result, military, space, and other personnel are often threatened with sleep deprivation and even clinically-recognizable sleep disorders, and because of this, they are at heightened risk of safety and health-related complications. Sleep issues must receive greater attention than they have in the past in order to preserve operational readiness and individual wellbeing. **OVERVIEW:** Research has shown that sleep problems are prevalent in modern military, space, and other populations, and there are indications that today's transient sleep difficulties often become tomorrow's persistent sleep disorders. Thus, it is critical to explore the factors that create and maintain sleep disruptions in demanding operational contexts. It is also necessary to understand the downstream consequences of insufficient and/or disrupted sleep on the health and wellbeing of personnel. This panel will explore the nature of sleep problems in demanding operational contexts, the factors that contribute to these problems, and the efforts that either are recommended or that currently are underway to address and correct sleep-related concerns. **SIGNIFICANCE:** Insufficient and/or disordered sleep jeopardizes the health, wellbeing, and safety of military, space, and other personnel. It is crucial to understand the extent of sleep-related problems and what is being done to solve them in order to optimize the performance and protect the long-term wellbeing of today's operational personnel.

[034] SLEEP IN THE U.S. MILITARY: AN OVERVIEW OF ISSUES AND THE BARRIERS TO CORRECTIVE ACTIONS

J.A. Caldwell[1,2] and H.R. Lieberman[1]
[1]US Army Research Institute of Environmental Medicine, Natick, MA; [2]Oak Ridge Institute for Science and Education, Oak Ridge, TN

INTRODUCTION: Sleep is a vital physiological function, and failure to obtain sufficient sleep has been linked to adverse outcomes including degradation in cognition and compromised mental and physical health. Unfortunately, sleep deprivation and sleep disorders appear to be common in the U.S. military, and they often fail to receive the attention they deserve. A better understanding of sleep issues in active duty personnel is needed to safeguard readiness, safety, and health throughout the services. **METHODS:** A review of select studies on sleep in the military, the consequences of insufficient/disrupted sleep, and barriers to addressing existing problems was conducted. **RESULTS:** Studies indicate that poor sleep quality and insufficient sleep duration are widespread among today's service members. In addition, upward trends in sleep disorders have been observed. As a result, operational readiness, as well as long-term mental and physical health, is compromised. In addition, there is evidence personnel often depend on coping strategies such as stimulants, hypnotics, and alcohol to address their sleep- and fatigue-related concerns. These strategies can help in the short run, but they ultimately can fail, exacerbating sleep disturbances and setting the stage for post-deployment PTSD, anxiety, depression, and even suicide. Unfortunately, sleep disorders and disturbances have not been adequately addressed due to cultural barriers (i.e., the perception needing sleep is a sign of weakness), insufficient manpower (too few personnel to accommodate the mission while ensuring adequate off-duty rest), less-than optimal sleep environments (in terms of lighting, temperature, and noise), insufficient understanding of the importance of sleep and appropriate sleep behaviors, and inadequate screening/detection systems for sleep disorders. **DISCUSSION:** Detailed exploration of sleep issues in the military, factors which predispose personnel to sleep problems, policies and practices to alleviate sleep concerns, and factors hindering or facilitating the implementation of these policies will help to mitigate the negative consequences of insufficient/poor sleep and promote greater sleep health among service members. **SUPPORT:** Supported by USAMRMC. The opinions or assertions contained herein are the private views of the author(s) and are not to be construed as official or reflecting the views of the Army or the Department of Defense.

Learning Objectives:

1. Understand the extent of sleep problems and what is being done to address these problems in U.S. active duty service members.

[035] SLEEP ISSUES AND MENTAL HEALTH

V.F. Capaldi
Behavioral Biology, Walter Reed Army Institute of Research, Silver Spring, MD

MOTIVATION: Mental agility and resilience to stress is essential in the military operational setting. The US Military is researching sleep as a measure of mental health and as a tool to improve resiliency and sustain fighting strength. Understanding the association between sleep and mental health is essential in this effort. **OVERVIEW:** In this lecture we will discuss the latest research on the association between sleep and psychiatric disorders and attempt to disentangle their relationship starting from pre-diagnosis through treatment. Even though disordered sleep is a well characterized comorbidity and an early symptom found in psychiatric disorders, the directional relationship of sleep and psychiatric illnesses is less clear. How much of an impact does disordered sleep have on the etiology, perpetuation, and remission of psychiatric illnesses? During this lecture, various forms of disordered sleep including insomnia, REM Behavior Disorder, and altered sleep architecture will be discussed in the context of psychiatric illness including depression, suicide, anxiety and PTSD. **SIGNIFICANCE:** While the existence of a relationship between sleep and mental health has been well known, the exact associations, both deleterious and therapeutic, are harder to grasp, partially due to information being spread across multiple scientific domains. This presentation will disentangle and synthesize this information for the audience.

Learning Objectives:

1. Understand the link between sleep, mental health, and resiliency.

[036] FACTORS INFLUENCING ASTRONAUT SLEEP DURATION DURING SPACEFLIGHT

V. Real[2], Z. Caddick[3] and E. Flynn-Evans[1]
[1]NASA Ames Research Center, Moffett Field, CA; [2]National Space Biomedical Research Institute Summer Apprenticeship Program, Houston, TX; [3]San Jose State University Foundation, Moffett Field, CA

INTRODUCTION: In the spaceflight environment, astronauts are exposed to many factors that put them at risk for health and performance decrements. Sleep loss caused by circadian desynchrony, medication use, work overload, and various other environmental factors can compromise mission success and astronaut safety by negatively affecting astronauts' performance in space. Despite many studies being conducted on sleep in

space, there is little consensus on the factors that influence sleep duration. Prior research has been limited by small sample sizes and varying methodology used to study sleep outcomes. To better understand the effect of microgravity and spaceflight on sleep outcomes, we conducted a literature review summarizing data collected during spaceflight using electroencephalogram (EEG), actigraphy, and sleep logs. **METHODS:** We compiled sleep data from every spaceflight mission beginning with Gemini. We categorized the data by mission, type of data collection (research study or medical report), and method of data collection (ex: EEG, actigraphy, and sleep logs). In addition, we collected information on factors influencing sleep duration, such as mission schedule, circadian phase, environmental sleep disruption, sleep location and medication use in order to help identify which factors of spaceflight might affect sleep duration. **RESULTS:** We found consensus across missions supporting the notion that crewmembers obtain between 6-7 hours of sleep per night in space, which is less than they achieve on Earth. Shifting schedules, high workload, noise, and light pollution were documented as concerns in many missions. The use of sleep medication was documented in many missions, but does not appear to lengthen the duration of sleep in space. **DISCUSSION:** Throughout the history of spaceflight, astronauts have consistently achieved less sleep in space compared to on Earth. Our preliminary review suggests that there may be modifiable factors that contribute to the reduced sleep duration. The use of sleep medication does not appear to result in longer sleep duration. Further studies are required to determine how the reduced sleep duration affects astronaut performance.

Learning Objectives:

1. The participant will be able to understand what factors are associated with deteriated sleep quality and quantity among astronauts on Earth and during spaceflight.

[037] PREVALENCE OF EXCESSIVE DAYTIME SLEEPINESS, PVT PERFORMANCE AND SLEEP HABITS OF ACTIVE DUTY NAVAL PERSONNEL DURING SHIPBOARD OPERATIONS

N.L. Shattuck
Naval Postgraduate School, Monterey, CA

INTRODUCTION: Members of the US military have long duty hours in dangerous environments, often using work/rest schedules that run counter to a 24-hr circadian day. Almost all members of the US Navy are rotating shift workers with insufficient opportunities to sleep; in addition, the sleep that they receive is often in poor berthing conditions. All these factors contribute to elevated levels of fatigue, chronic sleep debt, lower morale and degraded performance. Researchers at the Naval Postgraduate School have examined the work and rest patterns of US Navy Sailors in an attempt to address the unique challenges posed by this operational environment. **METHODS:** Active duty service members (N=432) from three USN ships participated in assessments of approximately two weeks in length. Crewmembers completed a survey which included demographic questions, the Epworth Sleepiness Scale (ESS), and the Pittsburg Sleep Quality Index (PSQI). Sleep was assessed with wrist-worn actigraphy and activity logs. Performance was assessed with the Psychomotor Vigilance Task (PVT) administered before and after standing watch. All studies were approved by the Naval Postgraduate School Institutional Review Board. **RESULTS:** On a daily basis, crewmembers worked 11.7±3.4 hrs and slept 6.62±1.03 hours split into 1.6 episodes. Approximately 63% of the participants slept less than 7 hours, the physiological threshold to maintain health. ESS scores (10.2±4.43) indicated that 44% of the participants had excessive daytime sleepiness (ESS scores >10), with ~11% of the participants having ESS scores of 16 or more. The average PSQI Global score (8.71±3.15) showed that 85.2% of the participants were "poor sleepers" (PSQI score>5). Crewmembers had an average reaction time on the PVT of 355±158 ms, with a 12% error rate (lapses (defined as >500 msec) combined with false starts (defined as less than 100 msec). **DISCUSSION:** Crewmembers on US Navy ships have significant levels of fatigue and sleep deprivation due to their excessively long workdays and erratic sleep schedules. Crewmembers frequently take naps to attempt to recover from this sleep debt. They commonly report excessive daytime sleepiness and over 85% of them are classified by the PSQI as poor sleepers. These crewmembers also demonstrate slowed reaction times with higher rates of errors. This constellation of symptoms is an indication of the accumulation of both acute and chronic sleep debt that continues to plague members of our military.

Learning Objectives:

1. To inform the audience of the prevalence of sleep and performance issues in active duty Naval personnel.

[038] PREVALENCE OF MEDICAL ENCOUNTERS FOR INSOMNIA AND OBSTRUCTIVE SLEEP APNEA IN ACTIVE DUTY U.S. MILITARY PERSONNEL

J.A. Caldwell[1,2], J. Knapik[1,2] and H.R. Lieberman[1]
[1]US Army Research Institute of Environmental Medicine, Natick, MA; [2]Oak Ridge Institute for Science and Education, Oak Ridge, TN

INTRODUCTION: Sleep disorders are a threat to performance, health, and wellbeing. Approximately 10% of US civilians suffer from insomnia and obstructive sleep apnea (OSA), two of the most common sleep disorders. However, there is evidence that both are more prevalent among active-duty service members. In addition, upward trends in insomnia and OSA have been observed. This investigation updated the available data and examined factors associated with insomnia and OSA in active-duty U.S. military personnel. **METHODS:** Analysis of data on the entire military population serving between 2005 and 2014 was conducted with the Defense Medical Epidemiological Database (DMED). Prevalence of medical encounters for insomnia and OSA were obtained and stratified by sex, age, race, marital status, and military service. Population data were graphed and characterized with linear regression. **RESULTS:** Encounters for insomnia increased from 16/1000 in 2005 to 75/1000 in 2014, a 372% increase. Encounters for OSA increased from 44/1000 in 2005 to 273/1000 in 2014, a 517% increase. Service members experiencing the greatest increases in insomnia included women, individuals ≥ 40 years of age, blacks, senior enlisted personnel, and Army service members. Demographic groups experiencing the greatest rates of OSA were men, individuals ≥ 40 years of age, blacks, senior officers, and Army personnel. Rates of increase for every sub-population, except individuals <20 years old, increased linearly over time (R^2=.95-.99; p<0.01). **DISCUSSION:** Trends in medical encounters for insomnia and OSA exceeded those expected from reports from the US civilian population. An explanation for these increases is not apparent, but the escalating operational tempo of the DoD over the past several years may be a factor. Sleep-related problems should be aggressively addressed since disrupted sleep adversely affects today's operational performance as well as tomorrow's mental and physical health. **SUPPORT:** Supported by USAMRMC. The opinions or assertions contained herein are the private views of the author(s) and are not to be construed as official or reflecting the views of the Army or the Department of Defense.

Learning Objectives:

1. Understand the extent of insomnia and sleep apnea within the active-duty US military population.

Monday, May 01 ***10:30 AM***
Plaza F

S-008: PANEL: SPACEFLIGHT DECOMPRESSION SICKNESS - LEVERAGING THE PAST TO PLAN FOR THE FUTURE

Sponsored by Space Medicine Association

Co-Chair: Joseph Dervay
Houston, TX

Co-Chair: Jason Norcross
League City, TX

PANEL OVERVIEW: This panel presents an overview of lessons learned from the safe operation of hundreds of US extravehicular activities (EVAs) and thousands of EVA training events. Following this overview from both the NASA EVA Physiology Laboratory and Medical Operations Group, the discussion will shift to transitioning these lessons learned towards future

space exploration. These topics include intravehicular space suits preventing serious Decompression Sickness (DCS) due to a cabin depressurization; DCS treatment and possible International Space Station (ISS) EVA operational capabilities with an 8.2 psia compatible space suit, and finally an overview of how the reduced pressure, oxygen enriched exploration atmosphere of 8.2 psia and 34% oxygen will enable new EVA capabilities.

[039] NASA PREBREATHE PROCEDURES HISTORICAL OVERVIEW

J.R. Norcross[2], J. Conkin[1], A.F. Abercromby[3], J.H. Wessel[2], O. Bekdash[2] and M.L. Gernhardt[3]
[1]KBRwyle, Houston, TX; [2]EVA Physiology Laboratory, KBRwyle, League City, TX; [3]EVA Physiology Laboratory, NASA Johnson Space Center, Houston, TX

The operating pressure of the spacesuits used by NASA astronauts during extravehicular activities (EVAs) has historically been 25.5 to 29.6 kPa (3.7 to 4.3 psi) because lower suit pressures reduce the work that astronauts must perform to move the joints of the spacesuits. While lower pressures introduce the risk of decompression sickness (DCS) this risk has been managed through a variety of denitrogenation countermeasures with only 1 post-retirement anecdotal report of DCS during an Apollo flight and no reported cases of DCS in 450+ person EVAs. Different countermeasures used by NASA represent trade-offs between DCS risk, flammability risk, consumables usage, crew time, and crew exertion as well as constraints associated with different vehicle designs and mission objectives. Early exploration mission spacecraft operated at 34.5 kPa (5 psia) with Gemini and Apollo at 100% oxygen (O_2) and Skylab at 70% for the duration of the mission with the DCS countermeasure being ≥3 hours resting in-suit O_2 prebreathe prior to launch. Partially because of flammability risks as well as mission science objectives, the space shuttle and International Space Station (ISS) normally operate at an earth equivalent atmosphere, requiring significant denitrogenation prior to performing EVAs. Initially, space shuttle crews performed a 4 hour in-suit prebreathe prior to EVAs; this inefficient use of crew time led to the costly certification of the space shuttle to operate at 70.3 kPa (10.2 psia), 26.5% O_2, enabling a staged decompression concluding with a 40-70 min in-suit prebreathe. This staged prebreathe was effective until the space shuttle began docking with the crewed ISS, which required that both operate at 101.4 kPa (14.7 psia), 20.9% O_2. Following installation of the ISS Quest airlock in 2001, the Exercise Prebreathe protocol reduced prebreathe time at the expense of requiring vigorous exercise to accelerate denitrogenation. Later, the Campout protocol allowed astronauts to sleep overnight at 70.3 kPa (10.2 psia), 26.5% O_2 in the airlock prior to EVA, enabling a 50 min in-suit prebreathe on the day of the EVA. While Campout remains an option, the In-Suit Light Exercise protocol has been used exclusively since 2010, introducing in-suit light exercise and additional prebreathe time while eliminating overnight sleep in the airlock. Future missions are expected to use reduced-ppN_2 atmospheres and/or higher suit pressures to further reduce prebreathe durations.

Learning Objectives:

1. To understand how mitigation of decompression sickness functions as a major driver for spacecraft atmosphere and EVA preoperations.

[040] DECOMPRESSION SICKNESS TREATMENT PROTOCOL ON THE INTERNATIONAL SPACE STATION

R.W. Sanders[1,2]
[1]KBRwyle, Houston, TX; [2]Preventive Medicine and Community Health, University of Texas Medical Branch, Houston, TX

INTRODUCTION: Aviators or astronauts exposed to decreased ambient pressure without prior denitrogenation may develop debilitating, even fatal syndrome of bubble formation and propagation known as Decompression Sickness (DCS). Rapid treatment with pressure and oxygen (O_2) is key, but the gold-standard treatment vessels are heavy, expensive and staff/resource intensive. With the current robust prebreathe protocols and low anticipated DCS incidence, the cost and resources to place a traditional "chamber" onboard the International Space Station (ISS) were felt to outweigh the benefits, and thus another approach was taken, and that is to utilize the Extravehicular Mobility Unit (EMU, spacesuit) as the treatment vessel with staged over-pressurizations in the protocol. The habitation pressure onboard the ISS is "atmospheric" at 14.7 psia (760 mmHg) with 21% O_2 and 78% N_2. Astronauts are acclimatized or "saturated" at this pressure, thus all tissues are equilibrated. To conduct an Extravehicular Space Activity (EVA, spacewalk) and go "out the door" into the vacuum of space, the crewmember first performs one of three available prebreathe protocols and then will be exposed to a significant decrease in pressure, down to 4.3 psia. **CURRENT TREATMENT APPROACH:** Should a crewmember identify signs or symptoms of DCS, the spacewalk would be terminated and the crewmember repressurized inside the suit (100% O_2) to 19 psia (atmospheric pressure of 14.7 psi + nominal suit pressure of 4.3 psid) representing a pressure increase of 4.42 times (or a terrestrial equivalent of 112 fsw for a "dive" case of DCS. If the patient remains symptomatic after a preset time, then the pressure is increased incrementally using a pressure–relief override device known as the Bends Treatment Apparatus. Once installed the pressure will be increase to 6psi above ambient (20.7 psia, a pressure ratio of 4.81 times, 125 fsw equivalent) and then if only partial or incomplete response, the pressure may be increased to a maximum of 8 psid (22.7 psia, a pressure ratio of 5.28 times, or 141 fsw) while breathing close to 100% O_2 for several hours.

Learning Objectives:

1. The application of pressure, oxygen, and time are effective to treat decompression sickness but how these are provided is constrained by the operational context.
2. To understand and appreciate that decompression sickness is a risk during spacewalks.

[041] ESTIMATING RISK OF SERIOUS DECOMPRESSION SICKNESS AFTER LOSS OF SPACECRAFT ATMOSPHERE

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NASA, Houston, TX

INTRODUCTION: Pressure suits are worn inside spacecraft to protect crewmembers in the event of contamination or depressurization of the spacecraft cabin. Protection against serious (Type II) decompression sickness (DCS) in the event of an unplanned rapid cabin depressurization depends on providing adequate suit pressure to crewmembers because there is no opportunity for oxygen prebreathe. **METHODS:** A model was developed using literature reports from 41 altitude chamber tests totaling 3,256 decompressions (1,445 including exercise at altitude) with 282 cases of serious DCS. All data involved prebreathe durations < 30 min followed by ≤ 120 min exposures at 13.8 to 34.5 kPa (2 to 5 psia) in young men. A time-dependent index of decompression stress was calculated for the historical decompressions using an existing Tissue Bubble Dynamics Model. This index, in combination with physical activity level at altitude (resting vs. active), provided significant prediction of serious DCS in the dataset when used in a logistic regression model, which was then used to estimate serious DCS risk for a range of hypothetical suit pressures and decompression scenarios. **RESULTS:** The probability of one or more cases of serious DCS in a four person crew was estimated as 0.73 assuming initial saturation at 1 atmosphere, no prebreathe, ascent to 24.1 kPa (3.5 psia) in 30 sec, and 120 min of activity at 24.1 kPa (3.5 psia). The estimated probability reduced to 0.36 and 0.16 for equivalent exposures at 31.0 and 40.0 kPa (4.5 and 5.8 psia), respectively. Extrapolation to exposures longer than 120 min suggest further increases in serious DCS risk. **DISCUSSION:** The need to operate critical spacecraft functions coupled with delayed access to hyperbaric treatment further increases the risk to crewmember safety if serious DCS symptoms are experienced following cabin depressurization. A suit pressure of 40.0 kPa (5.8 psia) provides significantly greater protection to crewmembers than lower pressure alternatives. Lower pressure suits may protect against ebullism and hypoxia but may not be effective at preventing serious DCS following a cabin depressurization.

Learning Objectives:

1. Recognize the implications and limitations of model-based predictions of serious DCS for spacecraft cabin depressurization scenarios.

[042] MODELING OXYGEN PREBREATHE PROTOCOLS FOR EXPLORATION EXTRAVEHICULAR ACTIVITIES USING VARIABLE PRESSURE SUITS

A.F. Abercromby[2], J. Conkin[1] and M.L. Gernhardt[2]
[1]KBRwyle, Houston, TX; [2]NASA, Houston, TX

INTRODUCTION: Exploration missions are expected to use variable pressure extravehicular activity (EVA) spacesuits as well as a spacecraft "exploration atmosphere" of 56.5 kPa (8.2 psia), 34% O_2, both of which

provide the possibility of reducing the oxygen prebreathe times necessary to reduce decompression sickness (DCS) risk. Previous modeling work predicted 8.4% DCS risk for an EVA beginning at the exploration atmosphere, followed by 15 minutes of in-suit O_2 prebreathe, and 6 hours of EVA at 29.6 kPa (4.3 psia). In this study we model notional prebreathe protocols for a variable pressure suit where the exploration atmosphere is unavailable. **METHODS:** A probabilistic model of DCS risk based on a biophysical model of decompression stress was used to evaluate EVA scenarios, beginning from saturation at 101.3 kPa (14.7 psia), 21% O_2, followed by 95% O_2 breathing at suit pressures ranging from 56.5 to 29.6 kPa (8.2 to 4.3 psia) for up to 6 hours. Previous validation of the model was based on significant prediction ($p<0.0001$) and goodness-of-fit with 84 cases of DCS in 668 human altitude exposures including a variety of pressure profiles. **RESULTS:** Model predictions suggest that 4 hours at 56.5 kPa (8.2 psi) followed by 2 hours at 29.6 kPa (4.3 psi) would require a 2 hour prebreathe to limit DCS risk to 8.5%. The same 2 hour prebreathe would alternatively allow for 3 hours at 56.5 kPa (8.2 psia), 2 hours at 41.4 kPa (6.0 psia), and 1 hour at 29.6 kPa (4.3 psia) with 8.4% predicted DCS risk. The predicted DCS risk for the latter scenario reduces to 7.9% (0.5% reduction) when two 15-minute recompressions to 56.5 kPa (8.2 psia) are added during the 2 hours at 41.4 kPa (6.0 psia). **DISCUSSION:** Prebreathe benefits of variable pressure suits are limited if crewmembers are initially saturated at 101.3 kPa (14.7 psia), 21% O_2 and may be outweighed by increased fatigue and injury risk associated with working in high pressure suits. Previous modeling work and empirical human and animal data indicate that intermittent recompressions (IR) can reduce decompression stress; however, minimal benefit of IR is predicted for these scenarios because significant gas phase growth has already occurred before IR is available.

Learning Objectives:

1. Identify the possible applications of variable pressure suits in reducing oxygen prebreathe durations for extravehicular activities.

[043] LESSONS LEARNED CONDUCTING SPACE WALKS FROM THE INTERNATIONAL SPACE STATION

J.P. Dervay[1], K.E. Brandt[2,3], A.T. Washington[2] and M.J. Higgins[2]
[1]Space and Occupational Medicine Branch, NASA Johnson Space Center, Houston, TX; [2]Space and Occupational Medicine Branch, KBRwyle, Houston, TX; [3]Preventive Medicine and Community Health, University of Texas Medical Branch, Houston, TX

INTRODUCTION: Extravehicular Activity (EVA) has been an exceptionally vital capability in the construction and maintenance of the International Space Station (ISS). **METHODS:** Mission records for US segment EVAs in the Extravehicular Mobility Unit (EMU) from the ISS Quest Airlock were reviewed from 2001 to October 2016, representing lessons learned from a total of 117 two-person EVAs (thus, 234 astronaut excursions) totaling 770 hours 51 minutes, averaging 6.5 hours in duration. **RESULTS:** Breakdown by prebreathe (PB) method included: 4-hour in-suit oxygen (O_2) PB (1 use, 2 crew); Exercise PB - Cycle Ergometer with Vibration Isolation and Stabilization System (CEVIS) (21 uses, 42 crew); Campout (overnight in Quest Airlock) (73 uses, 146 crew); In-Suit Light Exercise (22 uses, 44 crew). Flight Surgeons and Biomedical Engineers closely track all PB and EVA activities and utilize Flight Rules to address off-nominal situations with the Mission Control team and ISS crew. Breaks in PB protocol requiring prescribed O_2 payback time, while on an O_2 mask during suit-up or in the EMU itself, occurred 4 times due to one of the following: issue with communications cap (2), mask regulator failure (1), and false warning alarms during CAMPOUT (1), requiring transition to another PB method. Water intrusion into the EMU helmet during EVA has occurred twice, with one episode causing a serious health and safety risk to the crewmember. No cases of decompression sickness have been reported from EVA. **CONCLUSIONS:** Lessons learned from PB and EVA will be reviewed. Procedures, training, and Flight Rules developed after off-nominal and close call events will be highlighted in an effort to ensure crew safety and mission success. These aspects of EVA and PB will be instrumental in development of EVA activities for future exploration operations for asteroid, cis-lunar, lunar, and Martian missions.

Learning Objectives:

1. Best plans and training for complex operations should also include contingency situations.
2. Continual evaluation of complex operations is required in order to improve safety, procedures and other products required for execution.

Monday, May 01 ***10:30 AM***
Governor's Square 14

S-009: SLIDE: CAN I FLY WITH THIS?

Chair: Deborah White
Poulsbo, WA

Co-Chair: Gary Ford
Springfield, OH

[044] INCIDENTAL FINDINGS IN MRI EXAMS OF APPLICANTS FOR MILITARY FLIGHT DUTY AFTER IMPLEMENTATION OF A NEW SEQUENCE PROTOCOL FOR A 3T MRI SCANNER

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PROBLEM STATEMENT: At the German Air Force Center for Aerospace medicine all applicants for military flight duty undergo a complex MRI exam to rule out potentially relevant pathologies that could endanger aviation safety. Since May 2016 these are obtained via a new state-of-the-art 3T MRI scanner with optimized sequence protocol. Its high resolution and newly implemented sequences lead regularly to multiple findings that otherwise would have remained undetected. **TOPIC:** In May 2016 our 1T MRI was exchanged for a new 3T MRI. Based on the new technical possibilities the old exam protocol was adjusted, expanded and optimized according to up-to-date examination standards. Among others it includes a time-of-flight-angiography to visualize arteries and thus helps to detect aneurysms and arterial anomalies. On the susceptibility weighted sequence vascular malformations, micro-bleedings and the smallest cavernomas can easily be detected. Furthermore, abnormal restriction of diffusion on diffusion weighted sequences help to discover active processes. Also, already standardized sequences gain additional diagnostic value through the high-resolution technology and decreased slice thickness. Furthermore, a broadened field-of-view allows more general overviews – for example of the abdominal organs and relevant findings close to the spine. **APPLICATIONS:** In this case study we present the implementation of our optimized and in parts newly developed MRI sequence protocol and its meaning for aeromedical evaluation using a selection of pathological findings in healthy young men and women. Within the first few months of implementation, we were able to objectify several serious findings. Intracranially we found microaneurysms and vascular malformations with an increased risk of bleeding. Particularly an increase in findings of white matter lesion were observed. In other screening sections findings like skeletal tumors or vascular anomalies of abdominal organs were detected. With regards to safety, financial and medical aspects these incidental findings demonstrate the significance of a wide-ranging MRI exam and an especially constructed sequence selection for pathologies, that threaten aviation safety.

Learning Objectives:

1. The participant will be able to understand, that a wide ranging mri exam can help to detect aviation safety threatening findings.
2. There will be a closer look to the composition of mri sequences to detect most of the pathological findings.

[045] CASE OF TUBEROUS SCLEROSIS IN A C130 PILOT

C.R. Skinner
Neurology, Ottawa Hospital, Ottawa, ON, Canada

This is a case report of 32-year-old C130 search and rescue pilot with over 2,500 flying hours who underwent a biopsy for a fibroma on his finger. The biopsy was positive for a periungual fibroma suggestive of tuberous sclerosis. The member has never had any events of loss of consciousness or seizures. There was no family history. His neurological

examination was normal. His MRI of the brain showed a hematoma in the left caudate. His EEG showed intermittent dysthymia over the left temporal area which was not epileptiform. The case is presented for discussion of the aviation experience and risk analysis associated with this member's aircrew status.

Learning Objectives:

1. To discuss the neurological complications of tuberous sclerosis in the context of an experience aircrew member who is essentially asymptomatic.
2. To discuss the investigations and risk analysis process involved in the risk analysis of the case.
3. To discuss the process of obtaining input from civilian and military neurological expertise to aid in the decision-making process.

[046] ZIKA VIRUS STRIKES A PILOT UNDERGOING INFERTILITY THERAPY

J.W. Cromar, R.P. Collier and D.C. Homeyer
Internal Medicine/Infectious Disease, 81 MDOS/U.S. Air Force, BILOXI, MS

PROBLEM STATEMENT: This case report describes an active duty U.S. Coast Guard male pilot in otherwise excellent health who presented with his wife to the reproductive endocrinologist for intrauterine insemination (IUI) following an operational deployment to the Caribbean and South America, and who is now testing positive for the Zika virus. **BACKGROUND / LITERATURE REVIEW:** Emerging infectious disease literature regarding the Zika virus, including its threat potential to deployed flyers, a brief look at the Zika virus microbiology and what we know about Zika virus will be discussed. This case will also highlight and pay particular attention to recent reports of transmission from sexual contact and finally a brief overview of microcephaly and the pathophysiology behind it as related to the end point of an active Zika infection. **CASE PRESENTATION:** A 36-year-old active duty U.S. Coast Guard male pilot in otherwise excellent health presented with his wife to the reproductive endocrinologist for IUI therapy for a long history of idiopathic infertility following a recent return from a 3-month long Coast Guard helicopter counter-drug operational deployment to the Caribbean and South America. Routine screening of the patient revealed a three-day history of a recent onset of retro-orbital headaches, fatigue, and diffuse joint pains. Patient then reported he noticed a non-pruritic diffuse rash starting a couple days later, followed by subjective fever, chills and malaise lasting about 48 hours. After subsequently endorsing multiple "bug-bites" during port calls throughout the region, patient's wife vocalized her concern that her husband was suffering a Zika virus infection, and demanded that he be tested prior to proceeding with IUI. Spouse is not pregnant, but they have had unprotected sexual intercourse since patient's return from deployment. Zika virus testing was performed after consultation with infectious disease, and the patient's Zika serologic IgM testing was positive. **OPERATIONAL / CLINICAL RELEVANCE:** We present our approach to an active duty flyer diagnosed with an active Zika virus infection upon return from deployment, and discuss our current approach to Zika virus diagnosis, management and prevention. We also focus on the unique situation surrounding this patient and wife, facing decisions related to IUI therapy, with future deployments to the same region already scheduled, and the prudent counseling that such a situation dictates.

Learning Objectives:

1. Highlight the current approach to Zika virus diagnosis, management and prevention in flyers, with a particular emphasis on those patients that may be considering infertility therapy upon return from deployments to areas with endemic Zika virus.

[047] LYMPHEDEMA NOT AFFECTED BY FLIGHT ENVIRONMENT IN A MILITARY FLIGHT SURGEON: A CASE REPORT

S. Fondy
US Army, Fort Bragg, NC

PROBLEM STATEMENT: This case report discusses a military female flight surgeon with breast cancer related upper extremity lymphedema (LE) that did not worsen during a year of aviation operations. **BACKGROUND / LITERATURE REVIEW:** As female aviation personnel advance, both in experience and in age, female aviators are increasingly subject to health conditions common to middle aged and older women. Literature review on LE combined with a variety of aviation-related terms elicited a total of four articles dating back to 1996: a case study, a retrospective questionnaire study, a prospective study of women at risk for LE, and a study on the use of compression garments in flight. All of these pertained to commercial air travelers rather than career aviators and all pertained to fixed wing flight. The results were mixed as to whether aviation could be detrimental to LE. **CASE PRESENTATION:** The subject was a 48 year old female US Army Flight Surgeon who had been successfully treated for stage III, grade 3 invasive lobular carcinoma with segmental mastectomy, axillary node dissection, chemotherapy, and radiation. Following completion of the radiation, she developed grade 1 lymphedema of the right upper extremity. After developing LE and upon completion of all cancer treatment, she returned to rotary wing flight duties as an HH-60 medical officer. From September 2015 - October 2016, she logged over 50 hours of flight time with flights ranging from 1.1 - 7.0 hours at altitudes zero to 8000 feet above ground level (AGL), averaging 1500 feet AGL. She tracked her arm circumferences, noting no change before and after 16 out of 17 flights, the lone exception being one flight of 7.0 hours that resulted in a 1cm arm circumference increase at two levels. That increase resolved by the following morning. **OPERATIONAL / CLINICAL RELEVANCE:** This case is important because it is the first case discussing lymphedema in an aviator. Importantly, this flight surgeon flies semimonthly or less and currently exclusively on rotary wing platforms: a pilot flying frequently or at high altitude may have a different outcome. A formal prospective study, preferably using bioimpedence, is needed. This will increase confidence in allowing aviators with lymphedema to resume aviation duties.

Learning Objectives:

1. Identify risk factors for lymphedema.
2. Discuss impact of aviation duties on lymphedema.
3. Increase awareness of lymphedema.

[048] HEALTH PROMOTION- A PILOT HEALTH QUESTIONNAIRE AT AIR NEW ZEALAND

H.S. Hundal[2], B. Johnston[2] and R. Pombal[1]
[1]UCS Integrated Healthcare, Lisbon, Portugal; [2]Aviation Medicine, Air New Zealand, Auckland, New Zealand

INTRODUCTION: A health promotion study undertaken to understand Air New Zealand pilots' opinion and attitudes regarding prevention of disease and health problems during points of contact with the medical services especially during the regular aero-medical certification exam. This is a New Zealand arm of a multi-centric study which was also undertaken in Portugal. **METHODS:** A 5 week observational study with prospective data collection undertaken at the Aviation Medical Unit at Air New Zealand in Auckland from mid July 2016 to late August 2016. A paper form was printed for all the pilots. The questionnaire was filled by the individual pilots while awaiting their aeromedical certification exam. The data was then captured on the Survey Monkey by the receptionist. All data were anonymized. **RESULTS:** 79 pilots participated in the study. 91% (72) of the participants were males and 9% (7) were females. 98.73% (78) were class 1 and only 1.27% (1) were class 2. Most of the pilots felt it was an opportunistic time to discuss health promotions strategies during the aeromedical examination. However, some still felt it was something that needs to be discussed by their family physician. Fatigue remained a key issue and most pilots felt it was important and relevant. Cardiovascular Diseases remained a key issue of probability of negatively impacting their medical certificate. The 2nd probability was depression. Almost 65% of the participating pilots wore spectacles. 75% of the pilots were not on any long term medications and the same felt they did not have any long term or family diseases. 3.80% were over the age of 65; 20.25% were between the ages of 60-65. 68.34% are in the 30-60 age. The rest were less than 30 years of age. Of the participants, half of them were pilot trainers or flight instructors for the airline. Three quarters of the pilots fly to the tropical countries for work and leisure. **DISCUSSION:** Prevention is better than Cure. Health prevention is often a "hot topic" by any family physician but not for the Aviation Medical Examiner. As part of ICAO Annex 19, Health promotion is a central element of occupational health. Efforts must be made to enhance aviation industry employee's physical, mental and social well-being. Attitudes towards prevention and health promotion

can be context and culture- specific. Our results will be briefly compared with those of a recent study in a Portuguese airline aeromedical center.
Learning Objectives:
1. Health promotion is important during the Aero Medical Certification Examination.

[049] AVIATION-RELATED WORKERS' COMPENSATION CLAIMS, ALASKA 2014-2015

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National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Anchorage, AK

INTRODUCTION: Commercial aviation in Alaska is unique in that many of the operations take place in remote locations under extreme weather conditions. These locations frequently have limited employees and infrastructure, and require tasks such as cargo and baggage handling to be performed manually. The types and causes of injuries among occupations within Alaskan aviation is poorly understood. **METHODS:** Workers' compensation injury claims for 2014-2015 were obtained from the State of Alaska Department of Labor and Workforce Development. Aviation-related claims were identified using keyword searches of the narrative field, aviation-specific North American Industrial Classification System (NAICS) codes (e.g. NAICS code 481*, 611512), and NAICS codes of industries likely to occur in an aviation setting. Potential claims were then manually reviewed to determine if aviation related. Injury description codes using Workers Compensation Insurance Organizations' system for part of body, cause of injury, and nature of injury were provided in the claims data. Occupational groups were coded based on the free-text occupation description variable. **RESULTS:** There were 705 aviation-related injury claims during 2014-2015. Scheduled passenger air transportation [NAICS code 481111] accounted for 71.8% of all claims followed by scheduled freight air transportation [NAICS code 481112] (11.8%). The most injuries occurred among ramp agents and baggage/cargo handlers (34.3%). The lower back was the most commonly injured body part (15.2%) and was one of the top three most frequently injured body part among pilots, mechanics, flight attendants, and ramp agents and cargo/baggage handlers. Among all workers, lifting pushing, or pulling (25.5%) was most often cited as the cause of injury, followed by falling, slipping, or tripping (18.7%). **DISCUSSION:** This study identified ramp agents and baggage/cargo handlers as having the highest injury count among workers in aviation occupations, although many occupational groups shared similar injury profiles, possibly due to groups performing similar tasks. Manual coding of claims using the Standard Occupational Classification (SOC) System will allow for calculations of injury rates among occupational groups. In depth analyses of these rates, injury types, and circumstances surrounding injuries can inform the development and prioritization of future injury prevention interventions specific to each occupational group.
Learning Objectives:
1. Describe the types and causes of injuries among aviation-related occupations in Alaska.

Monday, May 01 ***10:30 AM***
Governor's Square 15

S-010: PANEL: AUGMENTING PERFORMANCE WITH TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS)

Co-Chair: Lindsey McIntire
Dayton, OH

Co-Chair: Andy McKinley
Dayton, OH

PANEL OVERVIEW: This panel will discuss the effects of a form of non-invasive brain stimulation, known as transcranial direct current stimulation (tDCS) on aspects of cognition relevant to the military. The tDCS technique applies a weak direct current through electrodes attached to the scalp. The current passes through the underlying tissues and into the brain modifying neural excitability. These changes in excitability have been shown to generate performance improvements in a variety of cognitive tasks, especially learning, attention, and memory. This panel will showcase new experimental findings that provide evidence tDCS can improve attention/arousal, reduce fatigue, and increase information processing throughput. Additionally, the underlying mechanisms of action causing the behavioral changes will be presented and discussed. These mechanisms will be translated back to biomarkers expressed in breath that are predictive of behavioral outcomes. These markers may eventually serve as a feedback loop to determine the optimal time to perform tDCS.

[050] EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON DRIVING PERFORMANCE DURING PASSIVE FATIGUE STRESS

A. McKinley[1], L.K. McIntire[2], J. Nelson[3], L. Cech[4] and C. Goodyear[2]
[1]Applied Neuroscience, Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Infoscitex, Inc., Dayton, OH; [3]Wright-Patterson AFB, Dayton, OH; [4]Takata Corp, Auburn Hills, MI

INTRODUCTION: Driving, especially over long distances, is monotonous and can become automated resulting in declines in attention and increased fatigue. As a result, a driver's decision-making ability degrades resulting in poor driving performance (Sigari et al., 2014). A technique known as transcranial direct current stimulation (tDCS) has been shown to have a robust effect on attention (Nelson, et al., 2012; Nelson et al., 2014) and fatigue (McIntire, et al., 2014; McIntire, et al., 2015). This study examined the effects of tDCS on driving performance under passive fatigue conditions. **METHODS:** Twelve active duty Air Force members participated in the experiment. Each participant received training on the driving task. Once trained, participants received either tDCS at 2mA over the left dorsolateral prefrontal cortex (lDLPFC), sham tDCS over the same region, or null tDCS on different days in a randomized, counterbalanced order. Each data collection session was separated by 1 week. Participants were placed into an immersive driving simulator and instructed to follow a lead vehicle for 45 minutes. They were to maintain a distance of 100m from the lead car and maintain the center of their lane at all times. In addition, they completed a 1-back working memory task by looking for repeating signs on the roadside. **RESULTS:** A one-way ANOVA revealed there was a significant effect of tDCS condition on distance keeping performance from the lead car ($p=0.0247$). Post-hoc t-tests showed that root mean square error (RMSE) was significantly lower when participants received anodal tDCS at 2mA when compared to either sham tDCS or null tDCS. The data also suggest there was significantly less deviation in the lane during the anodal tDCS condition, particularly during the straight segments of the drive ($p=0.0398$). There were no significant effects of tDCS working memory performance. **DISCUSSION:** The results provide evidence that tDCS enhances driving performance during, long, monotonous drives, which is consistent with previous findings (Beeli, et al, 2008). Other studies have shown this tDCS paradigm produces a stimulant-like effect that improves mood, attention, and increases wakefulness that are likely responsible for the observed improvements in driving performance. It is believed that tDCS modulates activity of the locus coeruleus (LC) which in a primary norepinephrine nucleus and influences all three of the previously mentioned attributes.
Learning Objectives:
1. Understand the effects of transcranial direct current stimulation on driving performance.
2. The possible role of the locus coeruleus (LC) modulation in the behavioral outcomes related to arousal and attention.
3. The effects of transcranial direct current stimulation on physiology.

[051] PREDICTION OF SLEEP DEPRIVATION INDUCED FATIGUE FROM EXHALED BREATH VOLATILE ORGANIC COMPOUND ANALYSIS

S.W. Harshman[1], B. Geier[1], J. Martin[1], A. McKinley[2], L.K. McIntire[3] and C.C. Grigsby[1]
[1]Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Applied Neuroscience, Air Force Research Laboratory, Wright-Patterson AFB, OH; [3]Infoscitex, Inc., Dayton, OH

INTRODUCTION: Fatigue, both physical and mental, is a recurrent problem costing businesses an estimated $150 billion annually in loss of productivity. Caused by many factors such as sleep deprivation, persistent mental activity and prolonged physical exertion, fatigue can have negative effects on a large range of individuals across many walks of life, including the military. Therefore, the ability to detect and mitigate the risks associated with individuals who are fatigued is of grave importance. We propose that exhaled breath maybe an appropriate non-invasive medium for predicting sleep deprivation induced fatigue through volatile organic compound (VOC) biomarkers, and may provide an objective criteria to administer interventions such as tDCS. **METHODS:** Human volunteer subjects were exposed to a 24 hour period of wakefulness wherein various psychological outcomes were monitored. Each volunteer subject was randomly assigned to a cognitive intervention, either caffeine or tDCS, or control treatment arm, as part of an overall research program to investigate benefits of tDCS treatment. Subjects were required to perform various interactive tasks as well as complete subjective questionnaires every 2 hours. Exhaled breath was collected via bag samples at 4 independent time points throughout the course of the experiment on to Tenax TA thermal desorption tubes. All thermal desorption tubes were analyzed by TD-GC-MS using 70eV electron impact ionization. Data was analyzed for variability in VOC metabolite abundances and statistical correlations were assessed with regard to various behavioral outcomes. **RESULTS:** The TD-GC-MS analysis of the bag samples, taken immediately prior to, during, and following sustained wakefulness, identified networks of staggered VOC variation that may be used to predict future operator vigilance, mood and or side effects, respectively. Amongst several hundred candidate markers (VOC's), elastic net regression was able to successfully identify statistical correlations with good predictive value for 123/962 (12.79%) distinct end points taken from behavioral assays. **DISCUSSION:** This study establishes an experimental means for monitoring changes in volatile organic compounds in response to sustained wakefulness, a computational workflow for compound analysis and identifies potential VOC biomarkers of sleep deprivation, vigilance or variation in mood state as a result of sustained wakefulness.

Learning Objectives:

1. Grasp how exhaled breath can be used for non-invasive biomarker discovery and outcome prediction.

[052] EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON INFORMATION THROUGHPUT PERFORMANCE DURING A MULTITASKING ENVIRONMENT

J. Nelson[3], A. McKinley[1], L.K. McIntire[2] and C. Goodyear[2]
[1]Applied Neuroscience, Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Infoscitex, Inc., Dayton, OH; [3]Wright-Patterson AFB, Dayton, OH

INTRODUCTION: Multitasking has become an integral attribute within many military occupations. However, as the time on task increases, the incoming information can exceed the operator's cognitive ability resulting in an information throughput capacity. At this point, the human operator is no longer able to accurately interpret and respond to the incoming information and their performance begins to plateau or decline. This study examined the efficacy of transcranial direct current stimulation (tDCS) applied to the left dorsolateral prefrontal cortex (ldLPFC) to improve multitasking processing capabilities. **METHODS:** Sixteen active duty military members participated in the study. The participants were randomly assigned to two groups, each group consisted of six males and two females. Each participant completed a training session which consisted of nine segments of the multi-attribute task battery (MATB) each lasting a duration of four minutes. The segments increased in baud rate (difficulty). The next day was considered their testing session where each participant either received anodal or sham tDCS while performing the MATB program. **RESULTS:** The findings indicate that anodal tDCS significantly improve the human operator's overall information throughput performance at each of the nine baud input rates. When averaging across all nine baud input rates, the anodal tDCS group had a mean information throughput capacity that was 12.9% greater compared to the sham tDCS group ($p = 0.0006$). The data also suggests that anodal tDCS displayed the greatest enhancement during system monitoring and resource management compared to the targeting and communication components. Eye scanning patterns showed that the anodal tDCS group allocated significantly less amount of time in the system monitoring ($p = 0.0193$) and communication ($p = 0.0457$) components compared to the sham tDCS group. **DISCUSSION:** The results provide evidence that tDCS is an effective countermeasure to enhance information processing capabilities during a low, medium and high workload multitasking environment. Although very few studies have evaluated the effects of tDCS on multitasking, the select studies that have been performed displayed similar findings (Hsu et al., 2015; Filmer et al., 2013). Eye metrics also provide a deeper understanding of the processing capabilities of the human brain and how workload demands are allocated when the incoming information becomes overwhelming.

Learning Objectives:

1. The effects of transcranial direct current stimulation on multitasking performance and information throughput.
2. The effects of transcranail direct current stimulation on sustained attention/vigilance.
3. The effects of transcranial direct current stimulation on visual processing and visual search patterns.

[053] IN VIVO TRANSCRANIAL DIRECT CURRENT STIMULATION MODULATES SYNAPTIC PLASTICITY IN THE RAT HIPPOCAMPUS

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INTRODUCTION: Transcranial direct current stimulation (tDCS) is a noninvasive approach used in the clinical treatment of neuropsychiatric disorders. Recent evidence suggests that tDCS may also be used as a tool to augment cognitive performance in healthy individuals. However, much research is still needed to unravel the neurobiological mechanisms of its reported effects in clinical and laboratory settings. Rodent models are crucial to further our understanding of how tDCS modulates cellular and molecular pathways responsible for tDCS-induced benefits in cognitive processes. **METHODS:** One week following surgical placement of head electrode on the skull, freely moving male Sprague Dawley rats were subjected to either a single bout of 250mA anodal tDCS or sham stimulation for 30 minutes. In order to investigate the acute effects of tDCS administration, animals were euthanized immediately following tDCS. Brains were collected for assessments of neuronal excitability by ex vivo electrophysiology or dissected and immediately frozen for further biochemical processing by western blotting. Hippocampal and hypothalamic samples were used to determine tDCS-induced changes in the levels of total and phosphorylated glutamatergic AMPA receptor in cytosolic and synaptoneurosome cellular fractions. **RESULTS:** Our findings demonstrate that tDCS induced a robust enhancement of synaptic plasticity in rats quantified by the percent of LTP and the ratio of paired pulse facilitation measured by ex vivo electrophysiology. This enhancement was observed 90 minutes or 24 hours post stimulation, showing long lasting effects following a single bout of tDCS. Moreover, our recent data has shown that tDCS promotes phosphorylation and translocation of glutamatergic AMPA receptors into synaptoneurosomes in both hippocampal and hypothalamic brain regions. Importantly, these changes were observed following a single tDCS application, suggesting both the persistency of observed hippocampal excitability and prompt modulation of neuronal processes responsible for synaptic plasticity events. **DISCUSSION:** Our findings provide evidence that tDCS modulates cognition through changes in hippocampal mechanisms involved in learning/memory. Long lasting changes in synaptic plasticity were observed following a single bout of tDCS, in agreement with clinical benefits observed in humans. Taken together, our data contributes to advancing the mechanistic elucidation of how tDCS modulates cognitive performance.

Learning Objectives:

1. Understand the immediate effects trancranial direct current stimulation has on neural tissue.
2. Possible mechanisms of transcranial direct current stimulation that cause long lasting changes in cognitive behavior.
3. The methodology for examining neural mechanisms of transcranial direct current stimulation in a rodent model.

[054] THE EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS) ON MOOD IN HEALTHY HUMANS

L.K. McIntire[2], A. McKinley[1], J. Nelson[3] and C. Goodyear[2]
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INTRODUCTION: Originally developed to treat various psychiatric disorders such as major depressive disorder, schizophrenia, and post-traumatic stress disorder, transcranial direct current stimulation (tDCS) was thought to alter mood in all participants. However, new research has shown that mood does not change in healthy participants. Therefore, we hypothesize that across the studies in our lab that our healthy participants also show no changes in mood after stimulation with the exception of the introduction of a major stressor such as sleep deprivation. In that case, tDCS will have a profound effect on mood. **METHODS:** A meta-analysis of five non-sleep deprivation studies and two sleep deprivation studies conducted in our lab with pre and post stimulation mood ratings for healthy participants was performed. A total of 210 participants were included in the analysis. Participants received either 2mA of tDCS or sham stimulation. **RESULTS:** Our meta-analysis showed that single session of tDCS did not alter mood for healthy participants during their normal daily schedule ($p = 0.525$). However, when a single session of tDCS is administered during sleep deprivation mood becomes stabilized compared to control groups and it prevents the negative declines in mood that are commonly associated with sleep deprivation. Participants receiving tDCS report feeling more focused, content, and their average mood score is improved compared to their non-intervention counterparts. As expected, the pre to post mood change between non-fatigued and fatigued participants is significant ($p = 0.026$) for both sham and active stimulation. **DISCUSSION:** Based on current research and a meta-analysis within our own lab, tDCS does not alter the mood of healthy participants when they are engaged in a normal daily routine. tDCS has a profound effect on mood when a stressor is introduced such as sleep deprivation. While pre to post mood changes are significant in both sham and active conditions compared to non-sleep deprived participants; participants who are sleep deprived and receive tDCS have less of a pre to post mood change than participants who received sham stimulation. Therefore, not only can tDCS improve performance but it also can improve mood in the presence of an environmental stressor such as sleep deprivation.

Learning Objectives:
1. The effects of transcranial direct current stimulation on mood in healthy, normal participants.
2. The effects of transcranial direct current stimulation on mood in healthy, normal participants when under a major stressor.
3. The aspects of mood that are strongly influenced by transcranial direct current stimulation.

Monday, May 01 ***10:30 AM***
Governor's Square 12

S-011: PANEL: HAS FLIGHT SAFETY IMPROVED SINCE THE GERMANWINGS ACCIDENT?

Sponsored by AsMA Air Transport Medicine Committee

Co-Chair: Sally Evans
Gatwick, West Sussex, United Kingdom

Co-Chair: Martin Hudson
Crewe, Cheshire, United Kingdom

PANEL OVERVIEW: Following the tragic Germanwings accident in March 2015 and the publication of the BEA post-accident report the European Aviation Safety Agency (EASA) Task Force has made six recommendations in an attempt to prevent a similar accident in the future. These recommendations are:
1. Two persons should be on a flight deck at all times.
2. Pilot applicants should undergo psychological evaluation before commencing flying training or airline employment.
3. Drug and Alcohol testing arrangements.
4. Robust oversight of Aeromedical Examiners training.
5. Ensure an appropriate balance between patient confidentiality and the protection of public safety.
6. Pilot support and reporting systems should be mandatory in all airlines.

This panel will discuss these recommendations and review how far they have been implemented and what impact they will have on improving flight safety.

[055] THE IMPLICATIONS OF THE EASA TASK FORCE RECOMMENDATIONS IN EUROPE AND THEIR EFFECT ON FLIGHT SAFETY

M.F. Hudson[1,2]
[1]AsMA ATM Committee, Crewe, United Kingdom; [2]Company Medical Adviser, Thomas Cook Airlines, Manchester, United Kingdom

MOTIVATION: Flight safety is of paramount importance to all who work in the field of Aerospace Medicine. After any accident there must follow a learning process which should help to minimise the chances of a similar accident occurring in the future. This Panel is designed to assist this learning process by reviewing the recommendations which have been published and discussed following a major commercial aircraft accident with the loss of life of all onboard. **OVERVIEW:** The Germanwings accident occurred in March 2015 and this led to the establishment of a Task Force by the European Aviation Safety Agency. This Taskforce made six recommendations concerning:
1. Cockpit Doors and Security;
2. Psychological Evaluation of 'ab initio' commercial pilots;
3. Drug and Alcohol Testing;
4. Oversight of Aeromedical Examiners' Training;
5. Patient Confidentiality and Public Safety;
6. Introduction of Pilot Peer Support Programs in all airlines.

Since their publication some of these recommendations have been welcomed but others are controversial and debate has taken place among stakeholders concerning how practical some aspects of these recommendations are and how much impact they will make towards improving flight safety and preventing a similar accident occurring in the future. This Panel will review each of these recommendations and will firstly discuss their implication and impact on aviation safety and secondly outline what progress has been made towards their implementation. The review will also consider the BEA Accident report which was published in March 2016 as well as the AsMA Mental Health Group's recommendations published in May 2016. Those taking part in the Panel will present their opinions as they effect various stakeholders, including, the Regulators, the Airlines, the Aviation Medical Examiners and the Pilots. **SIGNIFICANCE:** Detailed analysis of any aviation accident is always followed by a series of recommendations. However some recommendations can represent a 'knee-jerk' reaction to an event and before they are implemented there is a need, after a period of discussion and analysis, to review carefully the recommendations. This Panel is part of that review process and is intended to present a balanced view from experts working in the field of Aerospace Medicine.

Learning Objectives:
1. To learn about the EASA Task Force recommendations and the factors leading up to their publication.
2. To understand the implications of these recommendations, their value and how they can be implemented.
3. To assess what impact these recommendations may have in improving flight safety.

[056] AIRLINE PILOT PEER SUPPORT PROGRAMS - STORIES OF SANITY, SAFETY & SUCCESS

Q. Snyder[1,2]
[1]Aviation Medicine Advisory Service, Centennial, CO; [2]Air Line Pilots Association International, Herndon, VA

MOTIVATION: Professional airline pilots are key safety sensitive personnel who work in an environment that is not conducive to building peer relationships with regular interactions due to the bidding and crew pairing processes. They are afflicted with the full spectrum of mental and physical health conditions affecting the general population,

including substance use disorders, psychiatric disease, routine life stressors, aircraft accidents, recurrent training challenges and physical illness. Because of concerns for continued medical certification required for employment, pilots are reluctant to seek help for many conditions and frequently deny the adverse safety and personal health effects from ignoring or hiding these problems. Peer support programs have demonstrated effectiveness in reducing barriers to seeking help. **OVERVIEW:** Pilot groups have a long history of developing successful peer support programs for a broad spectrum of medical and psychological problems facing pilots. The Air Line Pilots Ass'n has a formal Pilot Assistance Group with several committees dealing with specific problems. These committees include Aeromedical, Critical Incident Response, Professional Standards and HIMS (substance use disorders). Several of these committees use a referral and interventional approach to include pilots with identified assistance needs while others use a passive peer availability approach to assist pilots requesting help. Blended approaches are also effective. Delta Airlines' Pilot Assistance Network is a cooperative program between the union and the airline using a passive availability approach. American Airlines' Project Wingman is also a successful cooperative union-airline program with professional referral resources. Keys to success are pilot awareness of the safe haven peer support network, training of peers, trust between individual pilots, the union and the employer, funding, referral thresholds and defined protocols. Because of the confidential nature of peer support programs, data on participation and outcome is difficult to obtain. HIMS has functioned for 40+ years with FAA, airline, union and medical professional cooperation and does maintain a dataset of outcomes. **SIGNIFICANCE:** Pilot peer support programs have a long history of assisting pilots reluctant to seek care for a broad spectrum of psychological issues as part of a safety, wellness and career preservation program. Aviation authorities are encouraging expansion of these programs.

Learning Objectives:

1. Attendees will comprehend the full spectrum of mental health problems that pilot peer support programs have demonstrated success in reducing disease burden and improving safety.
2. Attendees will be able to understand options for establishing pilot peer support programs depending on resources, philosophy and agreements with pilots and their employers.

[057] WILL EASA'S DRUG AND ALCOHOL TESTING PROPOSALS IMPROVE FLIGHT SAFETY?

N. Ahmed
Flying Medicine, London, United Kingdom

The presentation will look into task force recommendations on drug and alcohol testing within the industry. The subsequent development and uptake within the European airlines and compare them to the global picture. It will explore whether the proposals have or are likely to improve flight safety going forward and to address whether the cost of such programs can be justified.

Learning Objectives:

1. Drug and alcohol testing improves flight safety.
2. Drug and alcohol testing should have a clear rationale as to which substances should be tested and why.
3. The costs and logistics of drug and alcohol testing/ education should be carefully considered before implementation.

[058] PILOT ASSISTANCE PROGRAMS, THE REAL SOLUTION

C. Salicrup[1,2]
[1]Flight Surgeon-Pilot, Human Performance and Medical Committee member, IFALPA, Montreal, QC, Canada; [2]Boeing 787 Senior First Officer, Aeromexico, Mexico City, Mexico

When we speak about pilot mental health and safety, and try to arrange preventive measures we should point out that political or sensationalist media pressure may lead us to procedures that may not fully work, our aim is aviation safety and if we want to provide it we should address that the most positive measure is to build a place where pilots may raise their hands when they feel something is happening, without compromising their career. Involvement of the pilot association, the aviation authority and airline management is mandatory to comply with this objective. For many historical reasons, pilots will only trust pilots, so the involvement of their group is important. The figure of a flight surgeon that is part of the pilot group and flies along with them comes to our mind, in most of the countries the aviation medical examiners are not required to be involved in aviation operations, nor to fly in an airline cockpit or to have at least a private pilot training. The pilots associations are committed to have an 'inclusive' pilot assistance policy, dedicated to the promotion of the airline pilots' health, well-being, and professional performance. It has been demonstrated that Pilot Assistance Programs are effective for dealing with a wide range of problems experienced by pilots. Pilot Associations are strongly encouraged to establish these programs to assist their own members. Support from the regulator and operators are crucial to the success of these programs. An example of successful regulatory support for these programs includes the FAA, which has supported these programs for over 40 years with many success stories. Pilot Assistance Programs provide peer support to fellow pilots, offering referral to professional resources when appropriate, maintaining strict confidentiality and keeping no records. Pilot Assistance Programs help support pilots to address: Aviation-related medical issues, Emotional responses to accidents and incidents, Drug/alcohol intervention and rehabilitation for job reintegration, and other problems and stresses in their personal lives impacting professional performance. Addressing these issues supports the overall long-term well-being of the pilot, allowing continued functioning as an effective pilot and crew member while enhancing safety.

Learning Objectives:

1. To learn about the importance of Pilot Assistance Programs.
2. To learn about the importance of getting AMEs involved in aviation operations.
3. To learn about the Pilot Assistance Programs areas of involvement.

[059] THE UK CIVIL AVIATION AUTHORITY EXPERIENCE POST GERMANWINGS

S. Evans
Medical, UK Civil Aviation Authority, Gatwick, United Kingdom

INTRODUCTION: The UK CAA has created a number of initiatives since the Germanwings accident of March 2015 to address safety concerns that were highlighted by this tragic event and to put in place actions recommended by the EASA Task Force. Some of the actions were specific to the UK but the majority have synergies with other states and have implications for aviation medicine practitioners worldwide so will be of interest to all AsMA attendees. **DISCUSSION:** The UK CAA had two representatives on the Task Force and contributed to the EASA recommendations. It also convened a specialist working group including psychiatrists and psychologists in conjunction with the UK government that made 11 recommendations. As well as contributing to EASA rulemaking activities the UK has worked with UK Air Operator Certificate holders, Approved Training Organizations, the UK General Medical Council, the British Psychological Society, airline medical advisors and several Royal Colleges to enact changes to procedures and facilitate actions to enhance flight safety. In recognition of the need to support and continuously improve aeromedical examiner capability an electronic learning platform is being developed so that refresher training can be provided regularly and accessed easily remotely. The important role of AMEs as a trusted advisor in between medical examinations has been strengthened. There has been increasing emphasis on the importance of the declaration of medical history including the necessity for full and frank disclosure of medical conditions. The CAA has been actively involved in the development of operator's pilot support programs so that pilots are encouraged to seek confidential advice early when symptoms develop so that management of decrease in fitness can be optimized; efforts have also been made to heighten awareness of potential penalties for non-declaration. Ways to highlight the importance of doctors reporting potential flight safety concerns have been publicized. The CAA's web site has been amended to give clearer signposting for individuals to report potential concerns about

pilots to the authority. **CONCLUSION:** The UK has put a number of measures in place to enhance flight safety consequent to reviews undertaken after the Germanwings accident. The overall aim remains for there to be continuous improvement in all aspects of the aeromedical system.

Learning Objectives:

1. To understand what actions have been put undertaken by the UK Civil Aviation Authority since the Germanwings accident of March 2015 to enhance flight safety.

Monday, May 01 ***10:30 AM***

Governor's Square 11

S-012: PANEL: BRAIN MATTERS

Chair: Roger Hesselbrock

Wright-Patterson AFB, OH

PANEL OVERVIEW: Neurologic conditions continue to be an important area of concern in aerospace operations. Although mostly uncommon compared to other medical conditions, neurological disorders and their management present unique aeromedical challenges. Advances in the management of neurological conditions and accumulated clinical evidence have permitted safe recommendations for aviators to resume aerospace operational duties in many instances that previously would have resulted in continued disqualification. This panel will present and discuss several timely and challenging topics. Topics to be presented include a brief neurocognitive screening protocol tool, disc arthroplasties and return to flying, transport considerations in patients with neurologic conditions, stroke/transient ischemic attack and return to flying, and the role of long-term cardiac monitoring in the evaluation of aviators with stroke/transient ischemic attack. Dedicated time will be allotted for panel discussion and audience questions after the formal presentations. Audience participants will increase their knowledge about these neurologic topics, which will improve their clinical evaluation and aeromedical management skills.

[060] DISC ARTHROPLASTY AND RETURN TO FLYING

R.R. Hesselbrock

Aerospace Medicine Consultation Division, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

PROBLEM STATEMENT: Disc arthroplasties present unique aeromedical considerations for return to flying in aviators whose duties involve piloting high-performance aircraft and parachute jumping. **TOPIC:** Disc arthroplasty is an increasingly used treatment option for patients with spinal disc herniations or trauma. Several devices are approved by the Food and Drug Administration for use in all spinal segments. Disc arthroplasties have a good clinical outcome profile in the non-aviator population. They are generally acceptable for use in civil aviation with no additional specific aeromedical concerns. Until relatively recently, use of these devices was not approved for aeromedical waiver in military aviators. However, currently both the U.S. Air Force and U.S. Navy allow return to flying after disc arthroplasty in selected cases, with restriction from high-performance aircraft operations in cervical spine arthroplasties. Return to jump status has also been recommended for selected aviators with lumbar disc arthroplasties. Data from the U.S. Air Force and U.S. Navy on disc arthroplasties will be presented. Current aeromedical concerns and future trends will be presented and discussed. **APPLICATIONS:** Degenerative disc disease is ubiquitous and increases in incidence with age. Disc arthroplasty is one of several treatment options for patients with disc herniations or spinal trauma. Aeromedical concerns in addition to those of standard spinal surgical procedures include potential for hardware migration or failure. These concerns, particularly with cervical disc arthroplasties, have resulted in limited recommendations for use in military high-performance aircraft operations and for parachute jumping. Combined accumulated evidence in the military aviator population as well as civilian non-aviators may eventually safely permit expansion of recommendations to these cohorts.

Learning Objectives:

1. List the major aeromedical concerns of disc arthroplasties.
2. List factors that favor an unrestricted return to fly recommendation for military aviators with disc arthroplasties.

[061] RISK ASSESSMENT FOR RETURN TO FLIGHT AFTER TIA AND STROKE - INTERNATIONAL

C.R. Skinner[2] and J.D. Hastings[1]

[1]Aerospace Neurology LLC, Tulsa, OK; [2]Neurology, Ottawa Hospital, Ottawa, ON, Canada

The decision making process to return an aviator back to flying status following TIA and stroke is complex and requires a careful case by case approach of risk analysis of the neurological deficits, causation and occupational status of the individual. This session will review the current international standards for return to flight in various jurisdictions highlighting the similarities and differences. The session will propose a methodology of multi dimensional analysis including sequential analysis of the risk of recurrence of the event, the consequences of neurological damage, as well as the risk of recurrence during flight. These factors must also be considered in the context of the actual flying duties of the individual. The presentation will address specific issues such as return to flight after TIA with atrial fibrillation, PFO and disposition following lacunar stroke.

Learning Objectives:

1. Review current international policy with respect to decisions regarding return to flight status following TIA and stroke.
2. Present a framework for risk analysis using a multidimensional methodology.
3. Present risk assessments for specific issues such as atrial fibrillation, PFO, and lacunar stroke.

[062] RISK ASSESSMENT FOR RETURN TO FLIGHT AFTER TIA AND STROKE - UNITED STATES

J.D. Hastings

Aerospace Neurology LLC, Tulsa, OK

A highly individualized approach to determining eligibility for medical certification after TIA or stroke is essential. Risk factors, mitigation of risk and mechanisms of stroke must all be considered. Important aspects include long term monitoring for undetected atrial fibrillation in cryptogenic stroke and certification on anticoagulants with atrial fibrillation and an embolic event.

Learning Objectives:

1. Review of FAA policy and rationale for recertification after stroke.
2. Review recent literature affecting certification policy after TIA and stroke including long term monitoring for undetected atrial fibrillation and risk assessment for recurrent stroke with known atrial fibrillation and an embolic event.
3. Discuss risk assessment for large artery vs. small vessel lacunar stroke.

[063] TRANSPORT OF SEVERE NEUROLOGIC INJURIES

B. Atkinson

Aerospace Medicine, United States Air Force, Spokane, WA

TOPIC: In the civilian population each year in the United States there are approximately 800,000 strokes, 275,000 TBIs requiring hospitalization, and 12,000 new spinal cord injuries (SCI). During Operation Iraqi Freedom and Operation Enduring Freedom the percentage of wounds to the head and neck were 30% of injuries as compared to 16% for the Vietnam War and 21% for Korean War and World War II respectively. The majority of these head and neck wounds were from explosions (81%) versus gunshot wounds (8%). Emphasis for the treatment of these patients has changed over the last 30 years with the requirement for US civilian trauma patients to be transferred to the closest Level 1 Trauma Center as soon as possible. In the US military, during the Vietnam War era, patients were kept and treated in theater while the paradigm has now shifted to stabilization and transport via Critical Care Air Transport Teams to the highest level of care. This can be accomplished in as little as 18-24 hours from the point of injury. Types of transport include helicopter and fixed wing aircraft on both the civilian and military side. The level of stability and the experience of the transport teams determine when and how far a patient can be transported. There are a number of different aeromedical concerns that

should be addressed in the transport of these patients which include stability for a SCI patient, skull fracture, intracranial hypertension, cerebral edema, oxygenation issues and head placement during takeoff and landing. The aeromedical environment poses a very significant environmental threat that must be accounted. **APPLICATIONS:** This review will help inform the medical practitioner on the safest ways to transport these vulnerable patients based on current knowledge and best practice. This information can be utilized in civilian and military applications. **RESOURCES:** Owens BD, Kragh JF, Wenke JC, Macaitis J, Wade CE, Holcomb JB. Combat Wounds in operation Iraqi Freedom and Operation Enduring Freedom. The Journal of Trauma Injury, Infection and Critical Care. 64:295-9, 2008.

Learning Objectives:

1. Attendees well understand and learn the safest possible ways to transport patients with severe neurologic injuries.

Monday, May 01 ***10:30 AM***
Governor's Square 10

S-013: PANEL: AIRCRAFT AIR QUALITY MEASUREMENTS

Chair: Kathy Fullerton
Wright-Patterson AFB, OH

PANEL OVERVIEW: BODY: Aircraft air quality is an ongoing issue in the military and civilian arenas due to both short-term physiological events occurring during the course of flight and long-term health effects referred to as "aerotoxic syndrome." While a myriad of sensors exist to monitor the aircraft itself, few exist to monitor the environmental effects on pilots, crew, and passengers, creating a significant gap in understanding the cause of these health effects during post-incident response. This panel will provide a synopsis of this issue and current state-of-the-art and presents five ongoing research efforts to develop and employ a variety of sensors and physiologically relevant modeling platforms to provide assessments of potential exposures and the resultant effects on pilot physiology and cognition across a number of different types of airframes. The first presentation describes the development of a real-time air quality sensor for on-board oxygen generating systems in high-performance aircraft and describes results from initial test flights. Following that, a member of the Air Force Test Pilot School will discuss procedures, challenges, and solutions for transitioning science and technology products from the laboratory to in-flight testing using the real-time air quality sensor as a case study. The third presentation discusses the design of a plug-and-play sensor package for cargo aircraft air quality monitoring and provides lessons learned during flight testing and plans for future additions to the suite. The fourth presentation covers the deployment of the sensor package aboard an AC130J gunship and discusses initial results of air quality at various locations throughout the aircraft. Finally, *in silico*/computational modeling approaches being employed to better extrapolate in-flight exposures of pilots to compounds and thereby improve the decision process applied to mitigate aerotoxic syndrome will be discussed.

[064] MONITORING BREATHING AIR QUALITY OF HIGH-PERFORMANCE AIRCRAFT VIA A REAL-TIME AIR QUALITY SENSOR SUITE DURING FLIGHT

J. Martin[1], G.M. Slusher[1], B. Geier[1], K. Fullerton[1], D.K. Ott[1] and C.C. Grigsby[2]
[1]Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]711th Human Performance Wing, AFRL, Wright-Patterson AFB, OH

INTRODUCTION: Air quality data are not currently available on the quality of the breathing air supplied to the pilot. This work targets this capability gap by presenting a real-time air quality sensor (RTAQS) suite package for oxygen, carbon monoxide (CO), carbon dioxide, nitrogen oxide, and hydrocarbon volatiles, with environmental sensors for temperature, pressure, and humidity. A removable sampling media cartridge was included to provide a capability for more comprehensive contaminant testing using laboratory based gas chromatography-mass spectrometry for each sortie. The results reflect follow-on work from our initial laboratory-based testing of RTAQS to validate whether the sensor package will perform adequately under the extreme conditions encountered in the aerospace environment and to identify areas for improvement in future design iterations. **METHODS:** The RTAQS was installed within the map case, post-BRAG, on a high-performance training aircraft at Edwards AFB. Data for the RTAQS were logged for 32 sorties and analyzed by in-house chemists and statisticians following parsing, processing, and time-syncing with approved flight integrity data. The thermal desorption tubes collected during flight testing were analyzed using gas chromatography-mass spectrometry. Compounds were tentatively identified using publicly available software. **RESULTS:** Hundreds of compounds were tentatively identified from the testing, including elevated levels of compounds associated with fuels, paints, and plastics. Additionally, percent oxygen tended to trend *higher* than the expected on-board oxygen generating system altitude schedule, and several flights demonstrated transient, low-level spikes of CO. Machine learning techniques were utilized to predict the factors of aircraft flight profiles that are potentially driving CO events. **DISCUSSION:** Generally, the RTAQS package withstood the rigors of the aerospace environment throughout the duration of flight and provided crucial information on contaminants and future areas of improvement and investigation related to "Measuring Aircraft Air Quality." The long-term goal is to use RTAQS to rule out contamination as a cause following unexplained in-flight physiological events involving aircraft equipped with an on-board oxygen generating system or, if appropriate, to incorporate RTAQS into a system that will protect the operator from contaminant exposure through automated activation of the back-up oxygen system.

Learning Objectives:

1. Understand the types of compounds identified in pilot breathing air, and whether these compounds are correlated with specific flight events.

[065] COMPREHENSIVE EXPOSURE ASSESSMENT ABOARD THE AC130J GUNSHIP

C. Grabinski[1], J. Jackson[1], L.E. Flory[1], S.W. Harshman[2], B. Geier[2], J. Martin[2], D.K. Ott[1] and D. Yamamoto[1]
[1]Force Health Branch, 711 Human Performance Wing, Wright-Patterson AFB, OH; [2]Human Signatures Branch, Air Force Research Laboratory, Wright-Patterson AFB, OH

INTRODUCTION: AC-130 aircraft were designed for close air support missions. In this scenario, byproducts from weapons firing are released into the aircraft cabin, potentially exposing the aircrew to hazardous agents. We completed a comprehensive exposure assessment in the cabin and flight deck of the most recent model of the gunship, the AC-130J Ghost Rider, which has a 105-mm Howitzer and 30-mm GAU/23A Bushmaster II gun. The key chemical hazards of concern included carbon monoxide, volatiles, metals, and ultrafine aerosols, which were identified based on previous research in firing ranges and aboard earlier versions of the gunship. **METHODS:** Air sampling was conducted near the breathing zone of aerial gunners, weapons systems officers, and pilots and near the regulator intake for oxygen masks in the main cabin. Samples were collected at two different altitudes. Direct reading instruments were used for real-time analysis of ultrafine particle number and carbon monoxide concentration. Aerosols were collected onto filters for offline analysis by inductively coupled plasma mass spectrometry for metals. Volatiles were collected onto thermal desorption tubes for offline analysis by gas chromatography - mass spectrometry. Breath samples from aerial gunners and pilots were collected pre-flight and post-flight and analyzed for exposure markers. **RESULTS:** Carbon monoxide, ultrafine particles, volatiles, lead, and cadmium were found to be highest in the breathing zone of aerial gunners, but still at detectable levels for systems officers and pilots. Hazardous chemical exposure was a concern at both low altitudes where breathing air came from the ambient environment and high altitudes requiring the use of oxygen masks by the aircrew. Exposure markers were identified in breath samples from crew members post-flight. **DISCUSSION:** The results

from this research support the requirement of the Air Force Special Operations Command to ensure the safety of crew members aboard the AC-130J Ghost Rider. Also, determination of specific operational conditions associated with higher chemical exposure risk can be used feed requirements for administrative controls to mitigate exposure. Further, the results support the use of breath sampling as a noninvasive and practical method for analyzing exposures post-mission. This is especially valuable for identifying the cause of a mishap, such as accidental friendly fire, which may be attributed to hazardous exposures.

Learning Objectives:

1. Key chemical hazards of concern aboard the AC-130 gunship include carbon monoxide, volatiles, metals and ultrafine aerosols.
2. It is essential to understand the exposure of chemicals that can impair cognitive performance, such as carbon monoxide, to aircrew members who are required to complete critical tasks, such as the pilots and weapons systems officers.
3. Breath sampling is a noninvasive method for detecting exposure to hazardous airborne chemicals.

[066] DEVELOPMENT OF A SENSOR PACKAGE FOR ENVIRONMENTAL MONITORING OF CABIN AIR ON MILITARY CARGO AIRCRAFT DURING FLIGHT

C. Grabinski[3], J. Jackson[1], L.M. Thrasher-Stallard[3], A. Moore[5], L.E. Flory[6], A. Irvin[3], S.W. Harshman[3], B. Geier[4], J. Martin[2], C.C. Grigsby[2] and D.K. Ott[3]

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INTRODUCTION: Current cargo aircraft conduct world-wide missions, yet no data are available on the quality of the breathing air supplied to the pilot, flight crew, or passengers. Chemicals may enter the environmental control system (ECS), which provides air supply for aircraft cabins. The contamination can affect both the health and performance of crewmembers and passengers. A suite of sampling instruments was flown to characterize aerosols and volatiles delivered to the cabin during flight and to determine which instruments are capable of withstanding the rigors of flight. **METHODS:** Researchers from the 711th Human Performance Wing identified a special medical emergency evacuation device (SMEED) litter as a platform to safely secure the instruments and minimize vibrations. Real-time measurements of aerosols and volatiles were completed using direct reading instruments. Particles were collected onto filters for offline analysis by electron microscopy, and semi-volatiles and volatiles were collected onto glass fiber filters and thermal desorption tubes, respectively, for offline analysis by gas chromatography mass spectrometry. Vibration monitors were also employed to determine how much vibration relief was gained by using the SMEED. **RESULTS:** Real-time measurements indicated the emission of particles at very high concentrations, with peaks ranging from 350,000 to 450,000 particles/cm^3 during idle before take-off and after landing, but were reduced by two orders of magnitude to about 500 particles/cm^3 during flight. This indicates that particles were efficiently filtered in the ECS and that there was no emission source in the aircraft cabin. The concentration of volatiles spiked at various times during flight, indicating that emissions entered the ECS and were not filtered before entering the cabin air or there was a source for volatiles in the aircraft cabin. Vibration monitor data showed a decrease from 3.3 m/s^2 on the floor of the aircraft to 0.75 m/s^2 on the SMEED. **DISCUSSION:** This increased our ability to understand potential exposure risks to Air Force flight crew personnel and passengers, design exposure control strategies, and interpret data from threat detection instrumentation. The data gathered also assisted us to provide options for a deployable, interchangeable sensor package that supports crew and passenger health monitoring.

Learning Objectives:

1. Listener should have a better understanding of the challenges of measuring air quality onboard cargo aircraft during flight.

[067] IN SILICO/COMPUTATIONAL MODELING EFFORTS TO MITIGATE AEROTOXIC SYNDROME

H. Pangburn[2], D.K. Ott[2], Y. Chushak[1], T. Covington[1] and J.M. Gearhart[1]

[1]USAFSAM Aeromedical Research Department, The Henry M. Jackson Foundation for Military Medicine, Wright-Patterson AFB, OH; [2]Aeromedical Research Department, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: The 711th Human Performance Wing conducted a study to investigate the etiology of reported respiratory symptoms and alleviate one of the most common health-related complaints of high-performance aircraft flight. This study found a positive statistical association between respiratory effects and a short list of potentially toxic chemicals. To better extrapolate in-flight exposure of pilots to compounds and improve aerotoxic syndrome mitigation, physiologically based pharmacokinetic (PBPK) and quantitative structure activity relationship (QSAR) *in silico* modeling tools have been employed. **METHODS:** PBPK is a mathematical modeling technique for predicting the absorption, distribution, metabolism, and excretion of chemical substances in humans. QSARs are powerful analytical methods for estimating physicochemical and biological properties of a chemical from its molecular structure, thus facilitating predictions of chemical toxicity. PBPK and QSAR modeling were employed together to 1) distinguish study-identified chemicals that lead to biological responses and 2) provide prioritization of specific compounds for more extensive toxicological evaluation. In addition, a PBPK model accounting for operational conditions of flight was developed to most realistically simulate estimated concentrations of study-identified chemicals potentially inhaled by pilots. **RESULTS:** Using PBPK and QSAR models we were able to reconstruct potential in-flight exposures of pilots and compare these to permissible exposure limits, exposure levels, and symptomology from the literature associated with chemicals. Our models predict that some chemicals were likely below the short-term exposure limit exposure guidelines for standard temperature and pressure situations, while others likely exceeded their exposure limits. **DISCUSSION:** This approach produces informed knowledge judgment as to the probabilities that any particular chemical could have both the potential to have achieved high enough in-flight exposure concentrations and have a known level of toxic potency to be of consequence. The long-term goal of this effort is to produce aircraft cabin exposure guidelines that will assure limited probability of contaminated cabin spaces that might contribute to respiratory symptoms or could be considered a contributing factor in reported symptomology.

Learning Objectives:

1. The participant will understand how computational modeling tools are filling data gaps with physiologic relevant extrapolations of possible in-flight exposures providing valuable knowledge that can inform on how aerotoxic syndrome can be mitigated.

[068] PROCESS AND CONSIDERATIONS FOR TRANSITIONING PRODUCTS FROM THE LABORATORY TO FLIGHT TEST

D. Carroll[2], M. Preisendorfer[1] and D. Candelaria[1]

[1]416th Flight Test Squadron, 412th TENG/ENI, Edwards AFB, CA; [2]USAF Test Pilot School, 412th TENG/ENI, Edwards AFB, CA

INTRODUCTION: The U.S. Air Force has no high-performance aircraft dedicated to physiologic flight testing. Thus, an aircraft with an on-board oxygen generating system was modified to accept the 711th Human Performance Wing's real-time air quality sensor (RTAQS) test unit. Our flight test organization developed and executed a flight test plan. Data were successfully collected and delivered. This talk describes typical methodology for transitioning a product from research to flight testing using RTAQS as a case study. **METHODS:** The RTAQS was designed to be flight worthy but had not been flight certified, so the 412th Test Instrumentation Division examined the unit to ensure flight worthiness. Minor changes were required for local certification. The F-16 System Program Office assisted in the safety aspects of equipment design and installation. Various programming documents were required prior to flight tests. These documents specified agreed-upon requirements, deliverables, and cost. A T-2 modification process was initiated to install the RTAQS into a

416th test squadron F-16. A 416th program manager was assigned to create the test plan and control the test execution and schedule. The 416th Instrumentation Engineering produced and executed the day-to-day plan to log and control the data media and delivered it to the 711th. **RESULTS:** Various types of delays and other issues encountered during the testing will be discussed in detail. Solutions will be presented here and actual data will be presented in a separate presentation. Ultimately, sufficient data were collected and delivered to the 711th so worthwhile scientific conclusions could be made. **DISCUSSION:** Physiological flight testing in a high-performance military aircraft has numerous technical challenges. There are many processes involved in flight test to ensure that it is safe and that the results are scientifically valid. Various engineering and business disciplines are required as well as the test aircraft and test pilot. Ultimately, for RTAQS, a significant collaboration between the 412th Test Instrumentation Division Design and Operations, the 412th Maintenance Group, the F-16 System Program Office, the 416th Test Squadron, and the 711th Human Performance Wing and development laboratory resulted in successful RTAQS installation and subsequent data collection.
Learning Objectives:
1. Participants will understand that navigating through the three major processes, i.e. the PID/SOC process, the USAF T-2 Aircraft Modification Process and the Flight Test Management Process, leading to flight is achievable because experts in these processes are available at AFTC to help scientists get their research in the air.

Monday, May 01 ***2:00 PM***
Plaza A/B

S-014: PANEL: A PREMATURE OR TRAUMATIC ENTRY INTO THIS WORLD – SHOULD IT PRECLUDE ENTRY INTO AIR AND SPACE?

Co-Chair: Jonathan Ellis
Wright-Patterson AFB, OH

Co-Chair: Roger Hesselbrock
Wright-Patterson AFB, OH

Co-Chair: Dara Regn
Wright-Patterson AFB, OH

PANEL OVERVIEW: The rates of preterm birth has increased in all countries over the past 20 years with approximately 1 in 10 of the world's babies being delivered preterm. With the advent of medical advances such as the use of surfactant, overall survivability of preemies has also increased and many are now reaching adulthood. In addition, of every 1,000 infants born in the United States, 6 to 8 of them are born with a birth injury. This panel presents several cases illustrating the importance of asking about birth history during flight physical evaluations as premature birth and traumatic birth history require further evaluation and testing as this population is at risk for multi-organ system complications (pulmonary, ophthalmologic, neurologic and psychiatric) in adulthood that impose aeromedical risks. In the first presentation, we will discuss a patient that did not fully disclose being born premature that upon further investigation was found to have several of the co-morbidities associated with prematurity that will be discussed in the other panels. The major concern in this first case, and focus of the first presentation will be pulmonary complications in preemies reaching adulthood. The second presentation, will focus on a patient with traumatic birth resulting in neurologic abnormalities that the patient and his providers were not previously aware of prior to his flight physical. The third presentation, will focus on ophthalmologic findings in preemies. Finally, the fourth presentation will discuss common psychiatric co-morbidities seen in preemies.

[069] PULMONARY COMPLICATIONS OF PREMATURE BIRTH IN AN AVIATOR

D.D. Regn
ACS, USAF, Wright-Patterson AFB, OH

The rates of preterm birth have increased in all countries over the past 20 yr, with approximately 1 in 10 of the world's babies being delivered preterm. With the advent of medical advances such as the use of surfactant, overall survivability of preemies has also increased and many are now reaching adulthood. In addition, of every 1,000 infants born in the United States, 6 to 8 of them are born with a birth injury. This panel discussion presents several cases illustrating the importance of asking about birth history during flight physical evaluations; premature birth and traumatic birth history require further evaluation and testing, as this population is at risk for multi-organ system complications (pulmonary, ophthalmologic, neurologic, and psychiatric) in adulthood that impose aeromedical risks. In the first presentation, we will discuss a patient who did not fully disclose being born premature; upon further investigation the patient was found to have several of the comorbidities associated with prematurity that will be discussed within the panel. The major concern in this first case, and focus of the first presentation, will be pulmonary complications in preemies reaching adulthood.
Learning Objectives:
1. List the pulmonary complications of premature or traumatic birth in otherwise asymptomatic aviators.
2. Describe the pulmonary function testing abnormalities that can be seen in adults that were born premature.

[070] MENTAL HEALTH RISKS OF PRETERM BIRTH

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

PROBLEM STATEMENT: Preterm infants are more likely to survive than ever before. A generation of individuals born preterm is coming of age and are likely to interface with aerospace medicine. Psychiatric comorbidities in childhood, adolescence, and adulthood are known risks associated with prematurity. **TOPIC:** Long suspected, the literature has shown increasing data supporting risks of intellectual disorders, autism, and ADHD in persons born early. More recently, data has pointed towards risks of other psychiatric comorbidities that might not manifest until late adolescence or early adulthood. Risk for psychiatric comorbidities will be discussed along with current understanding of risk related to the degree of prematurity. **APPLICATIONS:** Awareness of prematurity and its associated risks of mental illness is important knowledge for flight surgeons as they encounter more and more adults who were born premature. These considerations are generalizable to military, commercial, and general aviation.
Learning Objectives:
1. Understand the current understanding of prematurity and risk of mental illness.
2. The participant will be able to describe at least one are of scientific debate (controversy) within the literature of prematurity and mental illness.

[071] AEROMEDICAL SIGNIFICANCE OF PRENATAL/BIRTH-RELATED NEUROLOGIC ISSUES

R.R. Hesselbrock
Aerospace Medicine Consultation Division, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

PROBLEM STATEMENT: Neurologic conditions resulting from prematurity, prenatal, or birth events often have significant aeromedical considerations, but may have minimal physical findings. Awareness of this possibility allows medical examiners to obtain more detailed historical information and additional physical examination steps. **TOPIC:** History questions regarding birth and early development are generally not asked routinely in otherwise healthy adults. Prenatal and birth insults often produce major clinical symptoms that would preclude consideration for aviation/space operations. However, otherwise asymptomatic individuals with a history of prematurity, prenatal, or birth difficulties can have a small possibility of having aeromedically significant neurologic findings on further investigation. To illustrate this, a case will be presented of an asymptomatic pilot applicant with somewhat unusual, prominent forehead, who was found incidentally to have a large frontal

arachnoid cyst on imaging obtained for head injury. The cyst was felt to be congenital based on radiographic findings. Aeromedical implications and assessment will be presented and discussed. **APPLICATIONS:** This topic is pertinent to all aviation medical examiners. Although of low yield, obtaining information on antenatal, birth, and development history does significantly add to evaluation time. Such information may prompt more careful, additional examination, which in turn could lead to previously unrecognized conditions that may be of aeromedical significance.

Learning Objectives:

1. List possible congenital or developmental neurologic conditions in otherwise asymptomatic aviators that could have aeromedical implications.
2. List strategies to assess otherwise asymptomatic aviators for possible developmental or congenital conditions that might have aeromedical concerns.

[072] AEROMEDICAL SIGNIFICANCE OF PRENATAL/ BIRTH-RELATED OPHTHALMOLOGIC ISSUES

J. Ellis
USAFSAM/FECO, Wright-Patterson AFB, OH

PROBLEM STATEMENT: Ophthalmologic conditions resulting from prematurity, prenatal or birth events often have significant aeromedical considerations, but may have minimal physical findings. Awareness of this possibility allows medical examiners to obtain more detailed historical information and additional physical examination steps. **TOPIC:** History questions regarding birth and early development are generally not asked routinely in otherwise healthy adults. Prenatal and birth insults often produce major clinical symptoms that would preclude consideration for aviation/space operations. However, otherwise asymptomatic individuals with a history of prematurity, prenatal or birth difficulties can have a small possibility of having aeromedically-significant ophthalmologic findings on further investigation. A literature review of the most common ophthalmologic conditions that arise from preterm birth and their potential aeromedical impact will be discussed. **APPLICATIONS:** This topic is pertinent to all aviation medical examiners. Although of low yield, obtaining information on antenatal, birth and development history does significantly add to evaluation time. Such information may prompt more careful, additional examination, as well as help explain the combination of examination findings seen, allowing for an appropriate aeromedical disposition.

Learning Objectives:

1. List possible ophthalmologic conditions resulting from preterm birth that could have aeromedical implications.
2. List strategies to assess aviators and aviator applicants for ophthalmologic conditions resulting from preterm birth that might have aeromedical concerns.

Monday, May 01 ***2:00 PM***
Plaza D/E

S-015: SLIDE: FATIGUE

Co-Chair: Michael Nehring
Koenigsbrueck, Germany

Co-Chair: William Porter
Fort Sam Houston, TX

[073] TEN THINGS I LEARNED WHILE DEVELOPING A FATIGUE RISK MANAGEMENT SYSTEM FOR THE ROYAL CANADIAN AIR FORCE

P.J. Morissette
Canadian Forces Health Services Group, Canadian Armed Forces, Dunrobin, ONCanada

MOTIVATION: Fatigue is a constant threat to the safety and well-being of personnel involved in safety sensitive operations worldwide. It has contributed to several high profile mishaps including the loss of the Space Shuttle Challenger in 1986. In response to this threat, commercial air carriers have increasingly been adopting Fatigue Risk Management Systems (FRMS) to manage the fatigue hazard. The same principles used in commercial air operations can now be applied to develop a FRMS that is suited to military aviation. **OVERVIEW:** The Royal Canadian Air Force (RCAF) FRMS is a multi-layered approach to preventing fatigue and managing risk which is command-driven and inclusive of air and ground personnel. It employs six layers of defence which include: (1) Education - through fatigue training and culture building tools; (2) Scheduling – through scheduling practices and fatigue prediction tools to optimize workload-personnel balance and sleep opportunities; (3) Sleep Quality – through sleep hygiene training, judicious use of sedatives, treatment of sleep disorders, and infrastructure optimized for sleep; (4) Workplace/Mission Design – through appropriately risk managed workplace infrastructure and mission design optimized for maintaining alertness; (5) Alertness Maintenance – through fatigue monitoring practices and the use of fatigue countermeasures; and (6) Reporting and Feedback – through ongoing data collection and analysis to drive continuous program improvement. Following successful pilots in three different military settings including tactical rotary-wing flying operations, aerospace control operations, and intelligence surveillance and reconnaissance flying operations, the RCAF endorsed the new FRMS concept on 30 March 2016. A phased implementation plan is expected to lead to full operational capability across the RCAF by the end of 2017. This presentation focuses on the lessons learned during the development of the FRMS that helped set the conditions for its successful implementation by the RCAF. **SIGNIFICANCE:** The adoption of a FRMS by air forces can have positive operational impacts including: (1) Empowering commanders to make informed decisions and better manage fatigue risk; (2) Optimizing the safe operational envelope; and (3) Ensuring the safety & well-being of military air and ground personnel. The FRMS has applicability in both civilian and military spheres, including in joint and combined military operations.

Learning Objectives:

1. The participant will be able to apply the general principles highlighted in this session to the successful development of a fatigue risk management system for their organization.

[074] THE COMBINATION OF STRATEGIC NAPPING AND MODAFINIL ON OBJECTIVE AND SUBJECTIVE ASSESSMENTS OF FATIGUE

V. Schroeder[1], D. Huber[1], B.M. Hartzler[2], N. Beasley[1], M.Y. Hayes[1], C.B. Levin[1] and J. Caldwell[1]
[1]Aeromedical Directorate, Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH; [2]CareSource, Dayton, OH

INTRODUCTION: Napping and the use of modafinil, a pharmacologic alertness aid, have both demonstrated benefits to performance following sleep loss. Less is understood of the combination of a strategically placed 2-hr nap with 200mg modafinil on the objective and subjective performance of individuals having experienced 37 hours of continuous wakefulness. **METHODS:** Objective and subjective measures were examined in 24 individuals randomly assigned to either the modafinil (200mg) or placebo group. Participants completed 7 2-hr blocks of testing. Treatment was administered 30 minutes prior to a 2-hour nap strategically placed after 20 hours of continuous wakefulness for all subjects; testing resumed for an additional 17 hours upon waking. **RESULTS:** A Time X Group interaction was demonstrated for a peripheral information processing task ($F = 4.420$, $p = 0.001$, $\eta p^2 = 0.167$). The modafinil group maintained consistent performance (i.e., RT) across sessions, while placebo group performance degraded significantly immediately following the nap, followed by improved performance through the remaining sessions back to baseline levels. A significant Time X Group interaction was further evident on a complex continuous memory task ($F = 2.897$, $p = 0.020$, $\eta p^2 = 0.116$). The modafinil group, but not the placebo group, temporarily improved performance 3 hours post-nap, receding back to baseline levels 9 hours post-nap. There was an additional Time X Group interaction for mood, with the placebo group reporting an immediate increase in sleepiness following the nap not reported by the modafinil group; the modafinil group reported experiencing a gradual increase in sleepiness across the

remaining sessions (Visual Analogue Scale, Sleepy: $F = 3.647$, $p = 0.005$, $\eta p^2 = 0.154$). **DISCUSSION:** The combined effects of napping and modafinil benefit some operational performance measures for a limited duration compared to napping without modafinil. The modafinil/nap combination protected against degraded peripheral information processing performance, and temporarily enhanced performance on a complex continuous memory task as compared to napping in isolation. Subjective measures of fatigue mirror these results accurately for both groups, with the exception of memory performance by the modafinil group, whose memory increased despite reports of greater sleepiness in later sessions.

Learning Objectives:

1. Understand the effects of modafinil and napping on objective measures of cognitive performance relevant to occupational tasks.

[075] REAL-TIME COGNITIVE MODEL-BASED FATIGUE MONITORING

G. Gunzelmann[1], C. Fisher[2], M.M. Walsh[3] and L. Blaha[4]
[1]Cognitive Models and Agents Branch, Air Force Research Laboratory, WPAFB, OH; [2]Oak Ridge Institute for Science and Education (ORISE), WPAFB, OH; [3]Tier1 Performance Solutions, Covington, KY; [4]Visual Analytics, Pacific Northwest National Laboratories, Richland, WA

MOTIVATION: Missions often require operators to perform for long durations on highly variable schedules. Risk of error or injury is an inevitable consequence of sleep loss and/or circadian desynchrony during such missions. Current approaches to fatigue risk management are limited because they do not provide individualized fatigue assessment and they tend to emphasize preventing fatigue rather than focusing directly on reducing the risk of errors. One way to do the latter is to assess the developing behavioral consequences of fatigue and other cognitive moderators to guide forward-looking assessments of risk in situ, creating a capability to make task-specific, individualized predictions that can guide mitigation strategies. **OVERVIEW:** Our research utilizes simulation-based models of human cognition to monitor human performance in real time for fatigue symptoms before critical errors occur. Cognitive models provide accounts of how different components of cognition (e.g., perception, action, declarative knowledge, procedural knowledge) interact to produce behavior. By including mechanisms reflecting the moderating impact of factors like fatigue, predictions can be made about the particular deficits and decrements that are likely in specific task contexts (e.g., Gunzelmann, Veksler, Walsh, & Gluck, 2015). This level of analysis creates an opportunity to unobtrusively monitor human behavior for signs of degraded functioning that are indicative of fatigue and other cognitive moderators (stress, task load, etc.). **SIGNIFICANCE:** Understanding the relationship between measurable behavior, performance changes, and an individual's underlying state allows for targeted interventions to mitigate risk and optimize mission performance. This is critical in many operational contexts where cognitive impairment from fatigue and other cognitive moderators is unavoidable. Cognitive moderators must be managed effectively to successfully achieve mission objectives. This presentation will demonstrate how performance measures can be used in real time to estimate fatigue levels based on a computational cognitive model of the task that can interpret streaming performance data to make these assessments. Real-time fatigue estimation facilitates the early detection of fatigue symptoms so that targeted intervention can occur prior to the occurrence of consequential degradations in performance that increase risk to individuals, teams and mission, and which may lead to mission failure.

Learning Objectives:

1. Introduction to simulation-based models of human cognition as a way of making predictions about changes in cognitive performance and behavior based on moderating factors like fatigue.
2. Illustration of how behavioral data can be used to make an assessment of fatigue state, which can be presented to a supervisor or commander to help inform decision making about allocation of responsibilities, etc.
3. Demonstrate a new methodology for mitigating risk and optimizing mission effectiveness.

[076] PILOT DROWSINESS DETECTION DURING COMMERCIAL FLIGHT OPERATIONS

M.A. Corbett[2] and D.G. Newman[1]
[1]Aviation, Griffith University, Point Cook, Australia; [2]Swinburne University of Technology, Walkerville, Australia

INTRODUCTION: Pilot drowsiness and cases of sleeping aviators have become global issues of growing concern. Such incidents may result in missed radio calls and procedural lapses, which may lead to unsafe flight conditions. As the road transport and mining industries have been dealing with the issue of drowsiness for many years, this research aimed to draw upon that experience to investigate drowsiness in the aviation domain. The primary purpose of the research reported here was to determine the usability and acceptability of a drowsiness detection system in the cockpit. A secondary purpose was to investigate aviator drowsiness in airborne operations. **METHODS:** This research utilised a head-mounted infrared reflectance oculography system, to assess aviator drowsiness in the cockpit. The task involved a volunteer professional pilot cohort (4M) engaged in 12 commercial night freight operations during the primary window of circadian low. Participants completed a Work/Sleep/Excessive Fatigue diary and equipment User Survey. The Johns Drowsiness Scale (JDS) was utilised for assessment and reporting of Optalert™ data, with increasing numbers indicating a higher state of drowsiness (values range 0.0 to 10.0). Data was collected each minute whilst in the cruise phase of flight, with bio-feedback of drowsiness state disabled, to ensure a blinded study. Ethics approval for studies using human subjects was gained from Swinburne University Human Research Ethics Committee (2013/289). **RESULTS:** 5044 airborne data points were collected over 12 flight duty periods. Optalert™ was reported to be usable and acceptable in the commercial flight operations environment. 9.23% of data was above the Cautionary Warning level (JDS=4.5) for road transport, with 3.48% above the Critical Warning level (JDS=5.0). **DISCUSSION:** Optalert™ represents a usable and acceptable device for the collection of fatigue-related material in the aviation domain, as determined by aircrew. This data and that of previous research using this equipment has found it to be employable as a tool for informing FRMS development, combined with a self-awareness tool for pilots. Of significant interest was the proportion of time spent with a drowsiness state considered alarming for the road transport industry. Further research is needed to determine appropriate/acceptable levels of drowsiness for various operations.

Learning Objectives:

1. Determine usability and acceptability of fatigue detection technologies.
2. Gain insight into the drowsiness of commercial aviators.
3. Recognise significance of drowsiness in the cockpit.

[077] FLYING LONG HAUL FLIGHT IN A FOUR-PILOTS CREW VS. A THREE-PILOTS CREW: CONSEQUENCES ON FATIGUE AND PERFORMANCE

M. Klerlein[1,2], A. Gisquet[1,2], C. Cardines[1,2], M. Bouton[1,2] and M. Cantegril[1,2]
[1]Occupational Medicine, Air France, Roissy Charles De Gaulle, France; [2]FRMS Medical Team, Air France, Roissy Charles De Gaulle, France

INTRODUCTION: Some airlines have work agreements which are more favorable than the state regulations. In a major airline, these internal rules have been challenged in the purpose of reducing the pilot crew for a 13h30 flight from 4 to 3 pilots. We report the impact study done by the occupational health service and the FRMS team. **METHODS:** We compared a strictly 3 pilots group (n = 14) to a more than 3 pilots group, i.e at least one leg flown by a 4 pilots crew (n = 19). Fatigue and sleepiness were self-evaluated through Samn-Perelli (SP) and KSS scales, and performance through a 5 steps scale. Objective sleep indices were obtained through actimetry. Statistical methods included mean comparisons (t-tests, ANOVA) and multivariate analysis (logistic regression). **RESULTS:** Baseline quality of sleep and daytime sleepiness were beyond normal thresholds for respectively 24 % and 36 % of the pilots. The total time slept onboard was

much higher in the 4 pilots group (+ 30 %) but sleep fragmentation was much lower in the 3 pilots group (21.6 vs 29.5). No significant differences were seen for fatigue, sleepiness, and self-rated performance when comparing the two groups' means. The risk of self-rating a bad performance during flight estimated by logistic regression was enhanced by fatigue, sleepiness, baseline sleep quality, and daytime sleepiness but not by the number of pilots. **DISCUSSION:** This study provides new data on the consequence of flying long haul flights with 3 vs more than 3 pilots, for a complete five days pairing. The study failed to find any significant difference between the 2 groups of pilots for fatigue, sleep quality, and performance from 3 days before to 3 days after the pairing. The only significant difference found was an unexpected better sleep fragmentation index for the 3 pilots group, which could be explained by a higher need of sleep. Reducing the crew number doesn't necessarily impact self-rated fatigue or performance, but is perceived as making the pilot work more difficult.

Learning Objectives:

1. Understand the effect of crew composition on sleep quality and fatigue.
2. Discover the scientific approach in comparing the effect of work organization on fatigue, for flight crew.
3. Assess the relative importance of various items having effect of pilot's fatigue and self-rated performance.

[078] IDENTIFYING OBSTRUCTIVE SLEEP APNEA IN THE YOUNG AND HEALTHY POPULATION USING PHYSICAL FITNESS TESTS

C.G. Mahakian[2], B. Williams[1] and A.A. Ames[1]
[1]David Grant USAF Medical Center, Travis AFB, CA; [2]Residency in Aerospace Medicine, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: Obstructive Sleep Apnea (OSA) is an occupational safety hazard due to impaired concentration. OSA prevalence is increasing in the young population. The OSA of young adults is predominantly mild and can be difficult to detect clinically. Mild OSA has been shown to impair exercise and exercise intolerance may be the first presenting symptom of OSA in the young adult population. **METHODS:** In a retrospective study, sleep clinic records at Travis AFB during 2008-2012 were reviewed for evidence of exercise intolerance as indicated by recent military physical fitness test failure at the time of presentation. Predictive parameters were for a hypothetical model for early OSA screening consisting of two components: the presence of both self-reported high blood pressure and a recently failed military physical fitness test. **RESULTS:** Twenty four of seventy active duty sleep clinic patients between 20 and 39 years of age had experienced a recent physical fitness test failure. OSA was found in 46% of young adult sleep clinic patients with a recent fitness test failure. Clinic patients with both OSA and a recent fitness test failure demonstrated significantly elevated mean neck circumference ($p = 0.02$), a measure of OSA pathology, compared to other patients. An OSA screen with these two symptoms demonstrates 16% sensitivity, 98% specificity, 80% PPV and 68% NPV for OSA in young tertiary clinic patients. **DISCUSSION:** Exercise intolerance may be the first presenting symptom of OSA in young adults lacking other comorbidities associated with OSA. Previously, OSA was found in 35% of a military traumatic brain injury cohort and in 30% of a congestive heart failure cohort. We found OSA in 46% of young adult population sleep clinic patients with a recent fitness test failure. When combined with self-report of high blood pressure, physical fitness test failure predicts OSA with greater specificity and positive predictive value than existing screens in a young sleep center population. Developing an OSA screen using exercise intolerance as a component could result in highly specific screens with improved positive predictive value for the young adult population. Earlier treatment and diagnosis of OSA can mitigate serious risk of motor vehicle accidents, impaired job performance, and degraded occupational safety.

Learning Objectives:

1. Describe the prevalence and occupational risk of obstructive sleep apnea in the young adult population.
2. Compare the utility obstructive sleep apnea screening tools for young adults.

Monday, May 01 ***2:00 PM***
Plaza F

S-016: PANEL: UPDATES AND OVERVIEW OF SPACEFLIGHT MEDICAL SUPPORT IN RUSSIA & KAZAKHSTAN

Chair: Ted Duchesne
Houston, TX

PANEL OVERVIEW: This panel presents recent updates to and a comprehensive overview of the operational medical support provided to ISS crewmembers in Star City, Russia and Kazakhstan as part of UTMB/KBRwyle's Human Health & Performance contract. With the current Soyuz training flow, physician support is required for nominal training evolutions involving pressure changes or other potential physical risks detailed in this presentation. In addition, full-time physician presence in Star City helps to address the disparity in access to health care in these relatively remote practice areas, while also developing and maintaining relationships with host nation resources. A unique part of standard training in Russia also involves survival training in both winter and water environments; logistic details and medical impacts of each of these training scenarios will be discussed. Following support of a successful training flow, UTMB/KBRWyle's Star City Medical Support Group (SCMSG) is also responsible for configuring medical packs in support of Soyuz launches and landings. We will present the rationale for current pack contents within the context of specific operational needs. With respect to contingency events, the group will describe their preparedness to respond appropriately by activating both local and global resources as necessary, detailing a specialized subset of the group who continually work and update these assets, given changes in international infrastructure and other impacts.

[079] MEDICAL SUPPORT FOR ISS CREWMEMBER TRAINING IN STAR CITY, RUSSIA

N. Chough[1,2], J. Pattarini[1,2], R. Cole[1,2], R. Patlach[2] and A.S. Menon[3]
[1]Preventive Medicine, UTMB, Galveston, TX; [2]Space Medicine Operations, KBRwyle, Houston, TX; [3]NASA-JSC, Houston, TX

MOTIVATION: Medical support of spaceflight training operations across international lines is a unique circumstance with potential applications to other aerospace medicine support scenarios. KBRwyle's Star City Medical Support Group (SCMSG) has fulfilled this role since the Mir-Shuttle era, with extensive experience and updates to share with the greater AsMA community. **OVERVIEW:** The current Soyuz training flow for assigned ISS crewmembers takes place in Star City, Russia. Soyuz training flow involves numerous activities that pose potential physical and occupational risks to crewmembers, including centrifuge runs and pressurized suit simulations at ambient and hypobaric pressures. In addition, Star City is a relatively remote location in a host nation with variable access to reliable, Western-standard medical care. For these reasons, NASA's Human Health & Performance contract allocates full-time physician support to assigned ISS crewmembers training in Star City. The Star City physician also treats minor injuries and illnesses as needed for both long- and short-term NASA support personnel traveling in the area, while working to develop and maintain relationships with local health care resources in the event of more serious medical issues that cannot be treated on-site. The specifics of this unique scope of practice will be discussed. **SIGNIFICANCE:** ISS crewmembers training in Star City are at potential physical and occupational risk of trauma or dysbarism during nominal Soyuz training flow, requiring medical support from an on-duty aerospace medicine specialist. This support maintains human health and performance by preserving crewmember safety and well-being for mission success; sharing information regarding this operational model may contribute to advances in other areas of international, military, and civilian operational aerospace medicine.

Learning Objectives:

1. Participants will learn the day-to-day operations of astronaut medical support in Star City, Russia.

[080] RUSSIAN SOYUZ WINTER SURVIVAL TRAINING - MEDICAL SUPPORT FOR US AND INTERNATIONAL PARTNER ASTRONAUTS

J. Pattarini[2,3], N. Chough[2,3], R. Cole[2,3], A.S. Menon[1] and R. Patlach[3]
[1]NASA-JSC, Houston, TX; [2]Preventive Medicine, University of Texas Medical Branch, Houston, TX; [3]Space Medicine Operations, KBRWyle, Houston, TX

MOTIVATION: Astronauts assigned to Soyuz flights are required to complete a number of dynamic survival training scenarios, one of the most rigorous of which is winter survival. Conducted over several weeks in January each year, astronauts complete 3 days of exposure training in the forested area adjacent to the Gagarin Cosmonaut Training Center. Medical support is provided by the Star City Medical Support Group (SCMSG) physicians in cooperation with Russian host nation medical providers. Concept of operations for this resource-limited medical support is described, and key medical risks are discussed. **OVERVIEW:** Star City physicians provide around-the-clock medical support during winter survival training for both US and International Partner astronauts. In-person medical checks are performed twice daily and as-needed during the 3 days of exposure training for each crew, in addition to around-the-clock radio communication monitoring. Carbon monoxide surveillance and frostbite monitoring are key components of physician support. Medical hazards and injury cases were selected from SCMSG medical archives and incorporated into training materials for astronauts undergoing winter survival training. Historical precedence for Soyuz winter survival training is reviewed. **SIGNIFICANCE:** Clinical outcomes and lessons learned from pertinent cases that highlight the SCMSG's concept of operations and approach to operational constraints will be presented. Medical support for Russian Soyuz winter survival training underscores the challenges for healthcare providers working in austere environments with reliance on integration with host nation support. The medical risks of exposure training must be managed by the physicians charged with the safety of the crewmembers under their care.

Learning Objectives:

1. Understand the unique circumstances of providing medical support to USOS Astronauts performing Russian winter survival training.
2. Be able to explain the major medical risks encountered by crewmembers during cold weather exposure training.

[081] LAUNCH AND LANDING OF RUSSIAN SOYUZ - MEDICAL SUPPORT FOR US AND INTERNATIONAL PARTNER ASTRONAUTS

A.S. Menon[2], R. Cole[4], N. Chough[3], J. Pattarini[4,3] and R. Patlach[1]
[1]Space Medicine Operations, NASA, Houston, TX; [2]NASA-JSC, Houston, TX; [3]Prev Med/Space Medicine Operations, UTMB/Wyle/NASA-JSC, Houston, TX; [4]University of Texas, League City, TX

MOTIVATION: Astronauts assigned to Soyuz flights are currently required to launch and land from Kazakhstan. KBRWyle and NASA provide US physicians to support Soyuz launch and landing medical operations. The concept of operations for this resource-limited medical support is described, and key medical risks are discussed. **OVERVIEW:** Two to three US physicians travel to Kazakhstan via Russia to support Soyuz launch and landing of US and International Partner (IP) astronauts. These physicians work in conjunction with Russian and Kazakhstani physicians, nurses, search and rescue forces, and other medical support personnel to provide direct medical care and contingency support during Soyuz launch and landing operations. One US physician is assigned to the nominal landing site while another US physician is positioned at an alternate (ballistic) landing site. A Russia based US physician is also available for launch and landing. Equipment needs are based on past and predicted medical events to compliment the larger Russian medical supplies and providers in order to provide nominal and emergent initial clinical care. **SIGNIFICANCE:** Clinical experience, medical requirements, and future preparation depend on up-to-date metrics, evidence based medicine, and new outlooks from wilderness and remote medicine. Constraints on equipment size and volume push launch and landing preparations to optimize and efficiently manage resources while preparing for a wide range of medical scenarios from trauma, to altitude medicine, to basic clinical care.

Learning Objectives:

1. Cover launch and landing preparation for international space operations to the ISS.
2. Cover injury and illness considerations for launch and landing operations.
3. Describe current resources for launch and landing operations on a Soyuz.

[082] SOYUZ LAUNCH AND LANDING CONTINGENCY SUPPORT

R. Patlach[3], T. Duchesne[2], N. Chough[1], R. Cole[4], J. Pattarini[4] and A.S. Menon[5]
[1]Prev Med/Space Medicine Operations, UTMB/Wyle/NASA-JSC, Houston, TX; [2]KBRwyle, Houston, TX; [3]KBRwyle, Houston, TX; [4]University of Texas Medical Branch, Houston, TX; [5]Space Medicine Operations, NASA, Houston, TX

MOTIVATION: NASA sponsored astronauts and Russian cosmonauts travel to and from the International Space Station (ISS) aboard Russian Soyuz spacecraft. The Soyuz is launched from Baikonur Kazakhstan and returns to Earth in austere central Kazakhstan. The Star City Medical Support Group personnel support contingency medical plans for guests viewing the launch and supplement the Russian Federal Air Navigation Service (search and rescue) assets when recovering Soyuz crewmembers returning from the ISS. **OVERVIEW:** The planning of contingency medical operations for NASA-sponsored crewmembers and their guests during Soyuz launch operations and for crewmembers and support personnel during Soyuz landings in Kazakhstan can be challenging. Soyuz launch operations occur at the Baikonur Cosmodrome. Crewmember-invited launch guests have included young children as well as elderly family members with age appropriate medical conditions. Soyuz landing operations occur in austere locations in central Kazakhstan where long distance transportation to definitive medical care and lack of western medical standards of care must be addressed. This presentation describes the plans, assets and agreements NASA has in place to provide appropriate medical care for NASA sponsored crewmembers, their guests and operational support personnel during launch and landing operations. **SIGNIFICANCE:** All aspects of spaceflight operations are hazardous. Effective planning is essential to minimize negative medical outcomes caused by a launch or landing mishap. Aspects of NASA's planning serves as a model for development of contingency medical planning for future commercial spaceflight operations.

Learning Objectives:

1. Understand the challenges of providing medical care for crewmembers, launch guests and operations support personnel during Soyuz launch and landing activities in Kazakhstan.

[083] RUSSIAN SOYUZ WATER SURVIVAL TRAINING – MEDICAL SUPPORT FOR US AND INTERNATIONAL PARTNER ASTRONAUTS

R. Cole[1,3], N. Chough[1,2], J. Pattarini[1] and R. Patlach[2]
[1]Prev Med/Space Medicine Operations, UTMB/Wyle/NASA-JSC, Houston, TX; [2]Space Medicine Operations, KBRwyle, Houston, TX; [3]Emergency Medicine, University of Texas Medical School, Houston, TX

MOTIVATION: Astronauts assigned to Soyuz flights are required to complete a number of dynamic survival training scenarios. One of the most rigorous is water survival. Conducted at the beginning of summer each year, astronauts complete three days of exposure training at a Ministry for Civil Defense and Emergencies training lake near Noginsk, Russia. Medical support is provided by the Star City Medical Support Group (SCMSG) physicians in cooperation with Russian host nation medical providers. The concept of operations for this resource-limited medical support is described, and key medical risks are discussed. **OVERVIEW:** Star City physicians provide medical support during water

survival training for both US and International Partner astronauts. Astronauts are exposed to elevated heat loads while donning multiple layers of water survival gear inside the tight fitting Soyuz capsule. Medical evaluations occur immediately before and after exposure, as well as during radio communications. Carbon dioxide, core-body and ambient temperature surveillance are key components of physician support. Heat mitigation strategies have successfully been employed and reduced the risk of medical injury and training impact. **SIGNIFICANCE:** Clinical outcomes and lessons learned from pertinent cases that highlight the SCMSG's concept of operations and approach to operational constraints will be presented. Core-body temperatures will be compared before and after heat mitigation strategies were employed. Medical support for Russian Soyuz water survival training underscores the challenges for healthcare providers working in austere environments with reliance on integration with host nation support. The medical risks of exposure training must be managed by the physicians charged with the safety of the crewmembers under their care.

Learning Objectives:

1. The participant will be able to understand the medical risks of Soyuz water survival training and associated risk mitigation strategies.

Monday, May 01 ***2:00 PM***
Governor's Square 14

S-017: PANEL: ADVANCES IN AEROSPACE MEDICINE IN IBEROAMERICA

Sponsored by Iberoamerican Association of Aerospace Medicine
(Asociacion Iberoamericana de Medicina Aeroespacial)

Chair: Ramon Dominguez
Madrid, Spain

Co-Chair: Angela Gomez
Madrid, Spain

PANEL OVERVIEW: In 2017, the panel sponsored by the Iberoamerican Association of Aerospace Medicine (IAAM) celebrates its 20th year of sharing scientific advances in Iberoamerica. Conducted in the Spanish language, it will be chaired by the IAAM President, Dr. Ramon Dominguez-Mompell, of Spain, and co-chaired by Dr. Angela Gomez, of Colombia, the panel will commence with a description of a hypobaric chamber study conducted by Dr. Marcos Moreno, of Argentina, to evaluate cardiovascular risk factors present in aviators. Next, Dr. Daniel Porras, of Colombia, will characterize 6,125 medical events processed at El Dorado International Airport's Health Services Department. Dr. Rosanna Goette, of Argentina, will then discuss a 30-year comparative study of prevalent pathology in aviation vs. preventive measures. Dr. Jose Mirabal, of Venezuela, will complement the session by discussing advances in aeronautical psychology that have occurred over the last 20 years in terms of automation in the cockpit. Dr. Diego Garcia, of Colombia, will complete the session by presenting the epidemiological characterization of the aeromedical certified population in Colombia. As always, the panel offers an opportunity to learn from our colleagues and encourages an internationally united environment towards enhancing world aviation safety.

[084] MYOCARDIAL PERFUSION TEST IN THE HYPOBARIC CHAMBER TO EVALUATE PILOTS PRESENTING CARDIOVASCULAR RISK FACTORS

M.A. Moreno[1], L. DeBenedetti[2], V. Ciancio[1], G. DiGiovan[2], M. Buzzurro[2] and P. Oliveri[2]
[1]National University of La Plata, La Plata, Argentina; [2]Sanatorio Modelo Quilmes, Buenos Aires, Argentina

INTRODUCTION: According to the Manual of Civil Aeronautical Medicine, "the most dramatic form of disability though not the most dangerous, is death on the flight deck. Despite strict application of medical standards, unfortunate events continue to occur" (2012;3.1.15:76). Thus, it is valid to ask ourselves if the diagnostic screening methods we are using are appropriate to perform at sea level. Aircrew constitute a population with occupational and traditional risk factors with high prevalence of coronary disease. The Aeronautical and Space Medicine Council of the Argentinean Federation of Cardiology proposed a screening of this population with a myocardial perfusion test (MPT; Tc99m MIBI) while exposed to altitude in a hypobaric chamber. The aim was to assess the MPT for aircrew at rest and at altitude, the latter as a predictor of ischemia. **METHOD:** Two groups of volunteer research subjects participated in the study: Group 1 (G1) was composed of 10 healthy males, age 25-45 years, without evidence of cardiovascular risk factors (CRF). Both groups' body mass index ranged from 30 to 32. G2 consisted of 10 male pilots, age 40 – 52 years, with asymptomatic CRF. Testing was performed at sea level and at an altitude of 3000 m. Time at altitude was up to 3 Hrs. Oxygen was not necessary to provide as none of the subjects presented less than 90% oxygen saturation. Instrumentation included gated SPECT myocardial perfusion imaging, PICKER-AXIS gamma camera scanning, and ODYSSEY LX computer. Analysis of results included Chi squared statistics. **RESULTS:** Negative results at both sea level and at altitude were presented by G1. G2 presented ischemia in 6 of the subjects at altitude ($p <= 0.01$). **DISCUSION:** In this sample of subjects, the screening test allowed the detection of myocardial ischemia at altitude in asymptomatic pilots with CRF, while its presence was negative at sea level. These findings therefore propose the procedure as a method to screen these patients.

Learning Objectives:

1. Learn of an approach to assess cardiovascular risk factors at altitude.

[085] PREVALENT PATHOLOGY IN AVIATION DURING THE LAST 30 YEARS IN ARGENTINA

R.d. Goette and M. Botto
Administración Nacional de Aviación Civil (ANAC), Buenos Aires, Argentina

INTRODUCTION: The primary goal of the aviation community is to increase Operational Safety (OS), both in machinery and staff training. Aviation medicine has managed to increase OS through corrective actions. The current challenge are preventive measures, so we must rely on statistics to make a thorough analysis that will lead to improvements not only the OS but also the quality of life. The purpose of this study was to determine the most common disqualifying medical conditions that caused the end of Argentinian pilots' careers over the last 30 years. **METHODS:** Previous data published by the International Federation of Airline Pilots Association (IFALPA, 1983) corresponding to Argentinian pilots during the period from 1971 to 1978 was reviewed. Also reviewed were 5 years of medical records and disposition of pilot's careers as processed by the National Administration of Civil Aviation (ANAC) in Argentina for the period 2012 – 2016. **RESULTS:** A total of 3736 cases, with an average of 465 cases per year, were analyzed by IFALPA. Mental (34.54%), followed by cardiologic (32.73%), and oncological conditions (10.91%) were the most common causes of medical disqualification. For the 2010 cases evaluated by ANAC, mental conditions were found in 39% of the cases, of which 57% related to toxicology and 43% related to psychiatric disorders. The remaining 61% corresponded to other conditions, including cardiologic (7%) and neoplasm (9%) cases. Surprisingly, 11% of the cases were related to pathologies of the hearing system, as compared to 5.45% previously reported in the IFALPA study. **DISCUSSION:** The prevalence of medically disqualifying conditions in pilots found during the last 5 years remained the same as those reported 30 years ago. A reduction in disqualified cases due to cardiologic reasons may be explained by new surgical options, drug therapies, and preventive measures developed over the last 30 years. Perhaps the twofold increase in hearing loss problems may be explained by the lack of use of adequate protection equipment. Our results support the International Civil Aviation Organization's Standards and Recommended Practices on the subject of preventive medicine so that these become rules. Also, we recommend intensifying the implementation of preventive measures in order to reduce the percentage of disqualified pilots due to preventable conditions such as mental health and otorhinolaryngology issues.

Learning Objectives:

1. The prevalence of medically disqualifying conditions in Argentinean pilots found during the last 5 years as compared to those reported 30 years ago.

[086] AERONAUTICAL PSYCHOLOGY: AUTOMATION IN THE COCKPIT VS HUMAN, 20 YEARS LATER

J. Mirabal
Sociedad Interamericana de Psicología Aeronautica, Caracas, Bolivarian Republic of Venezuela

INTRODUCTION: More than 20 years ago there was a total change in the aviation industry to modify the analog cockpit instrument for the "glass cockpit" adding to modern aircraft the Flight Management System (FMS). The implementation of these new technological advances as was the automation of the cabin, caused an impact on pilots who had to adapt to this transitional change. This improvement modified several aspects of their education and training, such as change of attitude, the type of tasks, and their cognitive relationship between flight and its previous view. This change made in the aviation industry aimed to diminish the problems caused by human operators, reducing pilot workload, ease the tedious routine tasks inside the cabin, and improve their performance. **METHODS:** A review of the literature (Ammons et al 1978; Childs et al 1983; Gillen 2008; Ebbatson 2009; and Boeing, 2011) was performed in terms of the achievements and weaknesses of automation, including the following variables: errors in manual control, deficiencies in cognitive skills, and difficulties surveillance skills. **RESULTS:** It was found in previous studies that various phases of flight were carried out manually in a flight simulator: approach with instrument landing systems, missed approach, and go-around and holding. After reviewing these studies, we found that a significant number of accidents (49%) were caused by certified pilots who failed to control the aircraft properly so as to have a failure in automation and changed the operation of the aircraft to manual mode. The difficulties found were framed in three broad areas of action: manual control skills, cognitive skills, and surveillance skills. **DISCUSSION:** Cockpit automation has achieved many of its goals, but has created new problems mainly from the psychological point of view that are currently under study of aeronautical psychology specialists.

Learning Objectives:

1. Review of cockpit automation over the last 20 years.

[087] EPIDEMIOLOGICAL CHARACTERIZATION OF AEROMEDICAL CERTIFIED POPULATION IN COLOMBIA

D.M. Garcia, M. Salamanca, C.L. Olarte and J.A. Henao
El Dorado International Airport, Bogota, Colombia

INTRODUCTION: Epidemiological knowledge of aviation populations is essential for comprehensive understanding of health issues impacting aviation safety and the population's overall wellness. The purpose of this study was to characterize the certified aviation population (pilots, cabin crew, air traffic controllers, fire fighters) in Colombia. **METHODS:** We collected medical information from first-time aeromedical certificates (FTC) issued between January 2014 and December 2015 and renewals (RC) between September 2015 and August 2016, during the aeromedical certification process of the Office of Aerospace Medicine at the Colombian Civil Aviation Authority. Descriptive statistical analysis was performed. Variables included: class and type of license, age, gender, body mass index (BMI), medical antecedents, systems review, diagnoses, and medical certificate limitations. **RESULTS:** A total of 4,867 FTC and 3,002 RC were reviewed. For FTC, the average age was 23.3 years and ranged from 16 to 64 years. A total of 72.7% were female. BMI average was 23.7. Only 15% reported medical antecedents. Review of systems findings were reported for 37% of the certified personnel. A total of 52% of the certificates included at least one diagnosis; most frequent were visual (42%), metabolic (35%) and ear/nose/throat (ENT, 15%). The most common limitation was the need for visual correction (37%). For RC, most of them were first class pilots (64.7%) followed by second class (22.8%). The average age was 36.8 years, ranging from 17 to 74 years. A total of 90.5% were male. BMI average was 25.1. A total of 83.4% of the certificates included at least one diagnosis, most frequent were visual (47.2%), overweight (45.5%) and dyslipidemia (31.5%). The most common limitation was the need for visual correction (35.9%). **DISCUSSION:** High prevalence of metabolic disorders among this population are noteworthy. Cardiovascular disease is the leading cause of mortality worldwide and is 80% preventable. Epidemiological features are crucial to implement programs focused to the most prevalent diagnosis to improve healthy practices and habits among aviation personnel through regulation and oversight. Safety management in aviation medicine is one of the International Civil Aviation Organization's directives not just for Latin-America, but for all regions; and epidemiological characterizations of aviation populations are the key element needed to assess strategic health intervention.

Learning Objectives:

1. Gain knowledge of the epidemiological characteristics of the Colombian pilot population.

[088] EVALUATING PILOTS WITH HUMAN IMMUNODEFICIENCY VIRUS: CIVIL AEROMEDICAL STANDARDS FROM THREE DIFFERENT PERSPECTIVES

L. Criales[2] and C.L. Olarte[1]
[1]Aviation Medicine, Colombian Civil Aviation Authority, Bogota, Colombia; [2]Aerospace Med Residency Program, Colombian National University, Bogota, Colombia

INTRODUCTION: The natural evolution of human immunodeficiency virus infection (HIV)'s life cycle can be affected by early diagnosis, along with a timely and optimal treatment. It is necessary to use antiretroviral therapy (ART) to stop or slow the progression from one stage to another, as well as to decrease the risk of cognitive impairment and improve the immune status of the infected patient. The role of the institutions responsible for the management of safety in relation to medical fitness to fly is of paramount importance for the comprehensive evaluation of this pathology considering regulatory, aeromedical, and epidemiological settings in a case by case evaluation. The purpose of this presentation is to share our experience in the evaluation and certification of pilots with HIV from an aviation safety perspective. **CASE 1:** A 41-year-old male pilot, HIV positive, with initial diagnosis of Stage A1. He started ART without reported side effects. His medical certificate was initially suspended. According to the Reglamento Aeronáutico Colombiano (RAC, Colombian Aeronautical Regulations), the medical board decided to issue a special medical certificate to fly. **CASE 2:** A 52-year-old male pilot, HIV positive, with initial diagnosis on Stage C3. His medical certificate was canceled since it didn't fulfill RAC requirements. He received treatment for opportunistic infections and started ART with no medication intolerance. Laboratory findings reported undetectable viral load and CD4 of 703/µL. He was reclassified as seropositive for HIV. The case was re-evaluated under the RAC context and a medical board decided to authorize re-certification by issuing a special medical certificate to fly. **CASE 3:** A 42-year-old male air traffic controller (ATC), HIV positive, with initial diagnosis on Stage C3. His last evaluation reported gastrointestinal symptoms related to ART and bad adherence. He had CD4 of 225/µL and a viral load test of 193,116. According to the RAC, the case was evaluated and a medical board determined that the ATC was not fit to perform his duties. **DISCUSSION:** The RAC governed the disposition of these cases in accordance with the harmonization of international regulations. We will discuss each case and will describe aeromedical certification considerations in terms of Colombian and world civil aviation regulations.

Learning Objectives:

1. The attendees will learn the current evolution and treatment (case by case) and outcomes of HIV patients.

[089] CHARACTERIZATION OF DISEASES AT THE AIRPORT COMMUNITY: REVIEW OF 6125 CASES TREATED AT THE BOGOTA'S INTERNATIONAL AIRPORT HEALTH SERVICES

D. Porras and H. Fajardo
Aerospace Medicine, National University Of Colombia, Bogotá, Colombia

INTRODUCTION: Medical facilities at commercial airports worldwide vary considerably, from advanced facilities in large airports to non-existent facilities and equipment in some areas. Additionally, there are few scientific publications about diseases treated at airports. In Colombia, since 1984, there are rules and regulations pertaining to the specific functions and services of Airport Health Services. In 2013, Bogota's El Dorado International Airport, the main and largest airport in

Colombia, and third in Latin America, mobilizes more than 39 million passengers a year. The objective of this research was to characterize medical events seen at El Dorado International Airport by the Airport Health Service. **METHODS:** Medical records of 6,125 patients (passengers, crew, employees and visitors) who were treated at the airport's medical clinic from July 2013 to June 2014 were analyzed, including patients' medical diagnoses. **RESULTS:** The study found that 77.2% of the cases were adults, with an age range between 18 and 64 years. The majority of patients were women (59%). A total of 90.8% of the passengers and 81% of the crewmembers consulted the Medical Service because they needed an authorization to fly. General illness not related to the aerospace environment was the reason of medical consultation in 41% of employees and 74% of visitors (only, not passengers or crew members) respectively. Post-surgical procedures, pregnancies, digestive diseases, cardiovascular diseases, and diseases of the lower respiratory tract accounted for 59% of all cases. Surgical procedures (65.3%) frequencies were: orthopedic (36.8%), plastic (16.5%) and general (12%). Post-surgical procedures (22.6%) and ear/nose/throat (ENT) diseases (16.5%) were the most frequent causes of denial of authorization to fly. Four percent of the patients required to be transported by ambulance to a third level hospital. **DISCUSSION:** This data can be useful for planning and developing medical services at commercial airports; help passengers to stay healthy while in-flight; and therefore decrease the chance of flight diversions caused by medical reasons.

Learning Objectives:

1. Learn from the experience gathered at a major international airport on the planning and development of medical services at such sites.

Monday, May 01 ***2:00 PM***
Governor's Square 15

S-018: PANEL: SUPERMAN READINESS SKILLS VERIFICATION (RSV) FOR FLIGHT SURGEONS

Chair: Douglas Files
Fairborn, OH

Chair: John Cornell
Fairborn, OH

PANEL OVERVIEW: This panel will update flight surgeons on issues that affect the safety, health, and well-being of the aviator or passengers on the flight. It includes individual aircrew issues: physiologic events, human factors, human performance enhancement. The first topic will address human performance enhancement and sustainment. The second presentation is on aeromedical evacuation, such as how to mitigate physiologic stressors on the patient. The third presentation is on physiologic incident response and the reporting that needs to accompany it. The final program is about Mishap/HAZMAT response, that is, how to respond like Superman when your local area suffers a disaster. Each session will be interactive and informative. Aerospace medicine professionals will participate in all aerospace medicine scenarios as well as to explore the links between them. Panel topics are similar to last year but the patient cases presented will be different. This panel affords aerospace medicine professionals the opportunity to make aerospace medicine decisions which affect the mission and aircrews. Airmen will leave the panel better prepared to ensure the safety of the airfield.

[090] HUMAN PERFORMANCE ENHANCEMENT

D.S. Files
Aerospace Medicine Education, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

MOTIVATION: Aerospace medicine professionals sustain maximal aviator performance. One of those high-risk special interest items involves the use of medication. Flight surgeons prescribe sleeping pills to help aviators sleep prior to a sortie and in special circumstances prescribe stimulants to improve performance during critical phases of flight. This presentation will instruct aerospace medicine professionals in the proper usage of performance-enhancing medication for aviators. **OVERVIEW:** Aerospace medicine professionals study the physiologic effects and risks of flight. In order to ensure mission completion, flying safety, and individual health and well-being, flight surgeons sometimes prescribe medication for use. At times, hypnotics assist aircrew to sleep prior to a mission while other medications improve pilot alertness during critical phases of flight. Flight surgeon experience with using these medications is variable. This program will update flight surgeons on the use of performance-sustaining and enhancing medications. **SIGNIFICANCE:** The U. S. Air Force requires annual training regarding the use of performance enhancing medication. Many other services also use performance-enhancing medication. This program will model techniques and will aid all AsMA attendees participating in the session.

Learning Objectives:

1. Attendees will review updates in the field of human performance enhancement.
2. Review the use of hypnotic medications in aircrew.

[091] PHYSIOLOGIC INCIDENT RESPONSE

D.S. Files
Aerospace Medicine Education, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

MOTIVATION: Aerospace medicine professionals treat aircrew who suffer physiologic problems in flight. This presentation will train them in how to do this, utilizing simulated patient cases. **OVERVIEW:** Aerospace medicine personnel specialize in the effects of normal physiology in abnormal environments. However, not every flight surgeon responds regularly to such incidents. This program will remind aeromedical professionals how to respond to a physiologic incident and what steps to take to care for the patient. **SIGNIFICANCE:** The U.S. Air Force requires annual updates regarding physiologic incident response. Flight surgeons demonstrate how to discuss aircrew issues at the airplane, understand the physiologic causes, and treat the patient. These issues can indicate larger problems which may be present. For instance, coughing after smoke and fumes in the cockpit can indicate a predisposition to dyspnea. This physiologic response presentation will give flight surgeons an opportunity to learn about responses, incorporating the latest physiologic response information.

Learning Objectives:

1. Review how to deal with a physiologic incident in flight involving smoke and fumes in the cockpit.
2. Review U.S. Air Force Readiness Skills Verification issues regarding physiologic incident response.

[092] DISASTER RESPONSE EXERCISE

D.S. Files
Aerospace Medicine Education, United States Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH

MOTIVATION: Aerospace medicine professionals often specialize in mishap response including for aircraft crashes, HAZMAT spills, and mass casualty scenarios. This presentation will allow professionals to maintain currency by participating in a response exercise. **OVERVIEW:** Aerospace medicine professionals are first-in and last-out for disaster relief operations. They are concerned with the medical aspects of toxic and hazardous materials used on an airfield and consult on hazardous spills. They are asked to respond to aircraft mishaps, caring for the initial responders as well as those directly injured. However, the actual opportunity for any individual to do this is infrequent. This program will update aeromedical professionals on response issues by providing an opportunity for individuals to participate in a mishap exercise involving a HAZMAT spill. **SIGNIFICANCE:** The U.S. Air Force has determined that currency in Disaster Response requires recurring training. However, all AsMA attendees will benefit. Aerospace medicine professionals will improve their understanding of the nuances of dealing with other airfield organizations (i.e., fire dept, civil engineering, etc.), with federal authorities, and with local facilities that interact with the airfield during a disaster response. International professionals will gain insight into how disaster response flows in the United States and can export lessons learned to their own countries. Thus, all services and all countries will have an opportunity to experience a mishap response that incorporates the latest disaster response information.

Learning Objectives:
1. Review with attendees how to medically approach the case of a hazardous material spill in your area.
2. Renew U.S. Air Force officers' readiness skills verification requirements.

[093] AEROMEDICAL EVACUATION

D.S. Files
Aerospace Medicine Education, United States Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH

MOTIVATION: Aerospace medicine professionals oversee the health, and well-being of aircraft passengers and patients in flight. They medically clear patients being transported in an aeromedical evacuation system. This presentation will help professionals to maintain currency by performing medical clearances for simulated aeromedical evacuation patients. **OVERVIEW:** Aerospace medicine professionals specialize in the physiologic effects of flight at altitude. Medical care may be difficult to provide when patients with compromised physiology must be flown. This program will help ensure flight surgeons succeed in protecting patients being transported in aeromedical evacuation systems. One example might be a patient who could become hypoxic at altitude and how to mitigate the risk. **SIGNIFICANCE:** The U. S. Air Force requires recurring training for flight surgeons. Some of the flight surgeons who attend AsMA have never participated in aeromedical evacuation cases. Other services that attend AsMA interface with the U.S. Air Force's aeromedical evacuation system making the training widely applicable. This program will give professionals an opportunity to participate in the medical clearance of aeromedical evacuation patients. It will cover the latest trends and techniques and will be beneficial to all AsMA attendees participating in the session.
Learning Objectives:
1. Review safe methods to transport patients.
2. Review Readiness Skills Verification topics for U.S. Air Force flight surgeons.

Monday, May 01 ***2:00 PM***
Governor's Square 12

S-019: PANEL: PRESCRIBING A CABIN ALTITUDE RESTRICTION FOR A PATIENT REQUIRING AEROMEDICAL EVACUATION

Chair: William Butler
Chester, VA

Chair: Lawrence Steinkraus
Rochester, MN

PANEL OVERVIEW: Routine cabin altitude in aeromedical evacuation exposes ill/injured patients to flight stressors that can add physiologic insult to the initial illness/injury, the so-called second hit. Cabin altitude restriction (CAR) is a countering intervention that the validating flight surgeon can prescribe for an aeromedical evacuation patient. It sets the cabin altitude for a mission below the standard 8,000-10,000 ft. Conventional wisdom states the CAR is costly—longer flights, greater fuel use, more costly flights, lower cruising altitudes, and added physical stress to the aircraft; however, this thinking may not be entirely accurate. Traditional indications for a CAR have focused on countering both the hypoxia of altitude (e.g., severe pulmonary disease) and the consequences of Boyle's law (e.g., trapped gas and decompression illness); however, these may not be the only indications. This panel will address the physiologic foundation for prescribing a CAR, the evidence for prescribing a CAR (ecological population study, matched case-control study, and dual case-control study), the cost of prescribing a CAR (early Line assessment, matched case-control study, operational study), and a methodology for prescribing a CAR.

[094] PHYSIOLOGIC FOUNDATION FOR A CABIN ALTITUDE RESTRICTION (CAR): TISSUE OXYGEN DELIVERY (DO_2)

W.P. Butler
Aerospace Research, USAF School of Aerospace Medicine, Chester, VA

MOTIVATION: Cabin altitude restriction (CAR) has had a limited set of indications until recently, when the notion of tissue oxygen delivery (DO_2) optimization surfaced. To safely evacuate very ill/injured patients requires knowledge of DO_2 and its application as prescribed with CAR. **OVERVIEW:** Cabin altitude imposes two physiological challenges upon a patient: hypoxia and hypobaria. Hypoxia means reduced oxygen availability; hypobaria favors, through a number of mechanisms (e.g., increased vascular permeability, Starling forces, inflammatory upregulation, and bubble effects), fluid redistribution into the tissue space, or tissue edema. The overall physiologic result is a potential drop in DO_2. If DO_2 is inadequate, tissues suffer, and already compromised tissues suffer even greater perhaps to the point of patient morbidity or mortality. This potential drop in DO_2 can be countered by an increase in the fraction of inspired oxygen, an increase in hemoglobin, an increase in hemoglobin saturation, an increase in plasma oxygen content, and an increase in cardiac output. Within easy reach of the validating flight surgeon's prescribing pen are the fraction of inspired oxygen (supplemental oxygen), hemoglobin (transfusion), and CAR. **SIGNIFICANCE:** The presentation will detail this physiology, its potential patient impact, and how a CAR prescription may well mitigate that impact, not to mention introducing a methodology for conjoining the CAR prescription with patient DO_2. Consequently, a more physiologically based approach to flying patients can be effected in both military/civilian and domestic/international aeromedical evacuation.
Learning Objectives:
1. To understand the two principle physiological challenges imposed by an aircraft's cabin altitude --- hypoxia and hypobaria.
2. To understand how hypoxia and hypbaria may produce an environment conducive for a "second hit" physiological insult via a drop in tissue oxygen delivery.
3. To review the conventional indications for imposing a cabin altitude restriction while, at the same time, understanding how tissue oxygen delivery may benefit from cabin altitude restriction.

[095] THE EVIDENCE: MATCHED CASE-CONTROL STUDY (CAR VERSUS NON-CAR)

W.P. Butler
Aerospace Research, USAF School of Aerospace Medicine, Chester, VA

INTRODUCTION: Restricting cabin altitude below 8,000 ft is prescribed to counter altitude-induced stressors during aeromedical evacuation. However, conventional wisdom has cabin altitude restrictions (CARs) adding to mission time and fuel expense. **METHODS:** A retrospective review of 100 patients was conducted. Fifty CAR patients were randomly selected from 2007-2013 and matched, using International Classification of Diseases, Ninth Revision codes and, to some extent, aircraft, with 50 non-CAR patients. Patient data were taken from four different databases and merged to create a unique dataset for analysis. Patient demographics, inflight status, inflight incident reports, overall outcomes, and mission costs were investigated. **RESULTS:** Patient demographics, inflight status, and inflight incident reports were generally unremarkable. However, a significantly reduced number of postflight procedures were seen with CAR patients (CAR = 4.98, non-CAR = 6.08; $p = 0.032$). Specifically, there were a lesser number of both major and minor postflight procedures ($p = 0.047$). Other outcomes did not reach statistical significance (length of stay days, intensive care unit days, postflight blood product use, patients transfused, discharge status). Surprisingly, CAR did not significantly increase flight time ($p = 0.64$) or mission fuel cost per hour ($p = 0.48$). **DISCUSSION:** CAR-prescribed patients are associated with fewer major and minor postflight procedures when compared to similarly ill/injured patients flown without a CAR. This benefit appears to come without serious cost either in flight duration or fuel consumption.
Learning Objectives:
1. To understand how the direct patient impact of a cabin altitude restriction is examined with a case-control study.
2. To see how the cabin altitude restriction is associated a fewer major and minor postflight procedures.
3. To see how the flight duration and fuel cost is affected by cabin altitude restriction.

[096] THE EVIDENCE: DUAL CASE-CONTROL STUDY (CAR VERSUS NON-CAR & NON-CAR "FLOWN WITH A CAR" VERSUS NON-CAR) ALONG WITH OPERATIONAL IMPACT STUDY

A. Cherian
Human Systems Integration Directorate, 711th Human Performance Wing, Wright-Patterson AFB, OH

INTRODUCTION: Cabin altitude restriction (CAR) is thought to counter certain flight stressors. Liberal employment of CARs should result in improved patient outcomes. **METHODS:** Data from the U.S. Transportation Command Regulating and Command and Control Evacuation System and Landstuhl databases (January 2007 to February 2008) were merged creating a dataset of 1,114 patients. Three populations were identified: CAR patients (CAR, n = 442); non-CAR patients flown with CAR (non-CARw/CAR, n = 236); and non-CAR patients (non-CAR, n = 436). Consequently, there were two natural with-and-without-CAR patient comparisons: CAR vs. non-CAR and non-CARw/CAR vs. non-CAR. Operational mission data from Tanker Airlift Control Center were analyzed. **RESULTS:** Demographically, the three populations proved to be very similar. Injury severity scores were significantly different between CAR and non-CAR and between non-CARw/CAR and non-CAR; however, injury severity score clinical categories found CAR patients "severely injured," while both the non-CARw/CAR and non-CAR patients were "moderately injured." Despite being sicker, CAR patients displayed very similar outcomes as non-CAR patients. On the other hand, with non-CARw/CAR vs. non-CAR comparison, a CAR was associated with reduced postflight complications (number, $p = 0.02$; patients, $p = 0.0003$) and postflight procedures (number, $p = 0.01$; patients, $p = 0.01$). CAR missions exhibited statistically similar flight durations and fuel costs as non-CAR missions. **DISCUSSION:** More severely injured CAR patients had similar clinical outcomes when compared to non-CAR patients, while similarly injured non-CARw/CAR patients had superior clinical outcomes when compared to non-CAR patients. Cost of CAR missions was not significant when compared to non-CAR missions.

Learning Objectives:
1. To understand that there are two type of cabin altitude restricted patients: those prescribed a cabin altitude restriction and those flown incidentally with a cabin altitude restriction.
2. To see how the cabin altitude restricted patients faired equally with the nonrestricted patients, despite being sicker, and how the non-restricted patients, incidentally flown with a restriction, faired much better than the nonrestricted patients.
3. To see how little impact cabin altitude restriction had on flight duration and fuel consumption.

[097] TISSUE OXYGEN DELIVERY CALCULATIONS (DO_2) AND PATIENT VALIDATION

W.P. Butler
Aerospace Research, USAF School of Aerospace Medicine, Chester, VA

MOTIVATION: To successfully prescribe a cabin altitude restriction (CAR) beyond the traditional indications requires the application of optimal tissue oxygen delivery (DO_2). As a result, a methodology for calculating DO_2 is required. **OVERVIEW:** Altitude can impede DO_2 via hypoxia and hypobaria. CAR below 8,000 ft can potentially mitigate the drop in DO_2 during aeromedical evacuation (AE); however, beyond the traditional indications, there is little guidance on when to prescribe the CAR or at what altitude to impose a CAR. Calculated DO_2 offers such a potential guide. In calculating DO_2, three factors are of supreme importance and can be readily prescribed by the validating flight surgeon (VFS): fraction of inspired oxygen, hemoglobin, and CAR. However, the interplay of these three factors is not necessarily well defined. **SIGNIFICANCE:** This presentation will briefly review the applicable physiology and discuss the history of DO_2 use in AE (concentrating on patient validation by the VFS). In addition, the presentation will introduce the DO_2 calculator and the physiological and mathematical bases for its use along with results from early validity testing. And, lastly, the presentation will include a demonstration of the calculator and how it can be used by the VFS to manipulate the three factors, particularly the level of CAR, for the benefit of the AE patient, be the patient military or civilian, domestic or international.

Learning Objectives:
1. To understand how tissue oxygen delivery can impact patient well being while discussing the history of its conscious use in aeromedical evacuation.
2. To understand the primary physiological parameters within easy reach of the validating flight surgeon and how they affect tissue oxygen delivery.
3. To see how to calculate tissue oxygen delivery and apply that information to the prescribing of cabin altitude restriction for patients requiring aeromedical evacuation.

[098] THE EVIDENCE: ECOLOGICAL STUDY OF CABIN ALTITUDE RESTRICTIONS VERSUS POSTFLIGHT COMPLICATIONS ALONG WITH LINE ASSESSED MISSION IMPACT

L. Steinkraus
Division of Preventive, Occupational, and Aerospace Medicine, Mayo Clinic, Rochester, MN

INTRODUCTION: Cabin altitude restriction (CAR) is prescribed by the validating flight surgeon to mitigate physiologic risks associated with aeromedical evacuation. Two validating flight surgeons deployed during 2007 developed a systematic approach to aeromedical evacuation patients using tissue oxygen delivery calculations and liberally employed CARs. Since CAR seemingly adds to mission cost, there can be organizational resistance to it. **METHODS:** A retrospective ecological study was performed taking data from the U.S. Transportation Command Regulating and Command and Control Evacuation System (TRAC^{2}ES) (January 2006 through February 2008; 2,329 patients) and Landstuhl Regional Medical Center (January 2007 through June 2008; 2,744 patients) databases. From TRAC^{2}ES, monthly rates of CAR prescriptions were calculated; from Landstuhl Regional Medical Center, monthly rates of postflight complications (PFC) were calculated. Rates within the common timeframe (January 2007 through February 2008; 2,264 patients) were examined using the Spearman correlation. Mission impact of CAR for Balad to Ramstein and Bagram to Ramstein missions was obtained from the Line. **RESULTS:** CAR rates (0-67%) *during* deployment were significantly up compared to *before* or *after*, while PFC rates (15-36%) were significantly lower; *before* and *after* did not differ statistically. Furthermore, a significant inverse relationship between CAR and PFC rates (Spearman rho = −0.587, $p = 0.027$) was demonstrated. Line assessment did not reveal serious mission impact. **DISCUSSION:** CAR rate was inversely correlated to PFC rate. In other words, as the rate of CAR prescribing rose, the rate of postflight complications dropped. Moreover, Line appraisal of the CAR failed to demonstrate serious mission impact.

Learning Objectives:
1. To understand how a population-based ecological study can be used to investigate the utility of prescribing a cabin altitude restriction.
2. To see how the rate of prescribing cabin altitude restrictions is inversely associated with the rate of postflight complications.
3. To learn the mission impact of a cabin altitude restriction as assessed by the Line.

Monday, May 01 ***2:00 PM***
Governor's Square 11

S-020: PANEL: DEVELOPING, ORGANIZING AND CONDUCTING RESEARCH IN AEROSPACE MEDICINE AND HUMAN PERFORMANCE PART I: INITIATING AND ORGANIZING THE RESEARCH EFFORT

Sponsored by the AsMA Science and Technology Committee

Chair: William Fraser
Toronto, Ontario, Canada

Chair: Barry Shender
Patuxent River, MD

PANEL OVERVIEW: There are unique issues associated with undertaking research in Aerospace Medicine and Human Performance that do not normally arise in other operational, clinical or laboratory

investigations. Access to financial, human, and logistical resources, legal, ethical, and safety issues, collection and analysis of data, and the extensive documentation required over the entire process, are areas that may require more extensive effort than usual. This Educational Panel, organized and sponsored by the Science and Technology Committee of the Aerospace Medical Association in response to a request from the Executive Committee of AsMA, is focused on providing advice and guidance to investigators who are new to the field. With the changing legal and ethical requirements for both human and animal research and the development of advanced technologies that can support the research effort, the panel will hopefully provide useful information to the experienced researcher as well. The first of the two panel sessions is focused on initiating and organizing a research project, while the second session will focus on conducting the research and documenting the results. The first presentation from NAVAIR, Patuxent River, MD will discuss a real world example of organizing a research project. The second presentation, from the FAA/CAMI, Oklahoma City, OK, will address some of the unique challenges and difficulties when undertaking research with human subjects in the Aerospace arena. The regulatory/IRB issues surrounding human experimentation will be discussed in our third presentation from Wright-Patterson AFB, OH. The final presentation, from the Army Research Office, ITC-PAC, Tokyo, Japan, will address the process for obtaining research funds from a variety of sources.

[099] WHAT YOU NEED TO KNOW ABOUT ORGANIZING A RESEARCH PROJECT

B.S. Shender
Human Systems, NAVAIR, Patuxent River, MD

PROBLEM STATEMENT: There are a number of questions that need to be addressed prior to starting a research project. This talk details key considerations for a project's success, while the next in this panel discusses human subject issues. **TOPIC:** The critical first step is to derive a clear understanding of what knowledge or technology gap needs to be filled (and obtain written agreement from your funding sponsor) and how project results will be used. Unless the research question is firmly established and the desired end state defined, it will be impossible to determine when/if success is achieved. Next, determine if relevant data exists – do we need to run a study or not? Define the relevant environmental criteria, e.g., aircraft crash, conduct a relevant literature search, discuss with subject matter experts, and determine what is and isn't known. Next, as the principal investigator, admit that you do not know everything; assemble a research team of recognized experts and listen to their advice. Define the needs of the team, project, and sponsor, recognizing that these might not all be in harmony; but always remember who the ultimate customer is. Next, establish clear requirements for each team member and determine what is critical to have and what's nice to have. There will never be enough time and funds to do all that you want, so establish priorities. Determine what metrics are needed, establish the data analysis techniques, validation criteria, and the number of subjects required. It is important to distinguish between a statistically relevant vs. an operationally relevant result. Ensure that the outcome is actionable and can be turned into a product your sponsor can use. Determine if existing test methodologies are sufficient or if new ones will need to be created. Establish a project schedule that ensures that no team member is idle while waiting on another's results. Success depends upon close coordination and active collaboration from all team members. Maintain communication, particularly when different sites are involved, and meet regularly. Finally, plan on having interim results to show the sponsor progress and present findings at scientific meetings to obtain peer review. **APPLICATIONS:** The steps outlined above were used by the US Navy to develop a quantitatively validated probabilistic spinal injury prediction model suitable for developing life support equipment design criteria for aircraft ejection and crash.

Learning Objectives:

1. Determine the steps necessary to develop and conduct a successful research project.

[100] REGULATORY/IRB ISSUES SURROUNDING HUMAN EXPERIMENTATION AND RESEARCH COLLABORATIONS

K. London
711 Human Performance Wing, Air Force Research Laboratory, Wright-Patterson AFB, OH

PROBLEM STATEMENT: When conducting human subjects research, there are special regulatory requirements that must be met. This talk will provide a synopsis of the requirements, with emphasis on the most efficient Institutional Review Board (IRB) approval pathways, particularly in multi-agency collaborations. Certain funding sources do impact which regulatory requirements apply, and funding sources are discussed in the next presentation. **TOPIC:** Know and include IRB regulatory requirements in your study design to avoid failure, as well as delay in the approval process. A hand out will be provided to attendees that will succinctly describe these key requirements with insight on how best to meet them, which include: Minimize risk; risk vs. benefit analysis; equitable subject selection; informed consent; documentation; safety monitoring; data management plans. When multi-laboratory or multi-national collaboration is involved, requirements may vary and in such a situation the most stringent standards will be applied. Tips will be given on the best sources of comparisons of international requirements. Timely and expensive multi-IRB reviews can (and should) often be avoided with advance planning. Arm yourself with the "how to" knowledge to streamline laborious dual IRB review processes. Be familiar with special requirements related to "vulnerable" subject populations. Certain military populations likewise will require additional protections, such as local Command authorizations, avoidance of undue coercion, and informing subjects about additional risks to service members' duty status. Aerospace medicine research may require trauma patients as subjects, in which case be prepared for special rules about surrogate consent and need for direct benefit for subjects. This, and other unique U.S. Department of Defense rules will be provided in a handy comparison chart containing all military services' unique policies distinguished from federal rules and common international requirements. These tools and information will be valuable when developing research plans, including deciding on collaborators and source of funds. **APPLICATIONS:** Federally funded human performance research that involves use of a live human, identifiable private information, or biological specimens, will trigger need to consider IRB regulatory requirements, and additional requirements apply in the international research setting. **RESOURCES:** 32 CFR 108, 219; 10 USC 980; DoDI 3216.02, 2014.

Learning Objectives:

1. The participant will understand what IRB regulatory requirements to include in the design and development of a research study.
2. The participant will learn of the most efficient IRB approval pathways in multi-site collaborative research.

[101] FINDING AND SECURING FUNDING FOR RESEARCH

V.E. Martindale
Synthetic Biology, US Army Research Office, RTP, NC

PROBLEM STATEMENT: The best ideas in the world go nowhere without funding. This talk will address how to find funding sources, and how to maximize chances of receiving funding. **TOPIC:** Funding sources are many, but each is targeted to specific uses of funds, and each is controlled by several gatekeepers. Understand what the funder is after to identify a source. Understand what each gatekeeper is looking for to successfully apply. Search for funding sources that target your area of expertise and your subject population. Within DoD, each service has funding sources, and internal calls for research proposals. Universities maintain some in-house funding. For federal funds that are available outside DoD, the grants.gov website is your first stop. Other sources of funds might be National Institutes of Health, National Science Foundation, and specific charities. If your field has published research on which you wish to build, find out who funded the initial work. Look for a good fit between the findings you hope to prove or disprove and the goal of the funding agency. Once a good match is found, it is time to apply. Check for eligibility, levels of funding available, timeline for approval and for funding, and any special requirements. If at all possible, start with a conversation! Send an email or make a call and ask if what you are doing is a good fit. Follow up with a pre-proposal if allowed. Follow directions to the letter, edit your submission carefully, and be mindful of deadlines. Submit early when you can. Be honest about cost estimates. It is useful to understand when the funder will receive money to distribute. Some examples of real review situations will be covered, and some "hot tips" to include gauging the competition, selling the problem, good references, and the judicious use of

buzzwords. **APPLICATIONS:** The points given can be used to find and apply for research funding from a broad selection of sources. Attendees will receive a checklist.
Learning Objectives:
1. Find appropriate funding sources for a research project and write effective research proposals to attract funding.

[102] UNIQUE CHALLENGES OF THE AEROSPACE MEDICAL ENVIRONMENT

M. Bryant
CAMI, FAA, Oklahoma City, OK

Collecting data in an aerospace medicine environment faces unique research challenges. Though these challenges present unique limitations, aerospace medicine is called to provide scientifically sound research that advances knowledge and closes gaps within its domain. This presentation will outline steps to improve research outcomes in the applied aerospace medicine domain including: study design and methodology, valid measurement practices, protocol development, recruitment policies and practices, study reliability and validity, and special considerations for small sample sizes and time critical environments. Detailed recommendations for researchers in this domain will include examples from recent publications.
Learning Objectives:
1. Recognize appropriate study design and methodology in various aerospace medical environments.
2. Recognize valid measurement practices as they apply to various aerospace medical environments.
3. Recognize appropriate primary steps to implementing an experiment in an aerospace medical environment including but not limited to protocol development, recruitment policies and procedures, and considerations for small sample sizes.

Monday, May 01 ***2:00 PM***
Governor's Square 10

S-021: PANEL: AEROMEDICAL RISK ANALYSIS PRACTICE UPDATES – PART 1

Sponsored by the American Society of Aerospace Medicine Specialists

Chair: Richard Allnutt
Beavercreek, OH

Chair: Dan Van Syoc
Springboro, OH

PANEL OVERVIEW: During this panel, aeromedical clinical experts and Aerospace Medicine residents will present risk analysis-based clinical updates on topics related to the assessment and treatment of aviators and special operational 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.

[103] DECOMPRESSION SICKNESS IN THE AVIATOR

R. Allnutt
USAFSAM, Beavercreek, OH

MOTIVATION: Many advances in the understanding, prevention, and treatment of Decompression Sickness (DCS) have occurred since the last Clinical Update of the condition. Every specialist in Aerospace Medicine should be familiar with the approach and early treatment of this condition. **OVERVIEW:** DCS can occur from altitude exposure in aircraft or altitude chambers. It also occurs after exposure to hyperbaric conditions such as SCUBA diving or hyperbaric chamber environments. The resulting clinical conditions may range from mild pain-only bends to life threatening neurologic syndromes. **SIGNIFICANCE:** Early recognition of syndromes and symptoms caused by DCS is essential to favorable recovery. Treatment may include medication, 100% oxygen, and/or hyperbaric therapy. Among the newer concepts associated with DCS is the concept of personal variability – some aviators are more susceptible, and some much less susceptible, than the average. The existence of brain white matter hyperintensities seen on sensitive MRI images is a rapidly developing current research topic. Among those exposed to pressure changes, with or without symptoms of DCS, these white matter changes may signal clinically undetected DCS.
Learning Objectives:
1. Understand that similar clinical conditions can result from diving and from altitude exposure.
2. Understand that a previous DCS episode increases the risk for further DCS symptoms with subsequent exposures.
3. Be prepared with contact information on available USAF dive chambers.

[104] ASAMS AEROMEDICAL RISK ANALYSIS: EUSTACHIAN TUBE DYSFUNCTION

J. LaVan[1] and D.G. Schall[2]
[1]Naval Aerospace Medical Institute, Pensacola, FL; [2]Great Lakes Regional Office, FAA, Des Plaines, IL

Eustachian Tube Dysfunction is a condition which can occur out of the blue, but have a significant effect on aviator performance, due primarily to incapacitating symptoms. Though normally of benign etiology, there are some triggers which must be identified and treated if present. Some treatment options may impact qualification for aviation as well. This presentation will discuss the epidemiology, risk factors and natural course of Eustachian Tube Dysfunction as well as aeromedical risks associated with symptoms and treatment of Eustachian Tube Dysfunction. Finally, dispositions of this condition by various aeromedical authorities will be reviewed.
Learning Objectives:
1. Review epidemiology, risk factors and natural course of Eustachian Tube Dysfunction.
2. Review aeromedical risks associated with symptoms and treatments of Eustachian Tube Dysfunction.
3. Review aeromedical dispositions associated with the diagnosis of Eustachian Tube Dysfunction from the various US and international aeromedical qualification authorities.

[105] ASAMS AEROMEDICAL RISK ANALYSIS - HYPOTHYROIDISM

W. Rodriguez-Jimenez and C. Mathers
Department of Preventive Medicine & Community Health, University of Texas Medical Branch, Galveston, TX

INTRODUCTION: The purpose of this presentation is to provide the aerospace medicine physician an update on the aeromedical risks associated with hypothyroidism and to review current practice guidelines for the management of hypothyroidism. **METHODS:** An overview of hypothyroidism including epidemiology, pathophysiology, diagnosis, treatment as well as the aeromedical concerns will be presented. The authors will identify new relevant information regarding the aeromedical disposition of civilian airmen with hypothyroidism not included in the current ASAMS guidelines. **RESULTS:** Current guidelines such as the CACI process for hypothyroidism will be covered and new approaches to the aeromedical disposition of hypothyroidism will be identified to update ASAMS guidance. **DISCUSSION:** With medical knowledge in constant change, performing aeromedical risk analysis is a fundamental process for maintaining the validity of current practice recommendations.
Learning Objectives:
1. The participant will be able to understand the epidemiology, pathophysiology, diagnosis, treatment as well as the aeromedical concerns of hypothyroidism.
2. The participant will be able to recognize current guidelines such as the CACI process for hypothyroidism.

[106] ASAMS AEROMEDICAL RISK ANALYSIS – SPLENECTOMY

R. Suresh and J. Vanderploeg
Clinical and Preventive Medicine, UTMB, Galveston, TX

INTRODUCTION: Splenectomy and impaired splenic function place individuals at increased risk of life threatening infections, most often from encapsulated organisms. Clinical management, surveillance and aeromedical concerns for pilots with this condition will be presented. **METHODS:** The literature was reviewed for the epidemiology, etiologies, complications, and treatment of patients with impaired splenic function, functional asplenia, or splenectomy. Aeromedical concerns and aeromedical disposition of civilian pilots with this condition were identified. **RESULTS:** Findings of the literature review and a discussion of the relevant aeromedical concerns and aeromedical disposition of civilian pilots will be presented. **DISCUSSION:** An understanding of the underlying causes of functional asplenia or splenectomy, infection prophylaxis measures, and monitoring parameters are important for determination of aeromedical disposition and effective management and surveillance of pilots with this condition.

Learning Objectives:

1. Identify etiologies of functional asplenia and splenectomy.
2. Describe approriate prophylaxis measures for patients with functional asplenia or splenectomy.
3. Describe the aeromedical concerns and the aeromedical disposition of pilots with functional asplenia or splenectomy.

[107] CELIAC DISEASE IN THE AVIATOR

D. Van Syoc
Aeromedical Consultation Service, USAFSAM, Wright-Patterson AFB, OH

MOTIVATION: There has been an increased interest in recent years about food allergies and sensitivities. Prominent among them are those maladies related to wheat proteins. Celiac disease (CD) is a common wheat-related illness that can create significant aeromedical concerns. **OVERVIEW:** Once thought to be limited to gastrointestinal disease, CD is now characterized by autoimmune injury to multiple organs, and the manifestations are varied. Frequent manifestations of CD include chronic diarrhea, weight loss, bloating and gas, distention, and abdominal discomfort. It is also noteworthy to mention that about half of all patients have only extraintestinal symptoms. The mainstay of treatment is the gluten-free diet, and most of the treatment failures are due to a lack of strict adherence to the diet. **SIGNIFICANCE:** Many factors need to be taken into consideration before granting a waiver to an aviator with diagnosed CD. Does the member closely adhere to a gluten-free diet and is it feasible for him/her to do so under the current/projected operational demands? Are there any additional associated conditions like dermatitis herpetiformis, diabetes, or occult gastrointestinal malignancies? How often does the aviator need to be clinically evaluated, and is good medical care readily available? In general, as long as the aviator is symptom free and can easily get access to gluten-free foods, it is most likely reasonable to consider a waiver for military and civilian aviators.

Learning Objectives:

1. Understand that Celiac Disease (CD) presents in a number of organ systems.
2. Stress that the gold-standard treatment for all manifestations of CD is the gluten-free diet.
3. Understand that half of all CD patients have only extraintestinal symptoms.

[108] CHRONIC KIDNEY DISEASE: AN AEROMEDICAL UPDATE

K.D. Alford
United States Air Force, Wright-Patterson AFB, OH

MOTIVATION: Chronic kidney disease (CKD) is a common condition affecting 10% of adults in the United States. CKD affects all organ systems with several complications of aeromedical importance. **OVERVIEW:** CKD is defined by evidence of kidney damage or a reduction in glomerular filtration. While some causes of renal failure are reversible, the primary management of CKD focuses on slowing the rate of disease progression and managing the complications of renal failure. The aeromedical consequences of advanced renal disease arise from electrolyte disturbances, hypertension, and anemia. Furthermore, CKD is an independent risk factor for major adverse cardiovascular events placing aviators at increased risk for sudden incapacitation. The management of CKD requires close monitoring and active management of the aviator's medication list. **SIGNIFICANCE:** As the primary risk factors for the development of CKD – diabetes mellitus and hypertension – are increasing in prevalence in populations similar to the aviator population, CKD is likely to be encountered more frequently by the aerospace medicine practitioner. Appropriately monitoring for and treating the complications of CKD can prolong aviator health and improve aviation safety.

Learning Objectives:

1. Identify the aeromedical implications of chronic kidney disease.
2. Summarize methods to monitor and reduce progression of chronic kidney disease.

Monday, May 01 ***4:00 PM***
Plaza A/B

S-022: PANEL: EATING DISORDERS IN THE MILITARY AND THE IMPACT ON AEROSPACE MEDICINE

Chair: Laura Bridge
Beavercreek, Ohio

Chair: Meredith Brinegar
Dayton, OH

PANEL OVERVIEW: Research into the incidence and prevalence of eating disorders in the military is sparse. Evidence supports the conclusion that military members are at increased risk for developing an eating disorder and for the use of risky, disordered eating behaviors. The prevalence of eating disorders and disordered eating behaviors in the military appears to exceed that of the general population. To the knowledge of the panel presenters, there are no studies examining the incidence or prevalence of eating disorders in military aerospace medicine. These disorders remain under-recognized and underdiagnosed and can be associated with significant morbidity and mortality. Medical complications are common, may mimic other diagnoses, and may go undetected by the flight surgeon. The potential risks to the individual health and well-being of the aviator, crew safety, and mission readiness are high. Consequently, there is a need to increase education about eating disorders among aerospace medicine professionals. This multidisciplinary panel will provide an overview of eating disorders, discuss risk factors that may be unique to the military environment, explain medical complications and their aeromedical significance, and discuss strategies for a multidisciplinary approach to the care of the affected aviator.

[109] AVIATORS AND EATING DISORDERS: RECOGNIZING AND TREATING AN UNDERDIAGNOSED DISEASE IN THE FLIGHT MEDICINE CLINIC

L.M. Bridge[2] and M.G. Brinegar[1]
[1]Private Practice, Dayton, OH; [2]Aeromedical Consult Service, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

PROBLEM STATEMENT: A 31-year old, male, U.S. Air Force flight engineer presented to the flight medicine clinic after his aircraft commander reported concerns about the member's weight loss and eating habits during a deployment. **BACKGROUND / LITERATURE REVIEW:** Eating disorders are serious medical conditions with potentially fatal complications. Studies indicate that the rates of eating disorders in the military are significantly higher than the general population. It is suspected that multiple risk factors unique to the military environment may contribute to this higher incidence and prevalence, including stressors related to fitness and duty requirements, deployments, increased likelihood of trauma exposure, and geographic separation from support networks. Additional identified contributors include emphasis on elite athleticism, family strain, and job-related stress. Barriers to diagnosis and appropriate care include lack of knowledge and preconceived

stereotypes held by both providers and patients, reluctance of members to disclose symptoms due to fear of adverse career consequences, and fear of stigmatization. **CASE PRESENTATION:** The member was observed to eat little in the dining facility and to play with his food. He lost 15 lbs. over 6 months. He ultimately admitted to restrictive eating, over-exercise, fear of weight gain, and past binging and purging behavior. He was diagnosed with eating disorder not otherwise specified and referred to an intensive outpatient program. His case was complicated by duty-limiting gastrointestinal symptoms and by subacute hypothyroidism. His treatment required a multidisciplinary, integrated care approach. **OPERATIONAL / CLINICAL RELEVANCE:** There are multiple risk factors inherent in the military aviation environment that may lead to the development of significant disordered eating patterns or clinical eating disorders in susceptible aviators. Despite estimations that the rate of eating disorders within the military is elevated above the general population, eating disorders remain under-recognized, under-diagnosed, and under-treated in flight medicine clinics. Serious medical complications are common with these disorders and can result in significant aeromedical impact. There is a need to raise awareness among all aerospace medicine providers in order to improve the health of individuals and to reduce aeromedical risk and protect mission readiness.
Learning Objectives:
1. Understand the risk factors that predispose susceptible military aviators to develop eating disorders and disordered eating behaviors and barriers that may lead to a delay in diagnosis.
2. Explain the importance of an integrated, multidisciplinary approach to the medical and mental health care of an aviator with an eating disorder.
3. Describe the aeromedical significance of eating disorders and apply principles of aeromedical risk assessment and aeromedical decision-making with respect to the medical complications of eating disorders.

[110] THE MEDICAL COMPLEXITY OF EATING DISORDERS: DIAGNOSIS, MANAGEMENT, AND AEROMEDICAL RISK

L.M. Bridge
Aeromedical Consultation Service, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

PROBLEM STATEMENT: A 36-year-old, male, US Air Force 0 electronics warfare officer with a history of nephrolithiasis presented to the flight medicine clinic with a complaint of a sore throat. Upon evaluation, his flight surgeon noted a concerning weight gain. The member admitted that he used binging and purging behaviors to cope with stress. **BACKGROUND / LITERATURE REVIEW:** Medical complications of eating disorders (EDs) are frequent, affect every organ system, and result in significant morbidity and mortality. Of all psychiatric conditions, anorexia nervosa conveys the highest mortality. Bulimia also increases risk of death. Signs and symptoms related to end-organ effects of EDs may be the first presenting features in military aviators who are reluctant to discuss disordered eating behaviors due to fear of stigmatization or adverse career consequences. Poor understanding of the presenting features of EDs commonly seen in a primary care setting can result in unnecessary testing and diagnostic delay. Appropriate management of EDs requires screening and monitoring for common and potentially serious or life-threatening medical complications that arise due to weight loss, binging, or purging behaviors. **CASE PRESENTATION:** The member was diagnosed with eating disorder, not otherwise specified. His sore throat was attributed to gastroesophageal reflux disease, caused or worsened by binging, self-induced vomiting, and obesity. He developed recurrent and retained renal calculi, exacerbated by non-adherence to a therapeutic diet. Additional history was suggestive of obstructive sleep apnea. Successful treatment of his multiple comorbidities required intervention for his underlying ED. **OPERATIONAL / CLINICAL RELEVANCE:** Aviators with EDs may present to the flight medicine clinic with non-specific symptoms and signs due to a variety of medical complications caused by weight loss or disordered, maladaptive behaviors. Accurate aeromedical risk stratification and mitigation requires the flight surgeon to arrive at the correct diagnosis and effectively screen for and treat all comorbid factors. To optimize the health of affected individuals and to clearly define and minimize aeromedical risk in order to avoid potentially jeopardizing other crewmembers or the mission, there is a need to improve education and understanding among all flight medicine personnel about the common multisystem effects of EDs.
Learning Objectives:
1. Identify common somatic complaints and abnormal diagnostic findings that may suggest an underlying eating disorder in the appropriate clinical context and understand the relationship of these signs and symptoms with weight loss, binging, or purging behaviors.
2. Describe the medical evaluation of an individual with an eating disorder and identify appropriate screening and monitoring tests.
3. Describe the multisystemic medical complications of eating disorders and how they can impact aeromedical risk.

[111] BEHAVIORAL ASSESSMENT AND INTERVIEW STRATEGIES FOR THE PCP: AS APPLIED TO SUSPECTED EATING DISORDERS IN THE MILITARY PATIENT

G. Ford
Neuropsychiatry Branch, USAFSAM, WPAFB, Springfield, OH

PROBLEM STATEMENT: Eating disorders (EDs) are rated among the most improperly diagnosed and difficult to discuss of the mental disorders. Interview and assessment strategies for the flight surgeon and primary care physician to assess and discuss the topic of EDs with their patient are significantly limited. In the general population, EDs may not be self-disclosed with the primary care physician until the patient is experiencing obvious health and emotional problems. Primary care providers may be not be comfortable or have the time or training to initiate an adequate supportive assessment and dialogue with their patients regarding a very sensitive mental health and medical problem. In the military, there are a number of possible negative consequences due to weight and body requirements when self-identifying a condition that is considered a psychiatric disorder. **BACKGROUND/LITERATURE REVIEW:** Research studies and specific interview and diagnostic guidelines to instruct the flight surgeon and primary care physician in psychiatric interviewing and counseling techniques for military patients who present with various low base psychiatric disorders are quite limited. However, specialists in EDs estimate that the number of military members with ED symptoms is significantly higher due to suspected unreported eating problems. **OPERATIONAL/CLINICAL RELEVANCE:** Psychology and psychiatry can support the primary physician by sharing interview and assessment strategies to begin a dialogue with the patient in a non-threatening manner. Several validated and brief questionnaires and interview strategies that address the ED topic with patients, including the SCOFF clinical scale, eating disorder screen for primary care, BATHE technique, and motivational interviewing, will be discussed with examples of each.
Learning Objectives:
1. Share with the flight surgeons and primary care physicians several brief ED assessment instruments that can be administered in the primary care environment in a relatively short amount of time.
2. Discuss several interview techniques that can initiate the conversation with the patient regarding concerns the patient has about eating and overall health and well-being, using a supportive motivational interviewing type strategy.
3. Increase collaboration between the flight surgeon, primary care physician, and mental health professionals; in order to ease some of the stress and time involvement when confronted with medical cases that have a mental health component.

[112] PSYCHOLOGICAL TREATMENT OF EATING DISORDERS IN THE CONTEXT OF A MULTIDISCIPLINARY TEAM

M.G. Brinegar
Private Practice, Dayton, OH

MOTIVATION: Eating disorders (EDs) are complex conditions with a slow, nonlinear recovery process. They are psychiatric disorders with clear medical, behavioral, and dietary components. In addition, the high rate of psychiatric comorbidity makes treatment more challenging. As such, the care of EDs requires a multidisciplinary team

of specialized providers. It is critical that aerospace medicine specialists responsible for the primary care of persons suffering from EDs be familiar with the modalities of treatment that are standard of care. **OVERVIEW:** This presentation will focus on the assembly of a qualified treatment team and will examine the psychological and dietary aspects of treatment in greater depth. It is important that primary providers who identify disordered eating behaviors be able to refer their patient to the appropriate specialists to optimize the chances for recovery. In the context of military medicine, referral outside of the military treatment facility and coordination with civilian providers is often necessary in order to appropriately treat these complex conditions. Evaluation by a therapist trained in ED diagnosis and psychotherapy is essential. Psychiatrists familiar with ED treatment can titrate medications to address both the ED and underlying psychiatric or personality problems. Dietitians typically monitor weight and create and implement a meal plan. The experience of treatment team members and their communication with each other improves care, given that those who suffer from EDs frequently minimize symptoms due to a resistance to change or lack of insight into the maladaptive nature of their disorder. Underreporting may be particularly problematic in the military aviation setting, where there are various deterrents to disclosure of the full extent of the disorder. **SIGNIFICANCE:** EDs develop as mechanisms to cope with underlying life stress and, in some cases, comorbid psychiatric disorders. Educating flight surgeons about the essentials of ED treatment will improve coordination of care to address all of its facets. Focusing only on symptom relief without addressing the precipitating factors puts individuals at risk for relapse. For this purpose, sustained psychotherapy even after ED behaviors are eliminated is strongly recommended. EDs are complex and take time to treat, but if this complexity is honored and underlying concerns are addressed by a multidisciplinary team, full recovery is possible.

Learning Objectives:

1. Identify the different disciplines involved in the treatment of eating disorders and describe their role on the multidisciplinary team in the care of persons with eating disorders.
2. Explain the psychological obstacles to creating change.
3. Describe the natural history of eating disorders and explain the importance of sustained treatment in the maintenance of psychological and physical health of persons with eating disorders and in the prevention of relapse.

[113] THE NEW (AND IMPROVED) DIAGNOSTIC CRITERIA FOR FEEDING AND EATING DISORDERS: IT IS NOT WHAT YOU LEARNED IN SCHOOL

R. Peirson[1,2]

[1]Aeromedical Consultation Service - Neuropsychiatry, United States Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH; [2]Psychiatry, Wright State University Boonshoft School of Medicine, Dayton, OH

PROBLEM STATEMENT: Eating disorders rate among the most improperly diagnosed mental disorders. The majority of eating disorders are diagnosed as eating disorders, not otherwise specified. This is due, in part, to a mismatch in the diagnostic criteria to the natural history of eating disorders. In 2013 the diagnostic criteria were changed to improve the sensitivity and specificity of the diagnosis. A large number of flight medicine practitioners were trained prior to this change and may be unaware of its implications. **TOPIC:** The presentation will focus on the changes in diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition as compared to the previous edition (4th edition). Clinical and practical examples will be given to clarify the material. **APPLICATIONS:** The cross-cultural prevalence of eating disorders is variable, but significant in many countries. The particular focus on body image and health in the aviation setting may serve to minimize detection. Awareness of diagnostic changes will assist clinicians in providing the best care for their patients and improve disease surveillance. The topic is generalizable to military, commercial, and general aviation environments.

Learning Objectives:

1. Understand the basic changes in the diagnostic criteria of eating disorders.
2. Identify major changes in the diagnosis of anorexia nervosa and bulimia nervosa.

Monday, May 01 ***4:00 PM***
Plaza D/E

S-023: PANEL: INCORPORATING PSYCHOLOGICAL READINESS EVALUATIONS INTO MEDICAL STANDARDS FOR BATTLEFIELD AIRMAN DUTY

Chair: Hernando Ortega
San Antonio, TX

Chair: Emily Skinner
Dayton, OH

PANEL OVERVIEW: This panel presents the current state of the U.S. Air Force School of Aerospace Medicine's (USAFSAM) psychological testing efforts in support of Battlefield Airmen alignment and sustainment. It summarizes the past 5 yr of operational psychological research efforts, reviews the science developed, presents the methodology and product used in the Air Education and Training Command, and proposes integration of these findings into initial physical examination and fitness for duty standards. This panel includes an initial presentation of the problems facing the Battlefield Airmen career fields and early efforts to address high attrition rates in training, as well as the unique problems associated with providing precision-based medical and mental health care to special duty operators. The panel will then describe the approach, principles, and concepts used to develop measures of psychological "suitability" for creating a more holistic assessment process of special duty operators and for augmenting precision-based operational medicine practices and optimizing individually tailored human performance strategies. The panel will also briefly review results of USAFSAM aeromedical operational studies in the published literature that include the statistical methods applied and overall results for evaluating special duty operator and training candidate states of psychological readiness. The panel will include a review of the Specialty Training Adaptability and Readiness Rating and psychological topography resulting from USAFSAM studies. This will involve discussion of its specific use in pre-training, training, and post-training scenarios for enhancing performance and precision-based medicine. Finally, the panel will conclude with a description of how the Specialty Training Adaptability Rating supports operational and flight medicine procedures, as well as a proposed rationale and methodology for incorporating psychological suitability into medical standards and records for special duty operators.

[114] INCORPORATING PSYCHOLOGICAL READINESS EVALUATIONS INTO MEDICAL STANDARDS FOR BATTLEFIELD AIRMAN DUTY

R. Schultz[1], E. Skinner[4], W. Chappelle[3] and W. Thompson[2]

[1]711 Human Performance Wing, Longmont, CO; [2]Experimental Psychology/Physiology/Biostatistics, Neurostat Analytical Solutions, LLC, San Antonio, TX; [3]Neuropsychiatry, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH; [4]USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

MOTIVATION: Battlefield Airman (BA) Operators are frequently involved in demanding direct ground combat operations which require a high degree of physical, cognitive and non-cognitive capability. Subsequently, the training pipelines are lengthy and very rigorous; frequently challenging trainees in dynamic and deliberately uncertain environments to ensure they are prepared for the demands of modern combat. Historically, the BA training pipelines have been challenged with very high attrition rates, limiting AETC's ability to adequately produce qualified forces to meet operational demand. Proper psychological support and care in the training pipelines and most of the operational units have been non-existent. There are validated requirements to have integrated operational support to be an effective and sustainable force.

OVERVIEW: The Aeromedical Operational Psychology (AOP) Program implements precision based psychological support and care. This is accomplished through deliberate psychological screening and testing utilized to create the Specialty Training Adaptability and Readiness (STAR) rating which builds on other data factors to improve the whole person analysis of BA candidates/operators. It provides a quantified, AFSC specific rating on an individual's potential for success with a high level fidelity of a candidate/operator's strengths and weaknesses. Furthermore, it provides a psychological baseline for cradle-to-grave tracking, sustainment and maintenance throughout an individual's career. The STAR topographies utilized by credentialed and trained psychologists to assess pre-post injury recovery and readiness provides precision based medicine. **SIGNIFICANCE:** The AOP Program fills a broad capability gap in care and sustainment of the Battlefield Airman force through embedded elements within the Battlefield Airman units. These integrated support elements will improve training, readiness, and sustainment of the force with real time care and support. The utilization of the STAR rating in conjunction with psychologist review/interviews within the BA pipelines provides a validated tool for predicting potential performance outcomes in Battlefield Airman AFSCs. This screening also produces a profile used to individually customize training, mentorship and whether a candidate/operator meets aeromedical readiness requirements. This data can be used as a tool for improving precision based healthcare evaluations and tailoring strategies in an Airmen's lifecycle.

Learning Objectives:

1. Understand how utilization of non-cognitive psychological testing and evaluations can improve pipeline production and help in life-cycle sustainment of Battlefield Airman.

[115] THE DEVELOPMENT AND IMPLEMENTATION OF STATISTICAL MODELS IN THE IDENTIFICATION OF SUITABILITY AND ADAPTABILITY OF AIR FORCE SPECIAL DUTY TRAINEES

E. Skinner[3], W. Thompson[1] and W. Chappelle[2]
[1]Experimental Psychology/Physiology/Biostatistics, Neurostat Analytical Solutions, LLC, San Antonio, TX; [2]Neuropsychiatry, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH; [3]USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

MOTIVATION: AF Special Duty career fields have experienced high rates of attrition for several decades. Subject Matter Experts within the career fields identify that a key element for failure in training is not a trainee's intelligence but rather their inability to emotionally adapt to the rigors of training. There is a growing body of literature focused on cognitive emotional control that provides great insight into the underlying causes resulting in failure to complete training. This six year study resulted in the development of statistical models which provide clinical psychologists objective insight into the underlying non-cognitive emotional profiles of training candidates. These models have been identified as the STAR (Special Tactics Adaptability Readiness) rating. This insight allows clinicians better opportunities to assess suitability of training candidates and additionally, provide targeted precision-based psychological support for trainees while in training, and throughout the life cycle of their operational careers. **OVERVIEW:** Data presented will focus on Battlefield Airman and SERE training candidates over six years of model development and validation of training outcomes from FY 2011 to FY 2016. Methods used for analysis will be described along with the reasoning and development of topographical maps for interpretive purposes. Utility of each method will be compared demonstrating justification for the use of survival analysis in use today. **SIGNIFICANCE:** The use of an objective STAR rating, along with the additional screening tools used for identifying those trainees who can adapt to the rigors of training and operations in Battlefield Airman career fields, will enable both leadership and medical support to more accurately assess if a given trainee should be retained, recycled or removed from operations. The result will be both increased efficiency within the given pipeline of interest, increased efficiency in providing target-specific, precision-based medical treatment, and enhancement in quality of life and longevity of the career of the operator.

Learning Objectives:

1. To provide a better understanding of how statistical modeling along with clinical assessment provides a more efficient screening methodology for selection.
2. To provide insight into how statistical modeling addresses interaction among variables not necessarily readily observed from viewing individual variable scores.
3. To help better understand the difference between statistical significance, clinical significance and operational significance.

[116] THE OPERATIONAL UTILITY OF PSYCHOLOGICAL TOPOGRAPHIES IN ASSESSING OPERATIONAL READINESS AND GUIDING PRECISION-BASED MEDICAL TECHNIQUES

E. Skinner[3], W. Chappelle[2] and W. Thompson[1]
[1]Experimental Psychology/Physiology/Biostatistics, Neurostat Analytical Solutions, LLC, San Antonio, TX; [2]Neuropsychiatry, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH; [3]USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

MOTIVATION: The enhancement of human performance has become an enduring focus throughout the Department of Defense and is of particular relevance for those developing and applying precision-based medical strategies to preserve and improve the capabilities of our military's premier special duty operators. There is a growing body of research indicating non-cognitive aptitudes and personality traits significantly influence training and performance outcomes. Within a military context, research supports the notion that psychological functioning in emotional, behavioral, and social domains is key to successfully responding and adapting to the rigors of special operations training and throughout the lifecycle of the operators career. **OVERVIEW:** A psychological topography is a graphic display of thirty facets of personality assessed pre-training. Development aimed to assist psychologists in evaluating candidate readiness by: (a) demarcating psychological (emotional, social, behavioral) strengths and weaknesses related to adaptation to training demands; and (b) displaying qualitative and quantitative differences among a candidate's psychological profile to that of a cohort of successful battlefield airmen. The functional utility extends beyond training into the realm of enhancing and sustaining performance by developing individualized performance enhancement strategies through targeting specific areas of non-cognitive functioning key to readiness and performance. Additionally, baseline assessment and development of psychological topographies can be integral to restoring performance and facilitating recovery after critical events, trauma, or injury by overlaying test results and topographies from pre-/post-injury to immediately identify where the operator may be experiencing difficulties and require mental health support. **SIGNIFICANCE:** Psychological topographies may be utilized to shape personnel selection and aeromedical practices by targeting specific areas of psychological functioning and personality traits key to readiness and performance for high-risk, high-demand career fields. The translational application of candidate topographies is multifaceted, providing aspects of operational relevance throughout the progression of a person's military career and can be utilized as an additional tool for psychologists to add to their repertoire of instruments geared toward providing precision-based evaluation and performance improvement and recovery strategies.

Learning Objectives:

1. The participant will be able to understand the various ways in which psychological topographies may be utilized in operational communities.

[117] A PROPOSED METHODOLOGY FOR INCORPORATING "STAR" PSYCHOLOGICAL SUITABILITY INTO USAF MEDICAL STANDARDS

H.J. Ortega[1,2]
[1]Flight Docs Unlimited, LLC, San Antonio, TX; [2]USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

MOTIVATION: It is imperative for the USAF to adapt to emerging and continuously evolving missions requirements by improving processes for evaluating and establishing the readiness of individuals for engagement in high risk, high demand missions and duty positions. The developing data on suitability for Battlefield Airman training is now strong enough to warrant inclusion into medical standards selection processes in the USAF. **OVERVIEW:** The DOD has established physical and medical standards for appointment, enlistment, or induction into the Military Services. Two of the major goals of standards are estimating if the applicant is capable of satisfactorily completing required training and is adaptable to the military environment. Since the 1930s, the USAF has used the Adaptability Rating for Military Aviation (ARMA) to assess the motivational and mental stability of aviation personnel. Tests range from a highly structured interview with accompanying point scale to simply noting a sense of poise and appropriateness during the physical exam process, a mostly subjective process. The Specialty Training Adaptability and Readiness (STAR) Rating supports flight and operational medicine procedures by providing an objective adjunct to the traditional ARMA. **SIGNIFICANCE:** Proposed wording for incorporating the STAR rating into USAF guidance is presented for discussion. The majority of Battlefield Airman Initial Flying Class (IFC) III or Special Duty examinations are performed at Lackland AFB. Initial procedures for considering STAR ratings in the Lackland physical exam process are proposed. Procedures for inclusion of STAR rating topographies into the medical record are outlined. Initial recommendations for waiver process at AETC and medical technician / physician training at USAFSAM are also presented.

Learning Objectives:

1. Gain perspective on the history of USAF's Adaptability Rating for Military Aviation (ARMA).
2. Understand how the Specialty Training Adaptability and Readiness (STAR) Rating supports flight and operational medicine operations.
3. Become familiar with proposed procedures for inclusion of STAR rating topographies into the physical examination ARMA determination and the medical record.

[118] MODERNIZING AEROMEDICAL PSYCHOLOGICAL EVALUATIONS FOR BATTLEFIELD AIRMEN TRAINING CANDIDATES

W. Chappelle
Aeromedical Psychology, USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: Battlefield airmen represent an elite group of airmen in aviation related career fields that are essential to fulfilling complex, high risk, high demand USAF missions across the globe. However, training attrition (30 – 90%) as well as aeromedical sustainment due to the risk for illness/injury within these career fields is high. The increasing problems with attrition and sustainment suggest the modernization to psychological tools is needed for assessing the readiness of training candidates to adapt to the high risk, high demand requirements for these career fields. **METHODS:** Approximately 3000 Battlefield Airmen training candidates were tested (2010 – 2016) several weeks prior to training using personality based measures assessing a wide range of emotional, social, and behavioral patterns of functioning. The testing measures were merged with training and medical outcomes. Statistical regression procedures were utilized to identify psychological predictors of performance and training outcomes. **RESULTS:** The results of the study reveal a collective combination of non-cognitive psychological areas of functioning predictive of outcomes. Regression analyses incorporating pre-training psychological testing scores may be used to develop an empirically based numerical rating delineating the psychological "readiness" of a training candidate as well as awareness of each candidates' strengths and weaknesses with regard to their ability to psychologically adapt to career field requirements throughout the course of their lifecycle. **DISCUSSION:** The outcomes of the study reveal the importance of including psychological testing and assessments within aeromedical evaluation processes when determining the readiness and capabilities of battlefield training candidates and operators. Discussion is provided on how results may be used to modernize aeromedical alignment and sustainment processes throughout the course of a battlefield airman's lifecycle.

Learning Objectives:

1. Psychological assessment of emotional, social, and behavioral areas of functioning are important to assessing the readiness of battlefield airmen training candidates.
2. Psychological areas of functioning have a significant impact on a candidate's performance and ability to adapt to training requirements.
3. Holistic approaches to assessing readiness that include psychological functioning are more effective than non-holistic approaches that only evaluate physical and cognitive functioning.

Monday, May 01 ***4:00 PM***
Plaza F

S-024: SLIDE: SPACE ENVIRONMENT COUNTERMEASURES & RISKS

Chair: Jeff Myers
Merritt Island, FL

Co-Chair: Charles Mathers
Galveston, TX

[119] COMPUTATIONAL MODELING OF SPACE PHYSIOLOGY FOR INFORMING SPACEFLIGHT COUNTERMEASURE DESIGN AND PREDICTIONS OF EFFICACY

B.E. Lewandowski[1], J.K. DeWitt[2], C.A. Gallo[1], K.M. Gilkey[1], A.P. Godfrey[3], B.T. Humphreys[3], K.M. Jagodnik[4], M. Kassemi[5], J.G. Myers[1], E.S. Nelson[1], J.A. Pennline[1], G.P. Perusek[1], W.K. Thompson[1], C.R. Werner[3] and M.M. Nall[1]
[1]NASA Glenn Research Center, Cleveland, OH; [2]KBRWyle, Houston, TX; [3]ZIN Technologies, Cleveland, OH; [4]Baylor College of Medicine, Houston, TX; [5]Case Western Reserve University, Cleveland, OH

MOTIVATION: Spaceflight countermeasures mitigate the harmful effects of the space environment on astronaut health and performance. Exercise has historically been used as a countermeasure to physical deconditioning, and additional countermeasures including lower body negative pressure, blood flow occlusion and artificial gravity are being researched as countermeasures to spaceflight-induced fluid shifts. The NASA Digital Astronaut Project uses computational models of physiological systems to inform countermeasure design and to predict countermeasure efficacy. **OVERVIEW:** Computational modeling supports the development of the exercise devices that will be flown on NASA's new exploration crew vehicles. Biomechanical modeling is used to inform design requirements to ensure that exercises can be properly performed within the volume allocated for exercise and to determine whether the limited mass, volume and power requirements of the devices will affect biomechanical outcomes. Models of muscle atrophy and bone remodeling can predict device efficacy for protecting musculoskeletal health during long-duration missions. A lumped-parameter whole-body model of the fluids within the body, which includes the blood within the cardiovascular system, the cerebral spinal fluid, interstitial fluid and lymphatic system fluid, estimates compartmental changes in pressure and volume due to gravitational changes. These models simulate fluid shift countermeasure effects and predict the associated changes in tissue strain in areas of physiological interest to aid in predicting countermeasure effectiveness. **SIGNIFICANCE:** Development and testing of spaceflight countermeasure prototypes are resource-intensive efforts. Computational modeling can supplement this process by performing simulations that reduce the amount of necessary experimental testing. Outcomes of the simulations are often important for the definition of design requirements and the identification of factors essential in ensuring countermeasure efficacy.

Learning Objectives:
1. The learning objective of this presentation is to understand how computational modeling can supplement research of spaceflight countermeasures.

[120] THE EFFECT OF NORMOBARIC AND HYPERBARIC HYDROGEN THERAPY FOR RADIATION SKIN INJURY IN RATS

M. Fujita[1], S. Watanabe[2], M. Ishihara[3], T. Nakamori[1], K. Takada[1] and Y. Kanatani[4]
[1]Division of Environmental Medicine, National Defense Medical College Research Institute, Tokorozawa, Japan; [2]Department of Radiology, National Defense Medical College, Tokorozawa, Japan; [3]Division of Biomedical Engineering, National Defense Medical College Research Institute, Tokorozawa, Japan; [4]Department of Health Crisis Management, National Institute of Public Health, Wako, Japan

INTRODUCTION: Radiation-induced injury is one of major topics in the field of clinical medicine or aerospace medicine. Due to the major role of the reactive oxygen species (ROS) in the injury, hydrogen was anticipated therapy or prophylaxis. Recently, it have been demonstrated that molecular hydrogen (H2) can selectively reduce cytotoxic ROS. We tried to examine the efficacy of normobaric and hyperbaric hydrogen therapy using hydrogen-containing gas (hydrogen (1.3%) + oxygen (20.8%) + nitrogen (77.9%)) for radiation-induced dermatitis and healing-impaired skin injury. **METHODS:** The effect of hydrogen therapy on radiation-induced dermatitis and healing of healing-impaired skin wounds was examined using Male Sprague-Dawley rats weighing about 350 g (10 weeks old). An X-ray dose of 20 Gy was irradiated onto the lower part of the back. Normobaric hydrogen therapy (2 hours at 1atm) and hyperbaric hydrogen therapy (2 hours at 3atm) was performed before or after irradiation. **RESULTS:** Hydrogen therapy before irradiation reduced the severity of radiodermatitis, accelerated healing-impaired wound repair, and apoptotic keratinocytes. Radiation-induced skin injury can potentially be alleviated by hydrogen therapy before irradiation. In our protocol, normobaric and hyperbaric hydrogen therapy generated same effects. Hydrogen therapy after irradiation generated no effects. **DISCUSSION:** Hydrogen therapy may be easier and safer prophylaxis to prevent the radiodermatitis. The hydrogen therapy before irradiation may provide a new clinical therapy in the treatment of radiodermatitis and oxidative damage caused by radiation treatment. Also hydrogen therapy may be expected prophylaxis for radiation injury from the aspect of aerospace medicine.

Learning Objectives:
1. The effect of hydrogen therapy before irradiation for rat radiation injury is described.
2. Hydrogen therapy before irradiation may be expected prophylaxis for radiation injury and valuable from the aspect of aerospace medicine.
3. Normobaric and hyperbaric hydrogen therapy generate same effects in our protocol.

[121] A PROTOCOL TO ELIMINATE THE CROSS-COUPLED ILLUSION DURING CENTRIFUGE ARTIFICIAL GRAVITY ROTATION

A. McCusker, K. Bretl, J. Dixon and T.K. Clark
Aerospace Engineering Sciences, University of Colorado at Boulder, Boulder, CO

INTRODUCTION: Prolonged exposure to microgravity causes physiological deconditioning in astronauts, but it may be prevented by artificial gravity (AG) produced by a centrifuge. However, the spinning environment creates the vestibular cross-coupled (CC) illusion (i.e., Coriolis illusion) when out of plane head tilts are made leading to motion sickness. Prior studies suggested spinning at < ~4 rotations per minute (rpm) to ensure CC illusions are tolerable, which requires a 112m diameter centrifuge to produce 1 Earth G of centripetal acceleration. For a more feasible, shorter-diameter design, a higher spin rate is required causing more intense CC illusions. However, based upon recent research, we hypothesize that with extended exposure (i.e., training) subjects will be able to tolerate higher rotation rates. **METHODS:** We utilize a protocol in which spin rate is incrementally modulated, on a personalized basis, such that the CC illusion is always near the subject's threshold (i.e., barely or not at all noticeable). After each prescribed head tilt, the subject reports whether they experienced any CC illusion. If none is experienced, the spin rate is incrementally increased by 1 rpm; otherwise it is maintained. This process continues for a 1hr session. Sessions are performed daily for 10 days. **RESULTS:** Our preliminary data (N=8 with 2 consecutive days) suggest this approach to be effective in enhancing the tolerable spin rate. At the beginning of the first day's session, 7/8 subjects perceived some CC illusion at the initial spin rate of 2rpm. By the end of the second day's session, the subjects reached an average spin rate of 5.3rpm (range=4-10). Furthermore, all 8 subjects were able to complete the 2 sessions without attrition due to motion sickness. Our current experiments aim to extend these results by training for many consecutive days. **DISCUSSION:** We hypothesize this training approach will lead to substantially higher spin rates (e.g., 15-20rpm) yielding no perception of the CC illusion. If higher spin rates are allowable, than it may be feasible to produce AG with a shorter radius centrifuge (e.g., 20rpm spin can create 1G with only a 4.4m diameter centrifuge). Through a series of brief training sessions, these results may make AG a more feasible countermeasure for spaceflight-induced physiological deconditioning, enhancing human space exploration capabilities.

Learning Objectives:
1. The intensity of the cross-coupled illusion can be reduced through a training exposure protocol, allowing for faster spin rates and thus a shorter radius of a centrifuge artificial gravity system for crewed space exploration.

[122] MEDICAL MALPRACTICE SUITS AGAINST COMMERCIAL SPACE PHYSICIANS AND OPERATORS BY CO-EMPLOYEES AND/OR SFPS

M. Carminati[1,2]
[1]University of Houston Law Center, Pearland, TX; [2]School of Law, University of Nebraska - Lincoln, Lincoln, NE

Despite ample jurisprudence limiting exposure for a physician's actions, especially when those physicians are employees or otherwise agents of a company, there are circumstances when physicians transcend the statutory or judicially created relationship and expressly or implicitly create a physician-patient relationship by providing diagnostic treatment and advice upon which the examinee relies. Physicians may wish to rely on their status as a contractor or a co-employee to claim immunity from a medical malpractice suit. However, these defenses have limits and well-established loopholes. In such a case, the physician's diagnostic and treatment advice to the patient (whether that patient is a crewmember or an SFP) transforms the relationship, and thus the duty, into one sounding in medical malpractice. In order to manage liability, therefore, CHSF operators should carefully manage the information flow between the SFPs, crewmembers, and the physicians employed by the CHSF Operator. They should also provide clear information to both regarding the scope of the relationship. This presentation lays out the factors that would transform an otherwise co-employee relationship into a physician-patient relationship that would therefore create liability. The presentation also looks at the possible ways an SFP could maintain a suit against a physician employed by a CHSF Operator.

Learning Objectives:
1. To understand under what circumstances a physician becomes an agent of the spaceflight operator and the effects of this agency on liability exposure for both the physician and the spaceflight operator.
2. To understand the concept of co-employee immunity, why it exists, and how it applies to liability between crewmembers and their physicians.
3. To understand the sources of duty between the SFP/Crewmembers and CHSF Physicians and how a physician can lose co-employee immunity.

[123] HIGH-ALTITUDE GROUND OPERATIONS UPDATE

C.B. Dodson
USAFSAM Research Dept., 711th Human Performance Wing, Wright-Patterson AFB, OH

PROBLEM STATEMENT: Military ground operations by some units occur at high elevations such as found in some parts of Afghanistan. Preventing and/or treating altitude illnesses is a required skill in these settings. Lack of this knowledge can cause mission failure. This topic is pertinent to the medical professionals who oversee personnel engaged in high-altitude ground operations. **TOPIC:** This session will cover etiologic factors in altitude illnesses such as acute mountain sickness, high-altitude pulmonary edema, and high-altitude cerebral edema; the prophylaxis and treatment of these altitude illnesses; and the use of pressure gear such as Gamov bags in these settings. **APPLICATIONS:** Knowledge gained in high-altitude mountain medicine has immediate impact on improving safety and enhancing mission success during high-altitude ground operations and is also useful to units of all U.S. military branches as well as to all international military and civilian organizations that conduct ground operations at high altitude including combat operations as well as search and rescue.

Learning Objectives:

1. Describe the factors that put a service member at risk for illnesses induced by high-altitude ground operations.
2. Describe the basics of: acute mountain sickness, high-altitude pulmonary edema, and high-altitude cerebral edema.
3. List the interventions to prevent and/or to treat altitude illnesses.

Monday, May 01 ***4:00 PM***
Governor's Square 14

S-025: PANEL: HOW THE ADVANCES IN DIAGNOSIS MAY IMPACT AVIATION MEDICINE?

Sponsored by SOFRAMAS (French Society of Aerospace Medicine)

Chair: Olivier Manen
Paris, France

Co-Chair: Eric Perrier
Paris, France

PANEL OVERVIEW: In care medicine, practitioners make regular progress in therapeutics but also in the field of diagnosis that may express in different ways: new techniques, changes in the methods, enlargement or reduction in their indications, assessment of the prognostic value. All these considerations theoretically may be of help in aviation medicine, and yet have not the same impact on the decision-making process. This panel will present different situations of diagnostic advances in which the consequences in aeromedical expertise will be highlighted. Electroencephalogram is of particular interest because it has been used during many years as a systematic test during initial examination because of its relation to epilepsy which represents one of the highest risks for flight safety, and yet this exam is neither required nor sufficient to pose a real diagnosis of epilepsy. Although it has been abandoned in civilian applicants, it is still performed in the military environment. A new study will discuss the rate of abnormal EEG, the relation to abnormal findings in brain MRI, and the clinical outcome of those subjects declared unfit. Coronary artery disease typically requires early screening because it may jeopardize the flight safety and cause unfitness during the career. On the one hand cardiac imaging has developed; on the other hand civilian professional pilots in Europe are examined less frequently, their periodical visits are of poor content, and the EASA regulations are not so much severe. Yet, it is interesting to wonder what the present pilot suffering from CAD looks like, and what the place of investigations in the screening of CAD and flying rehabilitation may be. Magnetic resonance imaging has improved a lot in the past decades in cardiology, and so the many advantages of cardiac MRI have led to an easy use in France, all the more because it is not very expensive. A review of literature and case reports will be presented to define the current indications in care medicine and the updated place in aviation medicine. All these diagnostic advances should not make flight surgeons forget the aim of aeromedical expertise and so the principles to respect for the use of investigations in aircrews. Whatever the situation is and the diagnostic test may be, two questions remain of major interest: will this test give me some interesting information? And have I thought about suitable and unsuitable results?...

[124] PREVALENCE AND PROGNOSIS OF EEG ABNORMALITIES IN MILITARY AIRCREW APPLICANTS IN 2016: A 9-YEARS FRENCH ORIGINAL STUDY

N. Huiban[2,5], A. Ferain[2,7], D. Dubourdieu[2,1], M. Monteil[2,4], A. Faivre[2,6], J. Monin[2,1], S. Bisconte[2,3], O. Manen[2,1] and E. Perrier[2,1]
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INTRODUCTION: While the interest of EEG for military aircrew applicants remains debated as well as the benefit of brain MRI performed in some countries, France has carried on with EEG during initial expertise. This technique aims at identifying functional abnormalities which may be at risk of clinical expression during flights, a logical attitude in the context of increasing world air traffic and a collection of flight events. **METHODS:** We report a descriptive study performed in Percy Military Hospital. A first retrospective part was a prevalence survey of EEG abnormalities in military applicants, carried out between 2007 and 2015. These abnormalities led to unfitness decision and a second-level procedure of expertise. The main criterion of disqualification was paroxysmal reactions or graphic elements suggestive of epileptic forms like polyspike-waves. The secondary criterion was abnormal or doubtful EEG in relation to « non-physiological » findings. Data about brain MRI for those who required such imaging were also collected. A second part was a fixed cohort study, forward-looking at the neurological events observed in these unfit applicants over this period. **RESULTS:** Preliminary results at this date showed 150 cases of unfitness for the motive « EEG » since 2007. Approximately a third of these subjects supplied exploitable data to determine in the outcome the occurrence of possible neurological events. **DISCUSSION:** This work is original as far as there have been very few studies on this theme. The French policy and procedure of over-expertise will be presented, as well as the old literature which initially had justified EEG for initial applicants. The attitude is to not stop using EEG but take decisions depending on results, with no underlying neurological pathology, is justified by the following arguments: the observation of « not-strictly normal EEG » is not rare; subclinical symptoms in first decades may be forgotten/minimized/hidden by motivated applicants; epileptic fits would be tragic during flight; and all working and flying conditions may temporary lower the epileptogenic threshold in pilots and favour symptoms in predisposed patients, and so the data of outcome on the ground clearly underestimate the real risk in aviation.

[125] THE NEW PLACE OF CARDIAC MRI IN AERONAUTICAL FITNESS

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BACKGROUND: Just an evolution or a real revolution? Recent technical and clinical advances of cardiac MRI have led this noninvasive imaging at an unprecedented level for clinicians and flight surgeons. **METHODS:** Illustrated by case-reports, we propose to review of common indications for which cardiac MRI has a particular interest to facilitate aeronautical fitness decisions. **RESULTS:** Cardiac MRI was used in a large variety of indications like myocarditis, hypertrophic or dilated cardiomyopathy, coronary artery disease, arrhythmogenic right ventricular dysplasia… All these diseases may impact the flight safety. That's why the early diagnosis is essential for the flight surgeon especially at the first assessment. Compared to other cardiologic investigations,

cardiac MRI is often more sensitive, more specific and allows sometimes the detection of prognostic elements. Furthermore, cardiac MRI is noninvasive, without the exposure to harmful radiation, safe, available and not so expensive. **CONCLUSION:** For all these reasons, nowadays cardiac MRI takes a special place in the evaluation of some cardiovascular diseases and situations in aircrew population, complementary to echocardiography and stress tests.

Learning Objectives:

1. To discuss the place of MRI in aeronautical fitness.
2. To learn new indications of MRI for aircrew members.
3. To present economic notions about cardiac MRI prescription.

[126] DO THE ADVANCES IN DIAGNOSIS REALLY HELP THE AEROMEDICAL EXPERT?

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PROBLEM STATEMENT: Each time care medicine makes advances in diagnosis, each time the aeromedical expert has to think about the usefulness of such a progress in his daily practice, as a ratio benefits/risks. The evidence-based medicine may not be sufficient to understand what the exact place of a new technique or protocol is for aircrews because some aeromedical concerns should not be forgotten. **TOPIC:** The following situations and/or case reports in the presentation will highlight the difficulties to include modern investigations « too easily » in the aeromedical assessment and decision-making process: acquired complete left bundle branch block and possible cardiomyopathy, brain magnetic resonance imaging and pineal gland tumor, diagnostic criteria for arrhythmogenic right ventricular cardiomyopathy, diffuse and severe sarcoidosis, sleep apnea syndrome and vigilance evaluation, a strange arterial dissection, kidney stones and scanner. **APPLICATIONS:** The aeromedical expert should consider the following questions before the acceptance of diagnostic progress: is this investigation required from a medical point of view or should we talk about « aeromedical indication »? Is the choice of the technique/protocol the most appropriate? Will this exam have a real impact in the final decision? Who should ideally prescribe the exam? What decision during the pre-exam period should be taken? Who should manage the result first? Should the interpretation be called into question? What to do in case of unexpected/unsuitable results?

Learning Objectives:

1. To know the main arguments to consider before including new diagnostic techniques and protocols in the aeromedical assessment.
2. To understand why the evidence-based medicine is not sufficient for the decision-making process but forces the aeromedical expert to make choices in the use of diagnostic tools.

[127] CORONARY ARTERY DISEASE IN AIRCREW MEMBERS: FROM THE DIAGNOSIS TO THE FLYING REHABILITATION. A FRENCH RETROSPECTIVE STUDY

J. Monin[1,3], C. Megard[3], G. Guiu[1,3], A. Hornez[1], N. Huiban[4], J. Oliviez[1], S. Bisconte[2], D. Dubourdieu[1], J. Deroche[1], P. Bertran[1], O. Manen[1,3] and E. Perrier[1,3]

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INTRODUCTION: Coronary artery disease (CAD) is a major preoccupation for flight surgeons because of the risk of in-flight incapacity it may lead to. Therefore the prevention and screening for CAD among aircrew members (AM) is systematic. The constant progress in cardiologic tests, especially imaging, can help flight surgeons to diagnose CAD in AM before the clinical stage. **METHODS:** The aims of this study were to describe the population of AM with a diagnosis of CAD, and to analyze the investigations that led to the diagnosis and those performed for the flying rehabilitation. All the medical files of AM suffering from CAD were extracted from the 86,691 files of AM who were examined in the aeromedical center of Percy Military Hospital from 01/01/2010 to 12/31/2015. **RESULTS:** Our population was composed of 120 AM with CAD (mean age: 53.2 +−/ 8.9 yo, 98.3% males, 79.2% civilians, 76.7% pilots). CAD was discovered after acute cardiovascular events (myocardial infarction/ sudden death) for 55% of the population, and on moderate symptoms (chest pain, dyspnea, palpitations) for 22.5%. For the remaining 22.5%, the diagnosis was posed thanks to the systematic resting electrocardiogram or the initial prescription of investigations (exercise test, coronary tomography, cardiac MRI, myocardial scintigraphy) which were asked as a result of an increased cardio-vascular risk. Invasive coronary angiography revealed a 2-vessel disease in 29.1% of patients and a 3-vessel disease in 24.8% of them. After a complete cardiologic assessment, 70% of AM were declared fit to fly with some limitations. **DISCUSSION:** Coronary tomography and stress tests are interesting tools as far as they allowed in our study an early diagnosis of CAD before the onset of symptoms or acute events for a significant part of aircrews. Nowadays, the diagnosis of CAD rarely leads to unfitness decision in civilian pilots whereas a return to flying duties in military aircrews is more difficult. A complete cardiologic assessment remains mandatory in order to evaluate the sequelae and the risk of primary or secondary clinical events. A multipilot limitation seems necessary for most of cases.

Learning Objectives:

1. To know how the diagnosis of coronary artery disease is usually posed in aircrew members.
2. To understand which tests could help for the diagnosis of CAD and which ones could help for the rehabilitation of aircrew members with a CAD.

Monday, May 01 ***4:00 PM***
Governor's Square 15

S-026: PANEL: HUMAN PERFORMANCE OPTIMIZATION IN RPA OPERATIONS AND BATTLEFIELD AIRMEN SYSTEMS

Chair: Stephen Savell
Lackland AFB, TX

Chair: Regina Shia
Wright-Patterson AFB, OH

PANEL OVERVIEW: This panel will highlight how technology optimizes human performance in RPA operations and ongoing research in Battlefield Airman Systems. In the first two presentations, cadets and instructors from the United States Air Force Academy will present the results of senior-year "Capstone" projects from the Department of Behavioral Sciences. These presentations examine how trust, decision-making, and automation affect the application of deadly force in Remotely Piloted Aircraft (RPA) operations. These presentations will show how human performance can be optimized to ensure RPA pilots and sensor operators can effectively make real-time decisions that have life-and-death consequences thousands of miles away. The last four presentations summarize work being accomplished by the 711HPW/Airmen Systems Directorate and Guardian Premier Solutions for the Battlefield Airmen Training Group (BATG). The mission of the BATG is to select, train and mentor Airmen for global combat operations. To do so, the Airmen Systems Directorate has been working with leadership at the 350th Training Squadron (TRS) to identify metrics that relate to mental stress, heat stress, and personalized nutrition & physiological feedback on performance. The research is geared toward improving production with state-of-the-art technology that will inform all factors involved in training deficits, such as self-initiated eliminations, medical incidents, and shallow water blackouts. The presentations will discuss current work that is on-going as well as visionary efforts to be proposed. The panel will include an introductory discussion of needs from the 350th TRS and then proceed with the application of biomarker expressions in stressful environments to the development of resilience at early stages in the Battlefield Airmen training pipeline. This discussion will end with the need for rapid bio-sensing technology integration. Technological advances in physiological monitoring of heat stress will also be discussed with examples of the critical need of real-time sensing and

the reduction of medically related attrition and optimized performance. The non-treaded territory of shallow water blackouts will be described with recommendations for safety monitoring in aquatic environments that will allow for trainees to excel in these stressful environments. Finally, accelerated learning potential with transcranial direct current stimulation technology for multitask learning in Battlefield Airmen training scenarios will be discussed. The panel is focused on techniques and technologies for human performance optimization for Battlefield Airmen.

[128] BATTLEFIELD AIRMEN STRESS RESILIENCE IN HIGH STRESS TRAINING ENVIRONMENTS

R.M. Shia[1], D. Isaacks[2] and S. Savell[3]
[1]Airmen Systems Directorate, 711 Human Performance Wing, Wright-Patterson AFB, OH; [2]Guardian Premier Solutions, San Antonio, TX; [3]CC 350th Training Squadron, Lackland AFB, TX

INTRODUCTION: According to Col Richard London, the United States Military is made up of only one percent of the adult human population, while the Air Force Special Operations Command (AFSOC) makes up only one percent of the Department of Defense. He further explained that because AFSOC is made up of relatively small teams performing the most demanding missions, every single member is critical for mission success. The length of the Special Operations training pipeline varies across career fields, but generally involves 24 months of rigorous and stressful training that requires mental, physical and emotional endurance. **METHODS:** Members of the 711th Human Performance Wing initiated a series of data collection efforts assessing biological, physiological, cognitive, and subjective information from Battlefield Airmen trainees at the initial stages of their training pipelines. The proposed presentation will discuss the methods of assessment as well as the results of three experiments conducted with one specific Battlefield Airmen career field. **RESULTS:** Results revealed that while almost each data point showed significant increases in Cortisol, Week 3 showed the largest spikes [($t = 11.89$, $p < .001$), ($t = 10.05$, $p < .001$), ($t = 15.11$, $p < .001$)] as well as the largest drops in DHEAS/Cortisol ratios [($t = -10.36$, $p < .001$), ($t = -7.68$, $p < .001$), ($t = -12.82$, $p < .001$)]. The last two experiments revealed the development of two resilient biomarker profiles. One profile is the relationship between Neuropeptide-Y and Cortisol as early as Week 3 ($r = .51$, $p < .05$; $r = .78$, $p < .001$). The other profile is the relationship between Neuropeptide-Y and Norepinephrine ($r = .56$, $p < .05$; $r = .82$, $p < .001$). **DISCUSSION:** The utility of assessing biophysiologic changes under high stress and in combination with other neuropsychological data will be highlighted. In addition, the application of this information for training and assessing a Battlefield Airmen throughout the operator's lifecycle will be discussed.

Learning Objectives:

1. The audience will be informed of high stress points during Battlefield Airmen training.
2. The audience will learn about biomarkers that can inform the development of stress resilience.

[129] PERFORMANCE AND SAFETY FOR OPTIMIZED PHYSIOLOGICAL OUTPUT

D. Isaacks
USAF, San Antonio, TX

INTRODUCTION: Battlefield Airmen training traditionally involves extensive physiological training in preparation for high performance in a variety of extreme environments. While the mechanics of the human system keep up with demands, cardiac and respiratory systems must also remain in synchrony. Vital sign monitoring is critical not only for real-time health monitoring applications, but for human performance monitoring and augmentation. State of the art sensors and diagnostic tools are continuously being researched, tested, and procured for every piece of high tech equipment in the Air Force while the most critical asset, the Airman, lacks diagnostics to analyze physiological wellbeing and performance. Heat stress, hydration levels, and physiological effort are largely self-assessed or visually assessed by a fellow Airman without any quantitative metric (prevalent in the training community). The benefit of this effort and product development is to provide the AF 350th TS with real-time vital sign monitoring for all land-based high stress environments. **METHODS:** Data was collected from 42 Battlefield Airmen trainees from three different courses (N = 14, 8, and 20 respectively) during a 3:00 AM Ruck March. This system provides the training squadron with objective information that will determine over-exertion and informs potential mitigation strategies to maintain high exertion under less invasive terrains. **RESULTS:** It was found that during a 3:00 AM Ruck March Average Heart Rate ($t = 17.55$, $p < .001$; $t = 16.95$, $p < .001$; 20.16, $p < .001$) and Average Estimated Core Temperature ($t = 12.39$, $p < .001$; $t = 10.38$, $p < .001$; $t = 8.89$, $p < .001$) significantly increased for all courses showing that this task requires physiological exertion. In addition, the two summer courses ($M = -0.989$, $SE = .09$; $M = -1.368$, $SE = .07$) revealed lower mechanical/physiological load ratios than the fall course ($M = -0.785$, $SE = .10$). This means that the cardiac system was not as capable of keeping up with the amount of activity the mechanical human system was putting out during the summer months. **DISCUSSION:** These findings coupled with the ability to mitigate heat stress led to the current effort to institute performance and safety monitoring for Battlefield Airmen to support technology development for human performance optimization. Advances in technology and application will be discussed.

Learning Objectives:

1. The audience will learn about human performance and safety monitoring applied to optimize physiological output of Air Force Battlefield Airmen.

[130] PERFORMANCE AND SAFETY FOR OPTIMIZED WATER CONFIDENCE TRAINING

G. Burnett[1], D. Sardo[1] and C. McLaughlin[2]
[1]Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]USAF School of Aerospace Medicine, Wright-Patterson AFB, OH

Shallow water black-outs (SWBs) occur in all areas of the Department of Defense during training programs throughout the pipeline as well as in operations. Victims of SWBs usually lose consciousness within 15 feet of the surface, where expanding, oxygen-hungry lungs of breath-hold divers literally suck oxygen from their blood. Hyperventilating adds very little oxygen to an individual's reserve, forcing carbon dioxide out of the lungs. Carbon dioxide is the trigger to the brain to breathe. Aquatic skills and water confidence training is a combat proven process and is an inter-service performance standard. The proposed presentation describes an effort that will provide special operations personnel and support staff with an emerging technology that will provide real-time vital sign monitoring in aquatic environments. We will be utilizing this technology during elevated risk training applications as well as real world operational readiness training. We also plan to apply this process to the aquatic component of training to reduce the number of aquatic related incidents that occur during water-based training. In addition, this tool can highlight levels of strain experienced and physiological changes that occur during training. The current presentation will discuss two prototypes: a Transmittance sensor and a Reflectance sensor connected to two units placed in various positions on the body and compared to a commercially used NONIN Onyx II finger pulse transmittance oximeter. The results indicate that hand oxygen saturation measurements with a Transmittance device coincide with the baseline hand measurements taken with the NONIN Onyx II. The data also indicates that toe oxygen saturation measurements with the Transmittance device coincide with the toe measurements taken with the Transmittance NONIN Wrist Ox with an average delta of 0.46%. The average delta between the proposed device and baseline is 2.10% indicating that oxygen saturation at the toe is on average 2% higher than at the finger when using transmittance sensors. Additional findings will be discussed as well as user feedback and challenges involved with application. Finally, the addition of new technology to assess physiological stress in the most stressful training environment (the water) and research initiatives to identify the utility of this novel capability will be discussed.

Learning Objectives:

1. Proper integration of an aquatic sensor is paramount to user acceptance.

[131] ENHANCHING BATTLEFIELD AIRMEN TRAINING EFFICACY AND VIGILANCE WITH TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS)

C. Whitehead[2,3], A. McKinley[1] and L.K. McIntire[2]
[1]Applied Neuroscience, Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Infoscitex, Inc., Dayton, OH; [3]USAF AFRL 711HPW, Wright-Patterson AFB, OH

INTRODUCTION: Transcranial direct current stimulation (tDCS) is a noninvasive brain stimulation technique that uses a mild electrical current passed between electrodes on the scalp to modify neuronal membrane resting potential. By elevating or lowering neuron excitability in a region, tDCS provides a promising means by which to directly modify human cortical function. Studies have demonstrated tDCS can enhance skills such as visual search, learning, memory, attention, decision making, and reaction time. This facilitation of cognitive skills has a wide array of possible applications, with improvements to specific skills having an immediate application to the military. **METHODS:** As tDCS is small, portable, easy to use, and relatively inexpensive, it can be added to briefings and practice situations currently in use to accelerate learning and reduce training time. Studies have also shown that tDCS may be well-suited to mitigate performance degradation in settings requiring sustained attention. When investigating the efficacy of tDCS to reduce training time and increase proficiency in spatial recognition using a simulated synthetic aperture radar (SAR) task, two groups of participants receiving training plus tDCS were compared to a control group. When assessing the effect of tDCS on sleep deprivation, three groups of 10 participants received either tDCS, caffeine, or neither during 30 h of extended wakefulness and performed sustained attention and visual reaction time tests every two hours. **RESULTS:** Results showed that attained visual search accuracies of both tDCS groups were 24.3% and 25.6% higher than those provided with sham stimulation ($p = .041$ and $p = .028$). The sleep deprivation study showed that the tDCS group performed significantly better than both the sham ($t = 4.64$, $p < 0.001$) and caffeine groups ($t = 2.84$, $p = 0.006$) on a sustained attention task. On a psychomotor vigilance task that records visual reaction times, t-tests showed that the caffeine and tDCS group performed significantly better than the sham group ($t = 2.88$, $p = 0.002$ and $t = 2.77$, $p = 0.005$, respectively. **DISCUSSION:** With the increasing demands on USAF personnel due to constantly expanding technological capabilities, the addition of tDCS could hasten the deployment of skilled individuals to the field. It could also help battlefield airmen maintain attention and goal-directed behavior for extended periods of time, mitigating the vigilance decrement and improving mission effectiveness.

Learning Objectives:

1. To represent tDCS as a safe and noninvasive way to modify neuron excitability in the brain, which can facilitate cognitive skills. As a result of this improved cognitive performance, TDCS has a wide variety of applications and benefits, some of which could have an immediate application to the military.

[132] HOW THE RISE OF REMOTELY PILOTED AIRCRAFT IN WAR IMPACTS DEADLY FORCE EMPLOYMENT DECISIONS

J.E. Kajdasz[1], J. Macdonald[2] and J. Schneider[2]
[1]Behavioral Sciences & Leadership, USAF Academy, Colorado Springs, CO; [2]George Washington University, Washington, DC

WITHDRAWN

[133] DECISION MAKING AND STRESS REACTION OF REMOTELY PILOTED (RPA OR DRONE) PILOTS

A. Schwartz, S.J. Burton, M. Grattan and S. Marshall
DFBL, United States Air Force Academy, CO

INTRODUCTION: Remotely piloted aircrafts (RPAs) have become important tools in military surveillance and combat, border protection, police, and disaster management. In particular, the use of weaponized RPAs has led to a discussion on the ethical, strategic and legal implications of using such systems in warfare. In this context, studies suggest that RPA pilots experience similar exposure to post-traumatic stress, depression and anxiety disorders compared to fighter pilots, although the flight and combat experiences are completely different. In order to investigate this phenomenon, we created an experiment that intends to measure the "moral stress" RPA pilots may experience when the operation of such systems leads to human casualties. "Moral stress" refers to the possibility that deciding upon moral dilemmas may not only cause physiological stress, but may also lead to changes in the evaluation of values and reasons that are relevant to problem solving. **METHODS:** The experiment includes an RPA simulation based on a game engine and novel measurement tools to assess moral reasoning. Participants are placed in one of three scenarios, military, firefighting, and surveillance, and take surveys afterwards to explain their decisions and reactions to the simulation. **PRELIMINARY RESULTS:** Preliminary results suggest that combat RPA pilots do experience physiological responses when subjected to moral dilemmas. Furthermore, Notre Dame's portion of the research shows a significant decrease in the utilitarian decision when a high value personnel is presented and even more when a family member is present. **DISCUSSION:** The moral dimension of piloting RPAs may be a significant factor for explaining the psychological distress experienced by operators. Detachment due to a purely screen-based interaction may actually not diminish the moral stress RPA pilots' experience. Rather, the lack of physiological involvement of the body in combat may undermine a mechanism that allows for justifications of actions requiring a more abstract reasoning that shows up in unsupported rationalization of killing. Moral decisions vary based on emotional connections to the single person, such as if the person was a commander or family member. It is important for RPA pilots to understand the stress they experience from making ethical choices.

Learning Objectives:

1. If there is an increase in physiological stress of the RPA Pilot when forced to make a more decision.
2. If there a significant difference in the amount of physiological response of military RPA Pilots when compared to civilian RPA Pilots when faced with the same moral dilemma.

Monday, May 01 ***4:00 PM***
Governor's Square 12

S-027: PANEL: AIRLINE MEDICAL SUPPORT - ADAPT OR PERISH!

Sponsored by the AsMA Air Transport Committee

Chair: Claude Thibeault
Montreal, PQ, Canada

Chair: Elizabeth Wilkinson
Harmondsworth, United Kingdom

PANEL OVERVIEW: Over recent years the number of airline medical departments within commercial airlines has reduced in many, but not all geographical regions of the world. Aviation medical support can be offered in different ways and models of delivery may have to change over time. Echoing words from the Bauer Lecture 2016, we have to adapt or perish, taking the many challenges as opportunities. The panel will present different models of medical support to airlines around the world along with the value it brings to flight safety and the business.

[134] THE ROLE OF THE AIRLINE MEDICAL SERVICE - FROM THE PERSPECTIVES OF THE AIRLINE MEDICAL DIRECTORS ASSOCIATION AND OF A "START-UP" AIRLINE

D.M. Powell[1,2]
[1]Medical Systems, Virgin Australia, Auckland, New Zealand;
[2]University of Otago, Wellington, New Zealand

The Airlines Medical Directors Association has for 70 years promoted practice and standards of aviation and industrial medicine as pertaining to airlines operations, also encouraging research and study of medical problems in these fields, and supporting scientific or benevolent associations furthering these objectives. This presentation encapsulates the perspective of AMDA's membership and constituent organisations on the roles of an airline medical service, and also outlines as a case study the perspective of one airline which is early on its growth trajectory.

Learning Objectives:

1. To consider the breadth of roles of an airline medical service.
2. To review different models of airline medical support and their advantages and drawbacks.
3. To consider airline medical support in the context of the objectives of the Airlines Medical Directors Association.

[135] IN-HOUSE MEDICAL SUPPORT FOR A RAPIDLY GROWING HUB CARRIER

S. May
Aeromedical Centre, Qatar Airways, DOHA, Qatar

In recent years Middle Eastern hub carriers have grown rapidly, with rising passenger and staff numbers. These airlines have tended to establish, maintain and grow in-house medical services in contrast to many legacy carriers. Medical departments in these airlines have to adapt quickly to keep pace with the operation. This presentation will explore the scope of services provided by an in-house medical department in an expanding Middle Eastern hub carrier and the business and employee benefits derived from them. The strategy and scope of services provided by an in-house medical division will be examined across the key areas of passenger health, employee health and corporate advisory services. The position of the medical department in the corporate structure and how this may impact on the operational support provided will be explored. The adaptation and development of services based on the voice of the business and voice of the customer (both passengers and employees) will be discussed as well as the potential benefits to the business and the customer. The challenges posed by a large multicultural expatriate workforce, rapid expansion and local / regional medical infrastructure will be highlighted.

Learning Objectives:

1. To gain insight into the extended range and volume of medical services provided in house to a hub carrier with large expatriate workforce.

[136] AVIATION MEDICINE SUPPORT FOR U.S. AIRLINES

A. Wolbrink
Aeromedical Advisors, LLC, Colorado Springs, CO

At some time, most of the major airlines in the U.S. have had physician-staffed medical departments. However, after multiple mergers and bankruptcies, these medical departments have either been significantly reduced or completely outsourced. This presentation will review the current state of affairs of aviation medicine support for major airlines in the U.S. by discussing how roles traditionally managed by an internal medical department are currently being handled. It will then attempt to identify some opportunities and challenges for aviation medicine practitioners as a basis for additional discussion by the panel.

Learning Objectives:

1. To review the current status of aviation medicine support for major U.S. airlines.

[137] THE PART TIME CONTRACTOR'S PERSPECTIVE

T. Stevenson
The Healthy Company Ltd, Shoreham by Sea, United Kingdom

Some larger airlines have evolved from small AOCs where operation management teams have "managed" without a comprehensive aviation medicine service, instead addressing medical issues as and when they have arisen or are mandated, with the aviation medicine needs being purchased and provided from external suppliers who have varying levels of expertise and experience. It is now apparent to airlines that they have an enhanced corporate responsibility, spurred on by changes in national and international legislation and performance based oversight, with greater demands placed upon them to ensure fitness to operate and for them to proactively manage decreases in medical fitness. There has also been a realisation that the various medical offerings required of a modern airline need and benefit from some oversight from within. One potential solution is for the company to buy in subject matter expertise to help shape and manage the service's requirements and the performance of its providers, while offering readily accessible, cost effective, high level advice on aviation medicine matters such as the management of communicable diseases, medical assessment of passenger's fitness to travel, in flight medical care, etc. These "on tap" subject matter experts give the senior management team confidence that they have appropriate corporate governance of the Aviation medicine matters that influence flight safety, and the wellbeing of staff and passengers. The appropriateness and effectiveness of the aviation medicine service that is needed by an airline should be constantly reviewed and the pros and cons of in house and outsourced services will have been debated on this panel and elsewhere. Utilizing part time advisory services of practitioners with experience of different models of aviation medicine provision can enable an airline to take decisions on health-related expenditure in an evidence- based manner while ensuring a cost effective and flexible solution to the constantly evolving Health related needs of Commercial aviation.

Learning Objectives:

1. To comment on the value added to an airline of a part time contractor in aviaition medicine.

[138] UNDERSTANDING AIRLINE INDUSTRY BUSINESS DRIVERS IN THE DESIGN OF AIRLINE HEALTH SERVICES

I. Hosegood
Health Services, Qantas, Mascot, Australia

The aviation industry is a challenging environment from a fiscal perspective. It is an industry with rapid and continuous growth but one that requires a massive capital investment and in which the profit margin is very narrow. The major cost components of the industry such as fuel and manpower have continuously risen whilst airfares have often fallen significantly. To succeed in this competitive and challenging environment, airlines have had to adapt through the use of innovative technologies but also through continually seeking efficiencies in their cost bases. Health Services are a cost centre for airlines with little or no contribution to revenue and often inadequate analysis of the contribution health services can make to the organisation. This has led many airlines to seek efficiencies through reducing or outsourcing health services. The variation in Health Service models internationally is significant with political, geographical and cultural factors often influencing the extent and type of services provided. Determining the appropriate model for an airline healthcare services requires an analysis of the business drivers for the airline and of how health services can significantly impact those drivers. Benefit analysis needs to consider the positive impact a holistic health service can make to the effectiveness of the workforce, to the efficiency of the operation and to the customer experience. Only with this analysis can a return on investment case can be made for heath service design.

Learning Objectives:
1. Participants will be able to understand the challenging fiscal environment of the commecial airline industry.
2. Participants will be able to understand how health services may significantly impact business drivers such as efficiency of the operation, customer experience and employee effectiveness.
3. Participants will understand other drivers for Health Service Design.

Monday, May 01 ***4:00 PM***
Governor's Square 11

S-028: PANEL: DEVELOPING, ORGANIZING AND CONDUCTING RESEARCH IN AEROSPACE MEDICINE AND HUMAN PERFORMANCE PART II: CONDUCTING, ANALYZING, AND REPORTING

Sponsored by the AsMA Science and Technology Committee

Chair: William Fraser
Toronto, Ontario, Canada

Chair: Barry Shender
Patuxent River, MD

PANEL OVERVIEW: The first session of this Panel focused on issues in initiating a research project including overall planning and execution, accessing funding, obtaining Institutional Review Board approval, and the unique issues of research in the Aerospace environment. This second panel session focuses on the process of conducting the research, including the documentation process, and collecting and analyzing the data. The first presentation, from Silatyuk Research, Toronto, ON, will discuss specialized tools for easing the burden of the documentation process from funding requests, IRB submissions, experimentation logs, data collection, to generation of the final report or journal paper. The second presentation from USAARL, Fort Rucker, AL addresses some unique challenges involved when there is a potential of injury to the human experimental subjects. Statistical analysis techniques are addressed in the third presentation from UTMB, Galveston, TX. The last presentation, also from Silatyuk Research, Toronto, ON, will provide some examples of open-source tools for research design, data collection, and data analysis.

[139] DOCUMENTATION - FROM FUNDING REQUEST TO JOURNAL PUBLICATION

W. Fraser
Silatyuk Research, Toronto, ON, Canada

PROBLEM STATEMENT: From the first discussions on undertaking a research project to the publication of the final report or research paper, documentation will consume an inordinate amount of time and effort. **TOPIC:** Research projects of any size require a variety of documents, including funding proposals and approval requests, literature reviews, institutional briefings, IRB submissions, subject recruitment presentations, instructions regarding experimental and/or simulation setups, subject information, notes, descriptions of the data analysis techniques, final reports, presentations, and open literature publications. This material can be prepared with a range of application software and saved in open-source or proprietary formats. Tools for collaborative documentation preparation are now available in proprietary (WYSIWYG) and open-source tools (LaTeX), including Web and Cloud capabilities. Tools such as Jupyter and Mathematica allow both the research narrative and analysis to be combined in a single, shared, web based document. Version control system should always be used to maintain a complete audit trail of all changes in the documentation. Upfront access to an organization's or a journal's publication templates and citation/bibliography formats can save time during the preparation of the final documentation. The enforcement of standardized text formats and styles in WYSIWYG applications and document classes and options when using markup languages will minimize the effort in generating alternate versions of papers and reports. Upfront identification of the supplementary documentation and data that a particular journal will require for paper acceptance will guide the overall process. Bibliographic database software such as Zotero, Mandeley, and Docear are valuable tools for collecting, organizing, formating, annotating, tagging, and analyzing multiple sources of information, including published literature, internal documents, images, videos, web pages and URL links, and emails. The database can be shared among all those involved in the project, as well as provide methods for generating drafts of final reports, presentations, and papers in a variety of formats and styles, including LibreOffice, MS Office, and LaTeX. **APPLICATIONS:** The tools discussed can be used to minimize the documentation workload and provide a detailed audit trail of the entire process. Attendees will receive links to all the tools discussed.
Learning Objectives:
1. Access tools for the efficient preparation of all documentation associated with a research project.

[140] APPROACH TO STATISTICAL DESIGN AND ANALYSIS FOR CLINICAL RESEARCH STUDIES

D. Nusbaum
Aerospace Medicine, University of Texas Medical Branch, Houston, TX

INTRODUCTION: One of the most difficult aspects of conducting scientific research is carrying out the statistical analysis needed to empirically answer a research question. Scientific questions are often formulated in a way that is statistically unanswerable and thus waste the time of the investigators and research subjects. Many times the research question is then changed post hoc to better align with the results of the data, which then biases the analysis. This talk is meant to educate new and inexperienced researchers on how best to create an appropriate design so that a scientific question is answerable in a statistically valid way. **METHODS:** This presentation will provide a stepwise approach for formulating a sound scientific study design that is able to be analyzed using standard statistical methods. **RESULTS:** The most important aspect of study design is forming a solid and answerable primary research question. This can often be done effectively by first developing a hypothetical (non-real world) research question and from there remove the aspects of the question that are unrealistic to carry out in the real world. From there, the question can be refined by asking framework questions such as: "What is the story I'm trying to tell?", "What do I hope to see?", "What if I don't see what I hope to see?", "What do I hope to conclude from my results?", "What should I do next?", and "How will this impact practice?". This work should be done in collaboration with a statistician that can help with choosing and refining appropriate statistical methods. **DISCUSSION:** We intend to provide a framework for new clinical research investigators for forming sound research questions and study designs. This is to ensure that the questions being asked can be answered using existing available statistical methods, and avoids wasting the time of the investigators and research subjects by asking questions that cannot be answered, collecting data that cannot be analyzed, or by modifying the question post hoc to better fit the results of the data, which ultimately will invalidate the analysis and conclusions.
Learning Objectives:
1. Learn how to develop an appropriate research question.
2. Learn how to better collaborate with statisticians for improving clinical research hypotheses.
3. Learn how to avoid potential biases that could invalidate study conclusions.

[141] SOFTWARE FOR RESEARCH DESIGN, DATA COLLECTION, AND ANALYSIS

W. Fraser[1] and M.K. Fraser[2]
[1]Silatyuk Research, Toronto, ON, Canada; [2]Silatyuk Research, Toronto, ON, Canada

PROBLEM STATEMENT: Designing research projects, collecting and storing the data, analyzing the data, and presenting the results is complicated by the volume and types of material collected. This talk will discuss some of the software tools to assist in the process. **TOPIC:** Preparation of research proposals and IRB submissions often require documentation of statistical power calculations and planned statistical analysis. The Comprehensive R Archive Network (CRAN) has an extensive collection of open-source R packages for developing experimental protocols, power analysis and design of statistical models. It is difficult to

maintain experimental and model based simulation results and supporting material such as time series records, subject information, calibration information, laboratory notebooks, simulation parameter settings, genetic data, videos, images, other data collected during the experiment or simulations, tables and graphs generated during analysis, and all the documentation associated with the research project in an accessible and auditable format. All this material can end up on multiple computers and distributed across multiple files and folders. Applications such as MS Access allow SQL based data extraction, but the open-source HDF5 database system that can securely store all types of data objects, including tabular data, videos, documents, and metadata. Tools are available for inputting and extracting the data and ensuring a full audit trail. Rather than using multiple software applications for data analysis, iPython, Jupyter, JupyterLab, or Mathematica can provide a single user interface to a large selection of R, Julia, and Python software. Use of Web based Notebook interfaces for these tools allows the integration of narratives, extraction of data from the HDF5 database, data analysis scripts, GUI based analysis tools, storage of analysis results into the database, and preparation of final reports and research papers with publication quality graphics into a single document that enables collaboration and full version control of the analysis process. **APPLICATIONS:** These tools provide capabilities that can be used to assist in the design of experiments, data collection, analysis and display, and documentation of the process. The techniques are relevant to experimental studies, clinical studies, field research, and modeling and simulation.

Learning Objectives:

1. Access the latest tools for collection, storage, and analysis of experimental and simulation data, and integrated documentation of the analysis process.

[142] HOW TO SAFELY CONDUCT POTENTIALLY INJURIOUS RESEARCH WITH HUMANS AND HUMAN SURROGATES

C. Chancey
Injury Biomechanics Division, USAARL, Fort Rucker, AL

PROBLEM STATEMENT: Human and human surrogate research within the military research community presents challenges and opportunities while conducting Aerospace Medicine and Human Performance studies. Unique and specific processes must be followed to ensure successful research, regulatory compliance, and safety for both volunteers and the research team. Lessons learned for human volunteer research and human surrogate aeromedical research efforts will be discussed. **TOPIC:** Education and experience beyond scientific and medical expertise are required to conduct aeromedical research in the military environment. The research team must understand the military environment, safety regulations, and regulatory compliance guidance. The military environment offers unique research opportunities. For instance with training environments, research must be conducted in a manner to minimize intrusion on the instruction, the training time, the trainees' free time, and the training mission. These training environments may involve potentially hazardous conditions for both the research volunteer and the research team. Therefore, when conducting research to examine potentially injurious conditions, risks must be managed for the human subjects as well as the research team members. Regulatory guidance enables a level of protection, but researchers must be actively engaged in planning for the safety of the human volunteers, the research team members, and scientifically-sound data as they best know the research hazards. One aspect that cannot be over-emphasized and that is required for sound science and the safety of all involved is communication. Particularly with multidisciplinary teams, continuous and efficient communication between research team members on science, engineering, and safety is necessary. Furthermore, managing ongoing and open communication with partners at military facilities, safety officers, and regulatory compliance officers is critical. While working through such issues for human subjects or for post mortem human surrogates, sound scientific practices must not be overlooked to allow research data and results to be used to address current and future questions. **APPLICATION:** The lessons learned will be illustrated through experiences conducting studies with human subjects and human surrogates. These lessons can be applied to ongoing and future potentially injurious research studies.

Learning Objectives:

1. Human volunteer and human biological surrogate research requires unique considerations for research teams.

Monday, May 01 ***4:00 PM***
Governor's Square 10

S-029: PANEL: AEROMEDICAL RISK ANALYSIS PRACTICE UPDATES – PART 2

Sponsored by the American Society of Aerospace Medicine Specialists

Chair: Richard Allnutt
Beavercreek, OH

Chair: Dan Van Syoc
Springboro, OH

PANEL OVERVIEW: During this panel, aeromedical clinical experts and Aerospace Medicine residents will present risk analysis-based clinical updates on topics related to the assessment and treatment of aviators and special operational 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.

[143] THE AEROMEDICAL IMPLICATIONS OF ANXIETY DISORDERS, 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 lifetime prevalence of anxiety disorders is 24.9%. Many of the emotional and behavioral manifestations of anxiety disorders can interfere with flying safety and mission completion. Severe anxiety can markedly impair the ability to focus and concentrate as well as cause significant distress. Anxiety disorders tend to have a chronic clinical course with low rates of recovery and high likelihood of recurrence. **TOPIC:** We will examine how aviators with disqualifying anxiety diagnoses receive the best possible assessment and treatment (including, potentially, psychotherapy, healthy lifestyle interventions, and psychotropic medication) and then obtain a waiver to resume flying duties. **APPLICATIONS:** Anxiety disorders represent the second most prevalent psychiatric condition in the United States after substance use disorders. They are also the most common cause of disability in the workplace in the United States. Aviators are not immune to anxiety, and a better understanding of aeromedical-specific considerations will assist the Air Force flight surgeon in preserving assets while encouraging better treatment and better outcomes.

Learning Objectives:

1. The participant will be able to describe the period of stability necessary to obtain a waiver to fly with anxiety in the USAF.
2. The participant will be able to describe at least one symptom of anxiety that impairs safe aerospace operations.

[144] THE AEROMEDICAL IMPLICATIONS OF ANXIETY DISORDERS, 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 appropriately identifying and managing anxiety disorders in Air Force aviators. **TOPIC:** We will examine how aviators with disqualifying anxiety diagnoses receive the best possible assessment and 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 mental health care 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. The purpose of this presentation is to highlight key aspects of appropriately identifying and managing anxiety disorders in Air Force aviators.
2. We will examine how aviators with disqualifying anxiety diagnoses receive the best possible assessment and treatment (including, potentially, psychotherapy, healthy lifestyle interventions, and psychotropic medication) and then obtain a waiver to resume flying duties.

[145] ASAMS AEROMEDICAL RISK ANALYSIS: CHRONIC LOW BACK PAIN

J. LaVan
Naval Aerospace Medical Institute, Pensacola, FL

Chronic Low Back Pain affects a large percentage of aviators but represents a broad spectrum of morbidity. The Aeromedical Risk associated with this diagnosis is multifactorial, based on symptoms of the condition, concerns for progression and adverse effects of treatments. This presentation will discuss the epidemiology, risk factors, prognostic factors and natural course of chronic back pain as well as aeromedical risks associated with symptoms and treatment of chronic back pain. Finally, dispositions of this condition by various aeromedical authorities will be reviewed.

Learning Objectives:

1. Review epidemiology, risk factors, prognostic factors and natural course of chronic back pain.

[146] MELANOMA: AN AEROMEDICAL UPDATE

D. Opris and C.J. Keirns
USAF, Wright-Patterson AFB, OH

MOTIVATION: Melanoma is the most serious and fatal form of skin cancer given its propensity for rapid spread to other parts of the body. Significant aeromedical concern surrounds the potential for metastatic spread in this disease that must be addressed prior to returning an aviator to the cockpit. **OVERVIEW:** Survival and disease recurrence risk for aviators with melanoma will largely depend on the stage of disease at time of diagnosis. Localized cutaneous melanoma includes Stage 0 (in situ melanoma), Stage I, and Stage II disease. Stage III melanoma is defined by the presence of regional nodal disease, and Stage IV melanoma is characterized by distant metastatic disease. Individuals with thin stage I melanoma are likely to have prolonged disease-free survival, while those with later Stage II to IV melanoma are at significantly increased risk of metastatic disease spread and death. **SIGNIFICANCE:** The primary aeromedical concern in aviators with treated melanoma stems from the symptoms associated with a potential systemic recurrence. The most common sites of systemic recurrence that are of aeromedical significance are lung, liver, and brain. Although risk of central nervous system involvement is the classically cited factor influencing waiver considerations, a recurrence of melanoma at any systemic site could result in symptoms or complications that would pose a risk to the safe performance of aviation duties. Depending on the site, symptoms would be variable and the initial presentation unpredictable. Unrecognized central nervous system recurrences are of particular concern due to the possibility for subtle performance decrements, in addition to the risk of sudden incapacitation resulting from a seizure or tumor-related hemorrhage. An aviator's individualized risk of disease recurrence must be defined before consideration of aeromedical waiver for military and civilian aviators.

Learning Objectives:

1. Identify the aeromedical implications of melanoma.
2. Review aeromedical guidelines related to aviators treated for melanoma based on staging of disease.
3. Highlight the importance of an aviator's individualized risk of disease recurrence and how that relates to the timing of initial aeromedical waiver.

[147] AEROMEDICAL RISK ANALYSIS - PROSTATE CANCER

J. Pavela and T. Castleberry
Preventive Medicine & Community Health, UTMB, Galveston, TX

INTRODUCTION: This presentation will review aeromedical risks associated with prostate cancer, practice guidelines, and aeromedical disposition. **METHODS:** Publicly and commercially available databases will be searched for review articles on prostate cancer screening, diagnosis, treatment, and prognosis. FAA and military resources for pilot medical examination and waiver-issuing guidelines will be reviewed. Literature concerning prostate cancer and aeromedical risks will be sought via search of the Aerospace Medicine and Human Performance journal and FAA CAMI publications. Potentially appropriate updates to the prior ASAMS clinical practice guideline on prostate cancer will be identified. **RESULTS:** The results, including the FAA August 2015 update to the AME guidelines to include a prostate cancer CACI (Conditions Aviation Medical Examiner Can Issue) worksheet, will be discussed during the panel. **DISCUSSION:** Prostate cancer is the most frequently diagnosed non-skin cancer in males, and is the second most frequent cause of cancer-related death in males. Currently, the vast majority of pilots are male, and male GU pathology is the sixth most commonly reported medical condition to the FAA. Review of aeromedical implications of prostate cancer is thus highly pertinent to AMEs and flight surgeons.

Learning Objectives:

1. Discuss aeromedical implications of prostate cancer.

[148] SPONTANEOUS PNEUMOTHORAX IN THE AVIATOR

D.D. Regn[2] and J.M. Sill[1]
[1]Eastern Virginia Medical School, Norfolk, VA; [2]ACS, USAF, Beavercreek, OH

MOTIVATION: In June 2016, the U.S. Air Force published a new medical standards update that now makes a history of a single episode of spontaneous pneumothorax (SP) disqualifying for all flying classes, and a medical waiver submission is now required to return to flying status. Previous policy required recurrent pneumothoraces to be medically disqualified for a history of spontaneous pneumothorax. **OVERVIEW:** The aviation environment increases the risk of SP due to pressure changes with the expansion of gas at altitude. In a retrospective case review that looked at Air Force members from 2002 to present who requested a waiver for SP, we found approximately 100 cases, half of which had had recurrence of SP. Aeromedical safety concerns include sudden incapacitation in flight, as at least eight of the cases occurred in flight with several occurring while flying in the deployed environment. We will explore the pathophysiology of pneumothoraces, the aeromedical risks associated with them, and how aviators are best treated and monitored post-occurrence. **SIGNIFICANCE:** Incapacitating symptoms such as shortness of breath, chest pain, and cough can occur with SP, jeopardizing aviator safety. To grant a waiver for SP, a thorough radiologic and physical examination and effective treatment of the underlying pathology are necessary to ensure reduced risk of recurrence. Unfortunately, the majority of cases of primary SP occur in those with previously undiagnosed lung disease. Baseline screening chest x-ray is insufficient for identification of underlying pathology and for clinical monitoring status post-occurrence of SP. Risk of recurrence of SP exponentially increases with each subsequent recurrence. Once diagnosed, SP requires expert evaluation and treatment to promptly recognize and treat underlying pathophysiology to ensure continued optimal pulmonary function and aviator safety.

Learning Objectives:

1. Identify the aeromedical implications of spontaneous pneumothorax.
2. Summarize methods of diagnosis of spontaneous pneumothorax and optimal definitive treatment and monitoring post-treatment in aviators.