Learning Objectives:

1. Many jobs, in and out of the military, require 24 hour, seven-day coverage, including aerospace operations such as air traffic control, security, and aircraft maintenance. Questions persist as to how shift work can be arranged to maximize performance, safety, and health while achieving requisite coverage.

[282] THE HUMAN PERFORMANCE SUSTAINMENT ELECTRONIC TOPIC GUIDE: PROOF-OF-CONCEPT DEMONSTRATION

J.W. Lasswell[2] and V.E. Martindale[1]
[1]Booz Allen Hamilton, Beavercreek, OH; [2]US Air Force, Fairfax, VA

INTRODUCTION: In order for evidence-based decision making to have an impact on human performance, there must be a mechanism for collecting and disseminating the evidence-based recommendations for use in the field. The Human Performance Sustainment Electronic Topic Guide (HPS ETG) was designed for storing, managing, and presenting evidence-based practice recommendations and associated information for use by Department of Defense (DoD) human performance practitioners. **METHODS:** This proof-of-concept demonstration was modeled after the U.S. Preventive Services Task Force (USPSTF) electronic topic guide hosted on the Agency for Healthcare Research and Quality (AHRQ) website. The DoD Human Factors Analysis and Classification System (HFACS), which provides a widely-used system for organizing information related to human performance, was selected as the entry portal and primary information organization method for the HPS ETG. **RESULTS:** Consultation with the human performance practitioners resulted in several methods for organization and retrieval of information. The primary access to HPS ETG topics is through categorization by the DoD HFACS. Topics are also searchable by intervention, performance decrement, and free text query. The platform includes material to support transparency and traceability, and allows for updating as new evidence becomes available. The initial proof-of-concept runs on a DVD, but is envisioned to become web-based. **DISCUSSION:** The Human Performance Sustainment Electronic Topic Guide is proven in concept as achievable and valuable to advance the practice of human performance.

Learning Objectives:

1. The audience will be familiar with the purpose and basic structure of the HPS ETG.

Wednesday, May 13 ***8:30 A.M.***
S. Hemisphere 1

[XLIX.] SLIDE: UNDER PRESSURE...OR NOT!

Chair: Diane Ritter
Biloxi, MS

8:30 a.m.
[283] EBULLISM IN SPACE: FACT VS. FICTION

T. Swaffield, D. Buckland, R. Slivka, and K.R. Lehnhardt
The George Washington University Hospital School of Medicine and Health Sciences, Washington, DC

INTRODUCTION: Popular movies that are based in space frequently portray inaccurate events, such as that which would occur in a decompression event. This misinforms the public and skews our understanding of the seriousness of just such an emergency. Decompression in space could lead to ebullism, which is the spontaneous evaporation of water from liquid to gas at a pressure of 47 mmHg or less. This process occurs at any altitude above 63,000 ft, which is a relative boundary known as "Armstrong's line." Above this altitude, a pressurized suit or spacecraft is necessary for human survival. In this project, we analyzed how scenes from popular science fiction movies misrepresent the physiological dangers of ebullism. **METHODS:** The movies "Europa Report" (ER), "Guardians of the Galaxy" (GG), "Star Trek Into Darkness" (ST) and "Star Wars Revenge of the Sith" (SW) were selected. We chose appropriate scenes from each movie and analyzed the duration of exposure, noticeable symptoms of those affected, apparent recovery (if applicable), and relevant information that is incorporated into the movie surrounding the decompression event. This information was then compared to available literature outlining the known pathophysiology and treatment of ebullism and validated for accuracy. **RESULTS:** The characters in ER and GG had longer exposures at >120 seconds. The characters in ST and SW had shorter exposures being ~9 seconds and ~15 seconds respectively. All characters survived exposure with minimal or no symptoms. **DISCUSSION:** It is possible that all individuals would have survived their exposures, just as the movies portray. However, the possibility of recovery depends largely on the length of exposure and the extent of cardiac/pulmonary damage. It was found that the selected movies improperly depicted the resulting effects of rapid decompression, which misrepresents the seriousness of this type of off-nominal event.

Learning Objectives:

1. To educate both physicians and the public alike about ebullism and its risks, given that science fiction movies frequently misrepresent the physiological effects of decompression in space.

8:30 a.m.
[284] IMPLICATIONS OF FIGHTER COCKPIT PRESSURIZATION RATES IN MODERN AIRCRAFT - SYNTHESIZING ENGINEERING AND AEROMEDICAL PERSPECTIVES

P. Lipinski[1], R. Jager[3], and R.M. Monberg[2]
[1]Air Force Flight Test Center, Lancaster, CA; [2]USAF, North Pole, AK; [3]JSF-ITF, USAF, Edwards AFB, CA

INTRODUCTION: Evaluating the modern military aircraft cockpit pressurization environment requires engineering and clinical perspectives across numerous engineering subsystems and disciplines. This presents a case study demonstrating the importance of maintaining this interdisciplinary mindset in complex aeromedical systems, examining a series of overpressurization events in a modern military fighter aircraft, from the initial discovery of the off-schedule events to the resulting reporting on the potential physiological consequences. **METHODS:** A series of over-pressurization events were observed in specific flight envelope and aircraft configuration combinations. Analysis of the pressurization subsystem, cockpit pressurization schedules, and rates of exposure were performed on data collected on the affected flights, and clinical assessment of the absolutes and rates of pressurization was performed alongside the engineering investigation. **RESULTS:** Over-pressurization was found to be related to specific aerodynamic conditions surrounding one of the cockpit pressurization valves, and rates of over-pressurization were found to be excessive. Aeromedical and life support reporting on the deficiency followed a previous environmental control systems report that had focused on the absolute value of pressure, not on the excessive rates. **DISCUSSION:** In complex aerospace systems, maintaining multiple perspectives is essential to fielding safe and reliable platforms for aircrew, and this case study serves as a demonstration of the real-world application of this mindset. An overview of over-pressurization absolutes and rates supplements the systems-level discussion.

Learning Objectives:

1. Understand the need for an interdisciplinary approach in evaluating human vehicle interface system deficiencies.
2. Understand the implications of excessive pressurization rates and levels in a modern fighter.

8:30 a.m.
[285] VALIDATION OF A METHOD ADAPTING AN AVIATOR'S MASK TO US CIVILIAN EMERGENCY MEDICAL SERVICES SYSTEMS

R.C. Kipp
U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: U.S. Air Force (USAF) guidance for the initial treatment of simple altitude-induced decompression sickness requires administration of 100% surface level oxygen. The current preferred method of delivery is a tight-fitting aviator's mask. As more USAF bases

transition from organic flight line response to relying on civilian emergency medical services (EMS) systems, the ability to provide 100% oxygen via an aviator's mask has decreased, due to a lack of compatibility between the USAF aviator's system and civilian systems. **METHODS:** Using a previously recommended, but unvalidated, design, an adapter was constructed. The mask and adaptor were tested through the range of the respiratory cycle and evaluated for performance using a civilian high pressure oxygen tank and hospital in-room wall oxygen as sources. Mask pressure and flow rate were recorded to confirm that appropriate oxygen was being delivered. **RESULTS:** 100% oxygen with positive pressure was provided via a USAF aviator's mask adapted for use with civilian oxygen delivery systems. A detailed description of the adaptor's operating characteristics will be discussed. **DISCUSSION:** This study provides validation that the USAF aviator's mask can be adapted for use in the civilian EMS system for treatment of decompression sickness.

Learning Objectives:

1. To understand the role of 100% surface level oxygen in the treatment of decompression sickness.
2. To review the pathophysiology of decompression sickness.

8:30 a.m.
[286] THE LONG-TERM MEASUREMENT OF EUSTACHIAN TUBE FUNCTION IN A HYPERBARIC CHAMBER USING AN EAR CANAL MICROPHONE

H. Fischer[1], A. Koch[2], W. Kähler[2], M. Pohl[1], and T. Zehlicke[1]
[1]Otolaryngology (ENT), Military Hospital, Hamburg, Germany; [2]Experimental Medicine, German Naval Institute of Maritime Medicine, Kronshagen, Germany

INTRODUCTION: Changes in ambient pressure require middle ear pressure regulation by the Eustachian tube. A dysfunction of the tube can lead to severe middle ear barotraumas i.e. aviation and diving. Existing direct and indirect measuring methods cannot be used to examine tube function over long term and during exposure to changing pressure conditions. The purpose of this study was to detect the sound of eardrum movements with an ear canal microphone (ECM) in a hyperbaric chamber to give more information about quantity and quality of the tube function. **METHODS:** A lavalier microphone was used as the ECM to detect the specific click sounds of eardrum movements caused by the middle ear equalization. The acoustic sound was amplified, filtered and recorded. Five voluntary test persons with regular tube function were examined in a hyperbaric chamber at the German Naval Institute of Maritime Medicine / Kronshagen. They were compressed and decompressed to / from ambient pressure of 3 bar (water pressure at 20 m depth). All active and passive equalization maneuvers were recorded and related to the subjectively perceived pressure regulation in the measured ear. **RESULTS:** The signals recorded were clear and reproducible. The acoustic analysis differentiated different kinds of equalization. The subjective impression was confirmed to the recorded number of eardrum movements. The sequence of active equalization maneuvers during compression was more regular and steady pattern while in recompression the click sounds varied more unevenly. **DISCUSSION:** The study established a technical method in analysing physiological circumstances in barometric pressure regulation. In comparison to previous approaches this objective and dynamic technique allows the continuous recording of active and passive equalization in a simple and practical way during high-pressure changes. Although the technical realization gives room for further improvement, the results achieved so far demonstrated the feasibility of the method.

Learning Objectives:

1. The audience will list at least two medical applications for a long-term measurement method for Eustachian tube function.
2. The audience will understand the idea of the ear canal microphone and its use in a hyperbaric chamber.
3. The audience will appraise the described technique as a dynamic, long-term measuring method for tube function due meeting two essential prerequisites.

8:30 a.m.
[287] ASSESSING THE EFFICACY OF ADJUNCTIVE HYPERBARIC OXYGEN THERAPY IN TREATMENT OF HIDRADENITIS SUPPURATIVA

E. Ercan[2], D. Yildiz[1], and D. Senol[3]
[1]Department of Dermatology, Eskisehir Military Hospital, Eskisehir, Turkey; [2]Department of Hyperbaric Medicine, Eskisehir Military Hospital, Eskisehir, Turkey; [3]TuAF Aircrew Health Research and Training Center, Eskisehir, Turkey

INTRODUCTION: Hidradenitis suppurativa (HS) is a chronic, inflammatory disease characterized by recurrent, painful abscesses and nodules primarily in intertriginous areas. Hyperbaric oxygen therapy (HBOT) has anti-hypoxic, anti-edema, and anti-infective properties, and may help to increase wound healing in hidradenitis suppurativa (HS). The aim of the study was to evaluate the efficacy of HBOT in patients with HS treated with a combination of systemic rifampicin and clindamycin. **METHODS:** The study was a prospective, single-center, randomized controlled. Efficacy was measured by using modified Sartorius Score (SS), HS Severity Index (HSSI), Dermatology Life Quality Index (DLQI), and visual analog scale (VAS) before treatment and after completing 4 and 10 weeks of treatment. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels were also measured. All patients received medical treatment with the combination of clindamycin (300 mg orally, BID) and rifampicin (300 mg orally, BID) for 10 weeks. Patients were randomly assigned to treatment with HBOT and 20 sessions at 2.4 ATA were administered. Statistical analyses were done with SPSS version 16.0. **RESULTS:** Forty-three patients (25 females, 18 males) were enrolled in the study. Of the 43 patients, 32 had moderate HS, and 11 had severe HS, as defined by HSSI. The patients were randomly divided into two groups: The first group of patients (n = 22) were treated with antibiotics and HBOT, while the second group of patients (n = 21) were treated with antibiotics only. The two groups did not differ in terms of gender distribution, age, BMI and smoking habits. Patients in the HBOT group showed a 50% or greater decrease from baseline at week 10 for SS, HSSI, DLQI, VAS, ESR, and CRP than control group. Clinically and statistically significant improvement from the baseline was observed after 4 and 10 weeks in HSSI ($p = 0.009$), SS ($p = 0.021$), DLQI ($p = 0.009$). **DISCUSSION:** Adjunctive HBOT was considered effective, significantly improving antibiotic treatment of HS. HBOT was well-tolerated, and no unexpected safety issues were identified. HBOT may reduce the time to heal and accelerate the patient's return to work, which reduces the economic and social burden of the disease.

Learning Objectives:

1. 1- Analysing of effectiveness of HBOT in hidradenitis spuritiva.

8:30 a.m.
[288] FOURNIER GANGRENE OF 4 CASE, APPROACH TO TREATMENT AND HYPERBARIC OXYGEN THERAPY

D. Emeksiz[2] and E. Ercan[1]
[1]Department of Hyperbaric Medicine, Eskisehir Military Hospital, Eskisehir, Turkey; [2]Department of General Surgery, Eskisehir Military Hospital, Eskisehir, Turkey

INTRODUCTION: Fournier Gangrene is an infectious disease of perineal, genital or perianal region which is characterized by developing necrotizing fasciitis. It is very important that symptoms should not be overlooked. Delay in diagnosis and treatment can be fatal and disease requires immediate surgical intervention. **METHODS:** Hyperbaric oxygen therapy (HBOT) sessions were given in a pressurized chamber and patients inhale 100% oxygen. This treatment is used in decompression sickness, air embolism, carbon monoxide poisoning, life threatening infections like Fournier gangrene, crush injuries, peripheral vascular disease and their complications, sudden hearing loss, central retinal artery occlusion and complicated wounds. **RESULTS:** Four Fournier gangrene diagnosed patients (3 female and 1 male) have been referred to our hospital after their first medical and surgical intervention since 2013. They were 32, 41, 58, 65 years old. They were inspected thoroughly and intensive care was provided. Laboratory analyses like total blood count, routine blood

biochemistry, ECG, X-Rays and microbiological (blood, wound) analyses were done. Aggressive surgical debridement followed wound care were administered and HBOT was provided after evaluation of patients. Multiple culture guided parenteral antibiotic therapy were added to treatment. This life threatening wounds and infections can only be controlled by multidisciplinary approach. **DISCUSSION:** Aggressive surgical debridement, culture guided parenteral antibiotic therapy, controlling systemic disease like diabetes, hypertension etc. are vital. There is chronic hypoxia in complicated wounds. HBOT has anti-hypoxic, anti-edema, and anti-infective properties that augment wound healing. HBOT augments fibroblast/neutrophil activity, collagen synthesis, neovascularization and epithelial growth. HBOT directly toxic effect on anaerobic bacteria via oxygen burst. Fournier gangrene has rare, insidious course of disease with high mortality rate. Urgent multidisciplinary intervention is crucial. All of our cases successfully treated and their wounds healed.

Learning Objectives:

1. 1- Life threatening wounds and infections can only be controlled by multidisciplinary approach.

Wednesday, May 13 ***8:30 A.M.***
S. Hemisphere 2

[L.] AEROSPACE MEDICINE GRAND ROUNDS: RESIDENT CASE PRESENTATIONS

Co-Chair: Patrick Storms
Wright-Patterson AFB, OH

Co-Chair: Richard Allnutt
Wright-Patterson AFB, OH

PANEL OVERVIEW: INTRODUCTION: This panel will consist of pairs of aerospace medicine residents presenting clinical cases of aeromedical interest or significance. **METHODS:** During their residency practicum years, residents provide evaluations of patients with diverse medical problems. Residents prepare and present a case report based on a patient encounter undertaken during their practicum experience. **RESULTS:** One resident from each pair presents the history of the presented problem. The other resident presents the physical findings and a discussion of the aeromedical policies associated with the condition. **DISCUSSION:** Learning aerospace medicine at the specialist level involves understanding the impact of medical conditions on aircrew health and mission accomplishment. The cases presented will not only be of academic interest but will also illustrate aeromedical decision-making in the operational environment.

Learning Objectives:

1. Improve understanding of clinical aerospace medicine.

Wednesday, May 13 ***8:30 A.M.***
S. Hemisphere 3

[LI.] PANEL: DYNAMIC ISSUES IN AEROSPACE AND OPERATIONAL PHYSIOLOGY

Sponsored by the Aerospace Physiology Society

Chair: Donald White
Washington, DC

PANEL OVERVIEW: This session is sponsored by the Aerospace Physiology Society whose mission is to stimulate, accomplish, encourage, promote, and advance the science and practice of aerospace and operational physiology. This expert panel will present a balance of the diverse methods used to enhance and sustain human performance integration through theoretical and applied solutions. The Aerospace Physiology Society is actively engaged by establishing and maintaining cooperation between aerospace and operational physiology translational research and integrating this work with other scientific disciplines. Human performance integration is a preeminent factor in the dynamic aviation and operational environment. Dynamic engagement by operational physiologists is aimed at enhancing mission, capability and outcome. Breakdown in human performance integration can quickly become a contributing or causal factor in an aviation or operational mishaps as well as organizational leadership shortfalls. Mission performance is maximized through education, training, and enhanced crew survivability. These elements are integrated with our translational research which includes physiological, psychological and environmental components.

[289] TURNING SPATIAL DISORIENTATION RIGHT-SIDE UP IN USAF UNDERGRADUATE PILOT TRAINING

A. Woodrow
A3FM, USAF, San Antonio, TX

INTRODUCTION: Between FY93-10, the United States Air Force (USAF) registered 62 Class A mishaps with SD listed as causal or contributory; this included 86 fatalities and $2.0B in lost resources and resulted in 4 Class A Mishap Recommendations that specifically called for full-motion SD trainers in pilot training. A 6-year, cross-MAJCOM, multi-divisional effort resulted in the successful acquisition of devices and inclusion of formal training to the USAF undergraduate pilot training syllabus. This effort aims to close a decades-old training and safety gap in USAF aviation. This presentation will provide a brief overview of the problem; a short history of previous efforts to include SD training in undergraduate pilot syllabi, and an overview of the UPT T-6 syllabus requirements and programmed unusual attitude recovery to recognize and recover from SD illusions using a physiological training device.

Learning Objectives:

1. Recognize the problem of spatial disorientation in the United States Air Force.
2. Identify the process of assessing the problem of spatial disorientation and the development of a solution through multiple channels leading up to execution of syllabus-based trianing.

[290] FIELD OF VIEW EVALUATION FOR FLIGHT SIMULATORS USED IN SPATIAL DISORIENTATION TRAINING

H. Williams, E. Littman, R. Folga, and F. Patterson
Aeromedical, Naval Medical Research Unit-Dayton, Dayton, OH

INTRODUCTION: Spatial disorientation (SD) is a deadly threat to aviation safety, so it is important to train pilots to recognize, avoid, and/or recover from it. Flight simulation is a safe and relatively inexpensive vehicle for SD training, but certain simulator characteristics, such as the field of view (FOV) required for effective training, need to be better specified. These specifications then need to be applied in upgrades to simulators used in SD training. **METHODS:** Three different out the window FOVs displays were evaluated for their utility for inducing responses associated with SD, namely the Opto Kinetic Cervical Reflex (OKCR) and Control Reversal Error (CRE). Twelve pilots flew a simulator in two different scenarios using a Small, Medium, and Large FOV. **RESULTS:** FOV size did not significantly affect the magnitude of head tilt (measured in degrees), but the association between aircraft angle of bank and degree of head tilt was stronger for the medium and large FOVs as compared to the small FOV ($p < .05$). The medium and large FOVs did not differ significantly from each other. There were five CREs observed in the small and large FOV conditions, and seven with the medium FOV, but this increase was not statistically significant. **DISCUSSION:** The Medium FOV was an optimum choice for eliciting the OKCR and CREs, since it generally outperformed the Small FOV and equaled the Large FOV, all at a lower price point and with a smaller footprint. This information is being directly applied to the advanced SD trainer acquisition process currently underway with Naval Air Systems Command. The results are applicable to other simulator systems as well, and implications and recommendations for SD training are discussed.

Learning Objectives:

1. Attendees will identify the impact of out the window display field of view on eliciting sensory spatial reflexes thought to contribute to spatial illusions and disorientation phenomenon.

[291] LASER-POINTER ILLUMINATION EVENTS IN NAVAL AVIATION OPERATIONS

J.L. Bradley, M.D. Reddix, R. Folga, and M. Tapia
Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH

INTRODUCTION: Laser pointers have been implicated in an increasing number of USN and USMC aircraft bright-light illumination events. **METHODS:** FY09-14 ground-based lasing events, as reported in U.S. Naval Safety Center aviation Hazard Reports and Commander Naval Air Forces Aviation Safety Awareness Program records were analyzed. Ground-to-aircraft slant range estimates for eye damage, temporary scotoma, and veiling glare were estimated for the most powerful commercially available blue, green, and red handheld laser pointers. **RESULTS:** A total of 336 laser-illumination events were reported over a six-year period. The most frequently reported aircraft illumination events were associated with green (n=264) lasers. Rotary wing (n=105), Patrol/Logistics/Fleet Support (n=125), and fixed-wing trainer (n=61) aviation platforms accounted for 86% of reported illumination events. This analysis revealed a twenty-fold increase in laser illumination event reports between FY09 (n=5) and FY14 (n=99). Most lasing events were described lasting only seconds; the longest exposure reported was approximately three minutes. Most aircraft laser illumination events were near airports while in the pattern or on approach; two hazard reports revealed exposures above 23K' Mean Sea Level. **DISCUSSION:** Risks associated with night time laser-pointer illumination events and associated bioeffects (especially veiling glare) are the fastest growing aeromedical and aviation safety threat. Further research is required to validate candidate material solutions combined with new tactics, techniques and procedures in dealing with these incidents.

Learning Objectives:

1. Panel attendees will gain knowledge of: a) the prevalence of laser illumination events of in US Navy and US Marine Corps aircraft operating environments; b) less-than-lethal laser exposures and their potential to degrade and potentially damage aircrew vision, and; c) exposure mitigation strategies and proposed solutions.

[292] EFFECTS OF SPATIAL DISORIENTATION COUNTERMEASURES TRAINING ON BLACK HOLE ILLUSION ONSET DISTANCE AND RECOVERY ALTITUDE

F. Patterson, H. Williams, and R. Folga
Aeromedical, Naval Medical Research Unit-Dayton, Dayton, OH

INTRODUCTION: Surveys and mishap statistics indicate excessively low Black Hole Illusion (BHI) landing approaches occur frequently among military pilots. Navy and Marine Corps aviators report BHI as the second most commonly encountered visual problem, surpassed only by misinterpretations of fixed horizon cues. Air Force surveys cite BHI as the leading visual problem for multi-engine aircraft pilots and among all types of USAF airframes, the third most common form of spatial disorientation. Conventional BHI explanations are based upon the concept that flying into unfamiliar airfields at night increases susceptibly to runway outline depth illusions. This study tested the hypothesis that BHI may also be caused by perceptual problems unrelated to variances in runway size or slope. **METHODS:** Simulator and didactic training emphasizing the critical role of primary (runway image) and secondary (glare shield image) spatial cue interaction were presented to participants. Keeping the runway and glare shield sight picture constant during descent made the glide slope appear constant; even though maintaining a fixed sight picture would in this case require a slight and often unintentional increase in downward pitch angle. **RESULTS:** Of the 26 pilots completing the simulated night landings trials prior to receiving BHI training, 22 began committing BHI errors 4.2 ± 1.4 miles from the runway and 21 recovery initiations occurred at 1.2 ± 0.4 miles. After receiving the experimental BHI training, only six subjects committed BHI errors at 3.2 ± 1.9 miles with four attempted recoveries at 2.2 ± 1.6 miles. **DISCUSSION:** BHI errors can occur at distances where unfamiliar runway dimensions (traditional BHI explanations) have little if any effect on approach performance. Informing pilots about appropriate spatial strategy methods reduces BHI frequency and improves altitude recovery.

Learning Objectives:

1. Participants will gain an understanding of pilot spatial strategies during night approaches and how those differ under conditions with and without a horizon.

[293] LOW CARBOHYDRATE NUTRITION FOR AVIATORS?

D. Bonetti
RNZAF, Auckland, New Zealand

INTRODUCTION: In addition to thermal, physical and cognitive stress, it is common for aircrew to be placed under conditions of significant hypoxia and accelerative forces, Physiologists are trained to advise aircrew that a high carbohydrate diet is essential to safely operate under these conditions. But could a diet that is low in carbohydrate safely produce the same or improved levels of performance? **METHODS:** A literature review was conducted investigating the safety and efficacy of low carbohydrate diets on human metabolism and performance. **RESULTS:** The physiological changes induced by a low carbohydrate diet are largely due to a change in metabolism, from a sugar burning state to a fat burning state, allowing access to >30,000 calories from adipose tissue reserves to fuel metabolism and protect from hypoglycemia. These changes are generally most pronounced when carbohydrate intake is < 50 g per day, leading to a state of nutritional ketosis, and the brain transitioning from glucose to ketones as it major fuel source. Substantial evidence is now available supporting the safety and efficacy of low carbohydrate diets in combating metabolic and cardiovascular risk factors in both healthy and metabolically dysfunctional populations. Once adapted to a low carbohydrate diet, there is also some evidence that cognition, submaximal exercise performance, muscular strength and hydration status is uncompromised. No studies have examined physical and cognitive performance following adaptation to a low carbohydrate diet in aviation specific environments. **DISCUSSION:** There is now substantial evidence that adaptation to a low carbohydrate diet may provide beneficial outcomes in metabolic and cardiovascular health. While the evidence is limited, cognitive performance and most indices of physical performance appear to be uncompromised. Additionally, access to the bodies most abundant source of fuel and protection from hypoglycemia could be beneficial to aircrew in long duration missions. We should now take note of the evidence, and start investigating the safety and efficacy of low carbohydrate nutrition in aviation specific environments.

Learning Objectives:

1. The safety and efficacy of low carbohydrate nutrition is described.

Wednesday, May 13 ***8:30 A.M.***
S. Hemisphere 4

[LII.] SLIDE: HOSTILE IN-FLIGHT ENVIRONMENT INJURY RISK MITIGATION

Co-Chair: Philippe Souvestre
Vancouver, British Columbia, Canada

Co-Chair: David Hardy
Beavercreek, OH

8:30 a.m.

[294] CT EXAMINATION OF THE PERICARDIUM AND LUNGS IN HELICOPTER PILOTS EXPOSED TO VIBRATION AND NOISE

J. Kåsin and A. Wagstaff
Institute of Aviation Medicine, Norwegian Defence Medical Services, Oslo, Norway

INTRODUCTION: Helicopter pilots are exposed to whole body vibration (WBV) and noise in their working environment. Some researchers have found that kinetic energy from both noise and vibration is believed to affect the pericardial thickness and lead to pulmonary fibrosis, known as vibroacoustic disease. The aim of this project was to determine whether we could find similar findings in a selection of helicopter pilots. **METHODS:** A case control study where 27 helicopter pilots were compared to an age-matched control group of typical office workers. High resolution CT scanning of thorax was used as the diagnostic method. Two medical radiologists interpreted the images independently not aware of the subjects being pilots or from the control group. **RESULTS:** There were no signs of pericardial thickening or significant lung fibrosis formations in any of the groups. The average pericardium thickness' for helicopter group: 1.38 mm, SD = 0.54 mm and control group: 1.37 mm, SD = 0.33mm. There was no significant correlation between pericardium thickness and flight hours or age. **DISCUSSION:** The average pericardial thickness values for the helicopter and the age matched control groups were almost identical. The results are within normal limits and comparable to an American study were 21 normal individuals were measured to 1.2 mm ± 0.8 mm in average of 26 different points by using Transesophageal Echocardiography.

Learning Objectives:

1. On the basis of CT scans, our findings do not support the existence of "vibroacoustic disease" where pericardial thickening is the most prominent sign.

8:45 a.m.

[295] HEARING LOSS CONSIDERING AMONG CIVILIAN AIRLINE AND HELICOPTER PILOTS AND AIR TRAFFIC CONTROL PERSONNEL IN IRAN

K. Soleimani
Air Medical Section, Civil Aviation Organization, Tehran, Iran

INTRODUCTION: The hazard of exposure to loud noise has been known for many years. Of course noise is also generated elsewhere in the aviation environment by machinery and tools - places where aircrew and ground-staff will frequent - such as maintenance hangars and aprons. In order to determine that the hearing loss was a result of aviation noise, a relative analysis of audiometric data from Iranian airline (fixed-wing) pilots, and helicopter pilots and air traffic control (ATC) personnel was carried out. The results may be of use in giving advice regarding preventive measures. **METHODS:** Airline, helicopter pilots and ATC were selected randomly from the aeromedical section files. There were 350 subjects included in the study:100 ATC (88 men 12 women), 50 Pilots -H (men), and 200 Fix Wing (men), subjects for ATC, helicopter, and airline pilots, separately . Audiograms with a 2 - 5yr interval were analyzed for each individual. Age discipline was arranged using data from identify standards . Beginning changes per year for the frequencies 3, 4, and 6 kHz were tested in special since age correction. **RESULTS:** All audiogram for all these groups were seen and average hearing beginning levels were more than standards prognostication for most frequencies. **DISCUSSION:** As anticipated, hearing beginning decreased with age in the group as a whole. Looking at the 3-, 4-, and 6-kHz frequencies in special, all groups had small but highly significant decreases in hearing beginning at 4 kHz between the first and last audiogram. Highly significant changes in hearing threshold after age correction, indicating may be noise-induced hearing loss, were found in all groups at 4 kHz. The reality that helicopter pilots had alike hearing loss to their other aviation colleagues indicates that current hearing protection for these pilots is productive in cancel out the increased noise levels in helicopters.

Learning Objectives:

1. In order that examine may be hearing loss as a result of aviation noise, a relative analysis of audiometric data from Iranian airline (fixed-wing) pilots, and helicopter pilots and air traffic control (ATC) personnel, was carried out. The results may be of use in giving advice regarding preventive measures.

9:00 a.m.

[296] A COMPARISON OF NEUTRAL AND FLEXED PILOTING POSTURES USING UPRIGHT MRI

P.E. Whitley[1] and M. Fox[2]
[1]CFD Research Corp, Huntsville, AL; [2]Upright MRI of Deerfield, Deerfield, IL

INTRODUCTION: Back pain in helicopter pilots has been frequently reported in the literature. Pilot task posture has been implicated in the development of back pain. The orientation of the lumbar spine was documented using Upright MRI in the normal and piloting task posture to facilitate adjustment of lumbar spine finite element models (FEM). **METHODS:** The sagittal plane lumbar spine orientation in the normal and piloting posture was determined for sixteen civilian subjects (eight male and female) between the ages of 21 to 40 without history of spinal problems using a Fonar Mega-Open™ 0.6 Tesla Upright MRI. The resulting sagittal plane images were analyzed using Fiji ImageJ. Inferior and superior endplate slopes, slope angle, body center location, and anterior and posterior disc heights were determined. Subject gender, sitting height, age, stature and weight were recorded. A Student's t-test was used to compare measured values by gender or posture. **RESULTS:** Statistically significant differences for superior (s) and inferior (i) vertebral surface slope and slope angle were found for all subjects starting at L4s through L1s and for males and females independently from L3i to L1s. Significant differences were found by gender for slope and slope angle at L2s for the slope and slope angle in the neutral posture and for L2i, L2s, L1i and L1s in the flexed posture. Significant differences were found by posture for the L1 and L2 vertebral body center horizontal location. **DISCUSSION:** While the neutral and flexed postures demonstrated similarities at the lower lumbar levels, significant differences were noted at higher lumbar levels which could lead to loading of the posterior ligaments and discs in this region. This data has already been used to modify FEM which will be used to study the effects of seated posture on the structures of the lumbar spine.

Learning Objectives:

1. The influence of seated helicopter piloting posture on spinal orientation.
2. The variation of spinal orientation by posture and gender and the potential for pain development.

9:15 a.m.

[297] THE FLYING FOOT: DESIGNING, IMPLEMENTING, AND DELIVERING A CABIN CREW PODIATRY SERVICE IN A MULTI-CULTURAL AIRLINE

R.J. Jones and R. Pieterse
Emirates Medical Services, Dubai, United Arab Emirates

INTRODUCTION: The cabin crew podiatry service within Emirates Airlines has proven successful delivering positive outcomes for cabin crew, service delivery and medical service. Work related foot issues were increasingly presenting to Emirates medical clinic. It represented an increasing trend of absenteeism and presenteeism. One type of cabin crew shoe was available to cater for the 139 different nationalities. It seemed intuitive that one shoe type would not accommodate the vast foot differences expected in such a multi-cultural population, particularly when those crew are industrial/professional foot users; those in heavy manual role who are on their feet for extended periods of time. **METHODS:** There was little in the medical literature relating to different foot types or those that predispose to problems in different nationalities. In 2012 an screening project to collect data on the multicultural foot types joining cabin crew was undertaken, with a study sample of 500, identified that approximately 34%would benefit from podiatry input. **RESULTS:** The scanning project results lead to a specialist cabin crew podiatry clinic being introduced in 2013 to assess and treat incumbent cabin crew. The clinic identified the inadequacy of one shoe range option. The volume of prescription and issuing of insoles has been as expected (30%). However, it became apparent the severity of mechanical foot problems combined with the limited choice of shoes, was greater than expected. As a result, a service to provide bespoke orthotic shoes was introduced sooner than planned to address both the

mechanical foot issues and need for a variety of different shoe dimensions. The aim is to introduce a number of additional cabin crew shoes. **DISCUSSION:** In professional foot users approximately 30% of cabin crew are predicted to develop mechanical foot problems requiring podiatry input. For Emirates this equates to 6000 crew based on projected cabin crew numbers in 2020, of 30,000. This not only presents a potential picture of increasing absenteeism and presenteeism but an enormous podiatry and pastoral challenge. The long term vision is to have an Emirates Group Shoe Shop providing a job specific one stop shop.

Learning Objectives:

1. Experience the burden of cabin crew foot problems on the airline, the crew and service delivery.
2. Review the steps and processes required to establish an effective cabin crew podiatry service in a rapidly growing international and multicultural airline.
3. Understand how the managing of foot and shoe problems in a large multicultural airline within a role specific podiatry service addresses the pastoral aspects of cabin crew health and aims to reduce the burden of absenteeism and presenteeism on the company.

9:30 a.m.

[298] CIVILIAN PILOT OCULAR EXPOSURE TO ULTRAVIOLET RADIATION DURING FLIGHT

A. Chorley[1], M. Higlett[2], K.A. Baczynska[2], B. Evans[3], M. Benwell[4], and M. Khazova[2]
[1]Medical, UK Civil Aviation Authority, West Sussex, United Kingdom; [2]Public Health England, Chilton, United Kingdom; [3]Institute of Optometry, London, United Kingdom; [4]London South Bank University, London, United Kingdom

INTRODUCTION: Long term exposure to ultraviolet (UV) radiation is known to cause increased risk of ocular conditions including cataract and pterygium. Although UV increases with altitude, pilot ocular exposure is greatly affected by the aircraft structure and optical properties of the windshield. There is good evidence that higher energy UVB is effectively filtered by the windshield, however it remains uncertain the irradiance levels of UVA during flight. **METHODS:** UV from 280-400nm was measured on the flight deck using a spectroradiometer with associated optics, automated software and shutter throughout six airline flights from London Gatwick to various destinations and differing times of year. Two identical UV illuminance meters were used in order to calculate ocular exposure during flight. Additionally, a series of ground transmission measurements were undertaken of front windshields and side windows from 15 commercial passenger aircraft of varying type. **RESULTS:** Two distinct types of windshield were discovered: those which effectively blocked UV up to near 400nm and those which transmit from around 365nm. Most of the oldest registered aircraft measured had superior UVA blocking windshields whilst more recently registered aircraft measured had poorer UVA blocking windshields. In flight measurements demonstrated that ocular UVA exposure to the unprotected eye always exceeded international exposure guidelines in aircraft with poorer UVA blocking windshields. This can occur within one hour of flight. UVA dose was found to be low over a nine hour flight in high irradiance conditions in an aircraft with superior UVA blocking windshields. **DISCUSSION:** The pilot has no means to assess the windshield UVA blocking properties visually. Whilst the use of sunglasses will offer the pilot protection from UVA, there is evidence that, in practice, these may be used minimally by a significant proportion of airline pilots. Some means of identification of differing windshields is recommended.

Learning Objectives:

1. Civilian airline and commercial helicopter pilots may receive an ocular exposure dose to UVA outside international recommended guideline limits. The main factors influencing this are the optical properties of the windshield and personal use of eye protection.

9:45 a.m.

[299] WORK PLACE INJURIES IN FLIGHT ATTENDANTS AND ASSESSING THEIR FITNESS TO RESUME FLYING DUTIES

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

INTRODUCTION: Flight attendants are exposed to very physical job demands that they often did not anticipate when accepting the job and often not well understood by health care professionals. We noticed that workplace accidents place a significant burden on the airline as well as the individual. No objective consensus or any guidelines exist to follow when deciding whether an injured flight attendant is considered fit to resume normal flight duties. **METHODS:** We analyzed 2500 work place injury reports; submitted during one calendar year and calculated the cost to the airline. Injured flight attendants complete an accident report and sign consent for the company to use the information gathered, with an in-house health unit it is then easy to access actual medical records rather than rely on questionnaires completed from memory often long after the injury occurred. We then compared our data to published data and also looked at different aspects unique to our environment and triggered by some of the trends we identified. **RESULTS:** We had 2500 reported work place injuries and 5570 flight attendants; this resulted in 16 700 work days lost for the calendar year. Injuries to the spine and shoulder accounted for 70% of all injuries. 60% of back injuries occur in the galley. On average 38 days lost for each reported case of a back strain injury. We projected in 2004 that 2 full time doctors will be required just to deal with work place injuries once our flight attendants reached 16 000, this proved to be true. The cost in salary alone for flight attendants absent due to work place injury in 2004 was $ 1.1 million. **DISCUSSION:** We established a centralized in-house, multi-disciplinary facility; focusing on these musculo-skeletal injuries and their rehabilitation applying sports medicine principles to occupational health. (Like posture analysis, muscle strength testing, job specific rehabilitation and conditioning) We developed an objective, standardized, measurable and repeatable 14-point fitness test for injured flight attendants to pass before resuming normal flying duties. We also included a clinical psychologist as part of the multi-disciplinary team approach.

Learning Objectives:

1. The purpose was to establish and test our "fit to fly" test protocol and determine whether the physical conditioning of flight attendants is adequate for the physical demands of the job.
2. The aim of the unit is to reduce the impact of work place injuries to the company as well as the individual and reduce the risk of re-injury.
3. By having a centralized unit; to gain a better understanding of the physical demands of the job and improve the management of these injuries by establishing a centralized data base and standardized approach.

Wednesday, May 13 ***8:30 A.M.***
S. Hemisphere 5

[LIII.] PANEL: HIGH AND HIGHER: SPECIFIC ASPECTS IN AVIATION AND SPACE MEDICINE (IN GERMAN)

Sponsored by the German Society of Aviation and Space Medicine

Co-Chair: Juergen Brandenstein
Cologne, Germany

Co-Chair: Jochen Hinkelbein
Cologne, Germany

PANEL OVERVIEW: Aviation and Space Medicine covers a wide range of specific topics related to both fields. This session aims to give insight into several interesting aspects. All presenters are members of the German Society of Aviation and Space Medicine (DGLRM). This session is

organized by the German Society of Aviation and Space Medicine (DGLRM). All presentations are given in either German or English language.

[300] MANAGEMENT OF PILOTS WITH CORONARY ARTERY DISEASE (CAD) NEEDING A SPECIAL ISSUANCE. ATTEMPT TO ENCOURAGE THE AUTHORITIES TO MODIFY THE REQUIREMENTS.

F.H. Hauer[1,2]
[1]Flugmedizin Oberkassel, Duesseldorf, Germany; [2]AeMC (Aeromedical Center Cologne), Cologne, Germany

INTRODUCTION: The aeromedical requirements for special issuances of pilots with CAD are published in the European regulation (EU) 1178-2011 and the AMC and GM to Part-MED, both laying down technical requirements and administrative procedures. The assessment of pilots with CAD using the above mentioned regulations defer in relevant parts from the international cardiologic guidelines. To avoid problems regarding both - EU - regulations and international guidelines - the examination of pilots with significant CAD requires often a different exam procedure. **METHODS:** By giving a case report of an airline pilot, I will demonstrate the possible and necessary approach to avoid problems in obtaining a special issuance by adjusting the examination methods and procedures. The international acknowledged methods in evaluating significant coronary artery lesions will be demonstrated. **RESULTS:** Looking at the methods to determine the degree of stenosis in CAD, the mostly applied technique is measuring the Lumina by an edge-to-edge method. By examining very small vessels slight differences in positioning the cursor may result in a considerable higher or lower extent of stenosis, which might be important in borderline cases. Therefore methods using IVUS (intravascular ultrasound), FFR (fractional flow reserve) or OCT (optical coherence tomography) are necessary to obtain the exact degree of stenosis. The methods and the benefit of IVUS, FFR and OCT will be discussed. Since 2010 the European Society of Cardiology (ESC) gave the highest level of recommendation to the FFR method to determine significant lesions (FAME-study 2009). **DISCUSSION:** CAD is a very common disease. Therefore it is not astonishing, that cardiologists discover a significant number of pilots with CAD. Focusing the discrepancies between the mentioned guidelines our mission should be to improve the aeromedical procedures in order to avoid loss of license. Because using an "at a glance" or edge-to-edge measurement is not very helpful in borderline lesions, it is necessary to apply other well acknowledged procedures like IVUS, FFR or OCT. The examining interventional cardiologist shall be informed to use one of these procedures for the precise assessment of the extent of stenosis in doubtful cases.

Learning Objectives:

1. Knowing the difference between the EU requirements and the international accepted Cardiologic Guidelines.
2. Learning to manage the necessary procedures in order to obtain best results performing a sufficient opinion concerning the underlying disease and to avoid possible risk of incapacitation.
3. Understand the evaluation of coronary artery disease with new procedures like IVUS, FFR and OCT.

[301] CELLULAR AND MOLECULAR SENSITIVITY IN CELLS OF THE MONOCYTE-MACROPHAGE SYSTEM TO ALTERED GRAVITY

O. Ullrich and C.S. Thiel
Medical Faculty, University of Zurich, Zurich, Switzerland

INTRODUCTION: During spaceflight, the immune system is one of the most affected systems of the human body. Substantial research and development activities are required to provide basic information for appropriate risk management and efficient countermeasures. The gravity-sensitive nature of cells of the immune system renders them an ideal biological model in search for general gravity-sensitive mechanisms and to understand how the architecture and function of human cells is adapted to life on Earth. **METHODS:** We investigated the influence of altered gravity on cells of the monocyte-macrophage-system (cell lines and human primary macrophages) on key functions, gene expression, metabolism and surface molecule expression in parabolic flight (13th DLR, 23rd DLR and 51st ESA PFC, centrifuge (SAHC, DLR Cologne), 2D clinostat, suborbital (TEXUS-51) and orbital (SIMBOX/SZ-8 and CELLBOX/SpX-3/ISS) space flight experiments. The CELLBOX Experiment was processed and launched through a partnership between the German Space Agency (DLR), Airbus DS and NanoRacks aboard the SpaceX CRS-3 Mission and was performed in the U.S. National Lab of the ISS. **RESULTS:** The release of reactive oxygen species (ROS) was reduced in microgravity, enhanced in hypergravity and responded rapidly to altered gravity within seconds. In long-term microgravity, we detected a severely disturbed actin cytoskeleton and reduced expression of CD18, CD36 and MHC-II. We also identified ICAM-1 as a rapidly-reacting gravity-regulated molecule in macrophagic cells. During the CELLBOX mission, we analyzed surface molecules, the cytoskeletal architecture and cellular metabolism. We detected gravity-sensitive expression of genes for cytoskeleton-associated proteins, NADPH oxidase subunits, cell-cycle regulation proteins, transmembrane proteins and ion channels during the TEXUS-51 mission. We were also able to identify genes, which demonstrated no altered expression levels in all tested conditions and therefore represent good candidates for the standardization of gene expression studies in altered gravity. **DISCUSSION:** We suppose that microgravity induces a phenotype, which is not capable of migrating or recognizing and attacking pathogens, and can no longer activate the specific immune system.

Learning Objectives:

1. The combination of parabolic flights, sounding rocket campaigns and orbital missions provided an overview about initial (seconds), mid-term (minutes) and long-term (days) functional alterations in cells of the monocyte-macrophage system in microgravity. We provided experimental evidences for the cellular basis of disturbed immune system function in space.

[302] OXYGEN(APPLICATION) - FRIEND OR FOE?

S. Braunecker and J. Hinkelbein
Department of Anesthesiology and Intensive Care Medicine, Germany, Cologne, Germany

INTRODUCTION: Oxygen is necessary to sustain human life and is used for energy production by oxidation in the mitochondria. Application of oxygen not only increases saturation in the patient's blood, but also has various secondary effects. It is therefore used to treat diseases that impairs body's ability to take up and use oxygen. But even healthy people can suffer from hypoxia when they ascend to high altitude. Here, altitude sickness can lead to potentially fatal complications such as high altitude cerebral edema or high altitude pulmonary edema. Since hypoxia can have disastrous consequences, hyperoxia is often tolerated in many pre- and in-hospital situations as well as in aviation and space. Whereas the effects of hypoxia are well studied, especially publications in the last decade have led to a new perspective on oxygen application. Besides pathophysiological changes as the peripheral vasoconstriction or reduction of contractility, especially changes on cellular level seem to be of great importance. Here, oxidative stress and change of protein synthesis in various organ are focus of current studies. High intracellular partial pressure of oxygen results in an increased amount of superoxide, which lead to oxidation of DNA, RNA and protein. As a consequence of this modification, hyperoxia in patients after successful resuscitation causes increased oxidative damage, increased neuronal death, and worse neurologic function. However, other organs are also affected by high oxygen. Thus, e.g. short-term administration of oxygen (3h) show significant alterations of protein expression in kidney and lung tissue. The thereby identified proteins indicate an association with cell growth inhibition, regulation of apoptosis, and approval of structural cell integrity and could be demonstrated up to 7 days after hyperoxia. Even if oxygen is essential to sustain human life and to guaranty high performance, an oversupply can have negative effects as well as a lack of oxygen. Oxygen application should therefore be adapted to the specific requirements.

Learning Objectives:

1. Besides supportive effects, oxygen and hyperoxia can also have deleterious effects. Molecular effects are demonstrated even 7 days after short-term hyperoxia.

[303] A PROTEOMICS-BASED APPROACH TO IDENTIFY AFFECTED SIGNAL CASCADES AFTER HYPEROXIA IN RENAL RAT TISSUE

J. Hinkelbein, O. Spelten, and S. Braunecker
University Hospital of Cologne, Cologne, Germany

INTRODUCTION: Hyperoxia is often tolerated to avoid hypoxia both in many pre- and in-hospital situations as well as aviation. On the other hand, it is known that hyperoxia may lead to deleterious consequences (cell growth inhibition, inflammation, and apoptosis) for numerous tissues. Whereas clinical effects of hyperoxic injury are well known for the brain or the lung, its impact on the expression of renal proteins has not yet been evaluated sufficiently. The aim of this study was to analyze time-dependent alterations of protein expression in rat renal tissue after short-term normobaric hyperoxia (NH). **METHODS:** After approval of the local ethics committee for animal research, N = 36 Wistar rats were randomized into six different groups: three groups with NH with exposure to 100 % oxygen for 3 h and three groups with normobaric normoxia (NN) with exposure to room air (21 % oxygen). After the end of the experiments, kidneys were removed immediately (NH0 and NN0), after 3 days (NH3 and NN3) and after 7 days (NH7 and NN7). Organ lysates were analyzed by two-dimensional gel electrophoresis (2D-DIGE) followed by peptide mass fingerprinting using mass spectrometry. Statistical analysis was performed with DeCyder 2D (GE Healthcare, version 7.2; $p<0.01$). Biological functions of differential regulated proteins were studied using functional network analysis (Ingenuity Pathways Analysis, IPA). **RESULTS:** pO_2 was significantly higher in NH-groups compared to NN-groups (581 ± 28 vs. 98 ± 12 mmHg; $p<0.01$), all other physiological parameters did not differ. Expression of 14 proteins was significantly altered: seven proteins were up-regulated and seven proteins were down-regulated. **DISCUSSION:** Even though NH was comparatively short termed, significant alterations in renal protein expression could be demonstrated up to 7 days after hyperoxia. The identified proteins indicate an association with cell growth inhibition, regulation of apoptosis, and approval of structural cell integrity.

Learning Objectives:

1. Hyperoxia leads to several protein alterations in the kidney.
2. Protein alterations are observable even 7 days after exposure.
3. The identified proteins indicate an association with cell growth inhibition, regulation of apoptosis, and approval of structural cell integrity.

[304] ALTITUDE AND HYPOXIA AWARENESS TRAINING - PREPARATION FOR TRANSATLANTIC FLIGHTS WITH THE DORNIER 228 NG

M.W. Trammer
Flight Medicine Clinic, Institute of Aerospace Medicine, Cologne, Germany

INTRODUCTION: Two crews prepare for transatlantic flights from Praia (Cape Verde Islands) to Natal (Brazil) with ten Dornier 228 NG - their final destination will be Venezuela. Due to performance limitations of the airplanes these long distance flights (1443 NM) across the South Atlantic can be realized only in high altitudes. Depending on weather conditions (wind / clouds) it will be mandatory to fly for several hours in FL 200 - 240. Flying at high altitude without pressure cabin causes various stresses for the crew. Altitude hypoxia will be addressed first, but also altitude decompression sickness should not be underestimated as a significant risk on this flight path. In cooperation with the Institute of Aerospace Medicine (German Aerospace Center) experts from the department of Flight Physiology and the Flight Medicine Clinic have developed a specific training for the crews. This "Altitude and Hypoxia Awareness Training" combines theoretical education with practical trainings. The lectures illustrate the different risks and inform the crews about possible countermeasures. The practical trainings consist of an exposure to hypoxia - with oxygen reduced breathing gas - and a "hands-on training" in one of the altitude simulation facilities of the institute. In the chamber the crews test their oxygen equipment at different simulated flight levels; individual oxygen consumption is measured as well as effects of physical activity and other disturbing factors. During the debriefing a detailed protocol for flight preparations (e.g. oxygen prebreathing) and flight planning is presented to the crews. As the flights are planned to take place between December 2014 and March 2015 this talk also will report about the outcome of this ambitioned project.

Learning Objectives:

1. Attendees shall learn about flight physiology. The different risks of piloting above FL 120 without pressure cabin will be discussed in detail with a focus on typical symptoms and countermeasures.

[305] INFLIGHT MEASUREMENTS OF OXYGEN SATURATION DURING "MOUNTAIN WAVE PROJECT" (MWP) HIGH-ALTITUDE GLIDER FLIGHTS IN THE HIMALAYAN REGION AND THE FRENCH ALPS

A. Gens[1], R. Heise[2], C. Gammel[1], and C. Ledderhos[1]
[1]German Air Force Center of Aerospace Medicine, Fuerstenfeldbruck, Germany; [2]Mountain Wave Project, Berlin, Germany

INTRODUCTION: Recent F-22 fleet incidents showed that unnoticed oxygen deprivation is still an issue during high-altitude flights. Currently, aircrews are trained in altitude simulation set-ups to recognize their individual symptoms, hoping that they would recognize them in a real-life scenario. Oxygen deficiency sensors are not commonly used. Earlier work of our group showed that various pulse oximeters are accurate enough to be used as warning systems for oxygen deprivation in pilots and that the sensors' signal quality degrades only negligibly in tests on vibration platforms and in flight. The objective of this study was to evaluate the failure rate of these systems at different measuring points (forehead, sternum, shin) in high-altitude flights with heavy turbulences and wide-ranging ambient temperatures and to optimize the crew's oxygen management. **METHODS:** In 28 high-altitude glider flights (up to FL 290) in the Himalaya and the French Alps, the signal failure rate of pulse oximetry sensors fitted at three measuring points was determined in 7 individuals. A Nonin, bicolor reflectance sensor was used with a WristOx 3100. SpO_2, heart rate and altitude values were recorded. **RESULTS:** 20 complete data sets were gathered. SpO_2 values recorded at different measuring points showed distinct differences: the highest values were observed at the forehead ($95.5 \pm 2.2\%$) (M $\pm$ STD), the lowest values were detected at the sternum ($84.6 \pm 6.4\%$). Furthermore, the failure rate was highest at the sternum ($29.5 \pm 19.6\%$ of the measuring time (omt)). At the shin, the mean SpO_2 was $93.6 \pm 4.7\%$ with a failure rate of $17.9 \pm 26\%$ omt. Measurements at the forehead were most robust, showing a failure rate of $3.8 \pm 6.6\%$ omt. **DISCUSSION:** The results clearly reveal the difficulties of obtaining signals that reliably reflect inflight blood oxygen saturation. Among the measuring points tested, the forehead appears to be most suitable.

Learning Objectives:

1. Measurements of oxygen saturation of the arterial blood in flight Pulse oximetry.

Wednesday, May 13 ***8:30 A.M.***
S. Hemisphere E3

[LIV.] SLIDE: VISION AND PERFORMANCE

Co-chair: Harriet Lester
Jamaica, NY

Co-chair: Yvette DeBois
Chicago, IL

8:30 a.m.

[306] VISUALIZATION OF THE EFFECTS OF HYPOXIA, NORMOXIA AND HYPEROXIA DURING DAYLIGHT AND ASSISTED NIGHT VIEWING

I.R. Moorhead[1] and D.M. Connolly[2]
[1]sciVIsion, Ashford, United Kingdom; [2]Aircrew Systems, QinetiQ plc, Farnborough, United Kingdom

INTRODUCTION: Altitude-induced hypoxia compromises visual function. Visual function also deteriorates as light levels decrease. In the military environment the latter is addressed by the use of night vision devices (NVDs) but the display luminance of these devices is within the mesopic to low photopic range. Night time aircraft cabin light levels are also typically mesopic. Recent studies have investigated the effects of breathing different gas mixtures on a range of visual tasks at these light levels. Whilst these studies have provided quantification of the effects, there is also a need to convey the impact on visual function in a direct way to end users. This work is being undertaken for the RAF Centre of Aviation Medicine to produce simulated imagery to enhance aircrew night vision training. **METHODS:** A detailed model of early human visual function enables visualization of the effects of hypoxia and hyperoxia on visual perception. The model processes images and incorporates key features of early vision: rod and cone vision, spatial channels at multiple scales, opponent color channels, non-linear contrast mechanisms and visual adaptation. The key element of the model for the present application is that the effects of different levels of oxygen can be equated to changes in light level. **RESULTS:** Details of the model and its implementation will be presented along with summary results from experimental studies. Imagery produced by the model, demonstrating the different visual effects and how these correspond to the experimental results, will be discussed. Examples from both visible band and NVD viewing will be provided. **DISCUSSION:** The model has been applied to visual band images and demonstrates the hypoxic reduction in visual function found experimentally. It also reproduces the improvement found when supplementary oxygen is provided. The model includes simulation of the effects when viewing with NVDs and can provide a direct visualization of how hypoxia can affect visual perception in military flying tasks.

Learning Objectives:

1. To gain an intuitive understanding of the influence of oxygenation state on visual performance in dim light.
2. To assess the relevance of oxygenation state to assisted night vision when using a night vision device in flight.
3. To demonstrate a powerful mathematical model for image manipulation that can be used to generate imagery to support aircrew night vision training.

8:45 a.m.
[307] HELICOPTER OPERATIONS IN DESERTS: PROBLEMS OF BROWN OUT

N. Rao and M. Dahiya
Institute of Aerospace Medicine, Bangalore, India

INTRODUCTION: Desert environment predisposes aviators to prolonged periods of flying in degraded visual environments. Flying in such conditions is a challenging task in helicopter operations. The brownout phenomenon, caused by the rotor downwash on a dusty or sandy helipad has caused several critical incidences and accidents in the past. **METHODS:** This paper brings out the incidence of brown out in Indian Army Aviation at a desert base in the western sector. This is a pilot study in the Indian scenario. This was a questionnaire and personal interview based study. **RESULTS:** A Total of 68 pilots participated in the study which was conducted over 2yrs. 18 incidents of brown out were evidenced. Fatigue, dehydration and long duration monotonous flying were identified as major contributory factors. No adverse incident was reported because of these brown out incidents. **DISCUSSION:** The incidence of brown out in Indian Army Aviation is found to be less that corresponding data of the western air forces. The paper discusses the dynamics in the occurrence of brown out and the available countermeasures in various helicopters against this phenomenon. It also deliberates on reasons for variation in the incidences among Indian and western literature. Further it focusses on the environmental, organizational and individual factors that need to be stressed upon to mitigate this potentially dangerous problem. Importance of the awareness and training about this phenomenon in aviators and other non-technological countermeasures to overcome this serious issue are also discussed. The incidence of brown out is very low and Brown out is not a cause for any accident/ Incidents in Indian Army Aviation. However, regular training of aviators is a must to continue to keep this problem at insignificant levels.

Learning Objectives:

1. To understand what is brown out.
2. To understand the magnitude of the brown out problem in India.

9:00 a.m.
[308] LONGITUDINAL OUTCOMES OF U.S. AIR FORCE PILOT APPLICANTS WITH WAIVERED ASTIGMATISM

D.E. Andrus and S. Wright
U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: Current U.S. Air Force (USAF) medical standards allow applicants to enter pilot training with up to 1.50 diopters (D) of astigmatism. However, waivers are considered for individuals with up to 3.00 D of astigmatism. While typically a benign finding, higher levels of astigmatism may be progressive in nature and can be associated with corneal ectasia (e.g., keratoconus) and loss of best corrected visual acuity. The goal of this study was to evaluate the long-term outcomes of pilot applicants waivered into training with astigmatism exceeding the aeromedical standard **METHODS:** Subjects were identified based on their enrollment in the Excessive Astigmatism Management Group maintained by the Aeromedical Consultation Service (ACS) at Wright-Patterson Air Force Base, OH. Metrics evaluated included refractive status, visual acuity, aeromedical waiver status, and safety data. Sources of these data included the Armed Forces Health Longitudinal Technology Application, Aeromedical Information Management Waiver Tracking System, Aeromedical Services Information Management System, USAF Safety Center, as well as databases internal to the ACS. **RESULTS:** Eighty subjects were tracked over an average period of 5.5 yr (max 14.3). Mean astigmatism at initial exam was 1.91 D (max 3.00 D), while mean astigmatism based on most recent exam was 2.19 D (max 5.00 D) and the average change in astigmatism per year was 0.04 D. No subjects developed ectasia or were disqualified from flying for vision or refractive reasons. All but one subject maintained USAF visual acuity standards throughout the course of study, although this individual did not meet standards upon entry. No mishaps were identified with vision being a causative factor. **DISCUSSION:** This study supports continuation of current USAF waiver policy, although a longer follow-up period is required to definitively make this determination.

Learning Objectives:

1. Discuss the symptoms and potential progression of astigmatism with time.
2. Discuss the diagnosis and management of progressive astigmatism.
3. Discuss the aeromedical risks of aviators with astigmatism.

9:15 a.m.
[309] AEROMEDICAL CONCERNS IN CERTIFICATION WITH IMPLANTED MULTIFOCAL INTRAOCULAR LENSES - AN INTERNATIONAL PERSPECTIVE

P. Masrani[1], C. Preitner[2], and V. Masrani[3]
[1]Consultant Aviation Medicine and Senior AME, V M Medical Centre, Mumbai, India; [2]Senior Medical Officer, Civil Aviation Authority of New Zealand, Wellington, New Zealand; [3]Travel Medicine, V M Medical Centre, Mumbai, India

INTRODUCTION: Use of multifocal intraocular lens (IOL) may result in visual distortion, reduced contrast sensitivity, halos, glare at night and requires time for neuroadaptation. It may also result in difficulties meeting the certification standards for near, intermediate and distance vision. In addition, pupillary size, pre-/post-operative astigmatism, type of lens implanted and surgical precision could influence development of dysphotopsia. The etiology of cataract, post-operative complications and need for YAG-laser contribute to the outcome of surgery. All these factors influence aeromedical decision making to determine fitness for aviation duties. This case study aimed at analyzing aeromedical concerns in evaluation for fitness for aviation duties after multifocal IOL implant in pilots. **METHODS:** This case study is about a young airline pilot who was diagnosed with unilateral cataract following keratitis. He underwent

phacoemulsification with a foldable multifocal IOL implanted a year back and YAG laser capsulotomy 10 months later. The protocol followed for evaluation and evidence based decision making for aviation duties is defined and discussed. **RESULTS:** The pilot was refused a Class 1 & 2 medical certificate by the regulatory authority on whose license he was flying overseas. **DISCUSSION:** FAA allows pilots with FDA approved multifocal IOLs implants to fly since 2005. Multifocals, compared to monofocal IOLs, offer patients with cataract a unique opportunity for independence from spectacles. However, most regulators, including DGCA India, are wary of allowing pilots to fly after implantation of multifocal IOL. Despite neuroadaptation, these lenses are considered to cause unacceptable impairment in vision in varied light conditions and at night; which is considered 'not satisfactory' for aviation safety. Objective evaluation criterion including adequate contrast sensitivity, acceptable standards of unaided visual acuity without complaints of glare and halos, could allow pilots with multifocal IOLs to fly with or without restrictions. A protocol for evaluation of such cases is proposed including workup and need for observation on ground to allow adequate time for neuroadaptation prior to certification for aviation duties is discussed.

Learning Objectives:

1. To understand the difference between monofocal and multifocal IOLs.
2. To appreciate how multifocal IOLs impair vision required for aviation safety.
3. Offer an international perspective of aeromedical decision making in pilots with multifocal IOLs.

9:30 a.m.
[310] OPTOMETRIC PREDICTORS OF PERFORMANCE AND DISCOMFORT FOR STEREOSCOPIC 3D PRECISION CONTROL TASKS

J.P. McIntire[1], P.R. Havig[1], E.L. Heft[1], S. Wright[3], L.K. Harrington[4], S.N. Watamaniuk[2], and L. K. McIntire[5]
[1]711th Human Performance Wing, U.S. Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Psychology Department, Wright State University, Dayton, OH; [3]OBVA Laboratory, U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH; [4]Ball Aerospace & Technologies, Corp., Dayton, OH; [5]InfoSciTex, Inc., Wright-Patterson AFB, OH

INTRODUCTION: Stereoscopic 3D (S3D) displays are being applied to many military-relevant domains including simulation, training, surgery, indirect vision driving, and aerial refueling. The idiosyncratic nature of visual depth perception makes S3D operator selection a challenge. Additionally, viewer discomfort is a prevalent complaint that can negatively impact user acceptance and performance. In this work, we investigate possible predictors of individual performance and discomfort on S3D precision spatial tasks. **METHODS:** Two experiments (12 subjects each) tested virtual object precision control, as conducted on an S3D system. Subjects underwent an optometric screening which measured refraction, acuity, phoria, binocular fusion ranges, and stereoacuity. In addition, subjects completed a personal demographic questionnaire which recorded variables such as age, dominant eye, gender, history of motion sickness, etc. In the first experiment, the task required precise positioning of a control object in alignment with a target object, and motion of the control object was limited to only 2 degrees of freedom (2DOF) in the horizontal plane. In the second experiment, a more complex 5DOF task simultaneously required both precise alignment and orientation. In both experiments, discomfort was measured using the Simulator Sickness Quesitonnaire (SSQ). **RESULTS:** In the first experiment, convergent binocular fusion ranges, total fusion ranges, and stereoacuity thresholds significantly correlated with positional precision. No other optometric or demographic variables predicted performance. In the second experiment, convergent fusion ranges, divergent fusion ranges, total fusion ranges, and stereoacuity thresholds correlated with either positional precision or rotational precision, or both. Across the two experiments, only one variable related to SSQ scores: a personal history of motion sickness. **DISCUSSION:** Viewers with larger fusion ranges, and lower (better) stereoacuity, tended to perform better on the S3D tasks. These results imply that common measures of binocular status (phorias) may not be as useful as suspected, and that less-common measures (stereoacuity thresholds, fusion ranges) may be more predictive of performance. No optometrics predicted discomfort.

Learning Objectives:

1. The relationship between optometric status, viewer discomfort, and spatial task performance on a stereoscopic display.
2. Demographic and personal history variables are also assessed.

Wednesday, May 13 ***8:30 A.M.***
S. Hemisphere E4

[LV.] PANEL: 1965, A PIVOTAL YEAR IN SPACE MEDICINE

Sponsored by the AsMA Archives Committee

Chair: Mark Campbell
Paris, TX

PANEL OVERVIEW: Fifty years ago, the year 1965, was a pivotal year in space medicine. In fact, it was the peak year as far as resources allocated to human space exploration, This panel will try to recreate the viewpoint from the perspective of 1965.

[311] SPACE MEDICINE RELATED ABSTRACTS FROM THE 1965 SCIENTIFIC MEETING

W.W. Dalitsch
Captain James A. Lovell Federal Health Care Center, Antioch, IL

INTRODUCTION: 1965 (fifty years ago) was a truly historic year in space medicine, as the U.S. manned space flight effort was in its peak year as regards to budget and personnel. The Gemini Program made great progress in 1965. Flight durations were progressively extended with a 4-day , 8-day and then a 14 -day flight. Medical tests and nutritional studies were conducted on all flights and the final conclusion was that no medical problems were found to prevent long duration (14-day) flights. The Gemini Program had many dramatic moments such as the first U.S. EVA by Edward White, the launch pad abort of Gemini VI, and the rendezvous of Gemini VI with Gemini VII three days later. Many engineering firsts were accomplished in the Gemini Program in 1965. The Soviets were successful in performing the first EVA (Alexi Leonov on Voskhod II on March 18). Progress in the USAF Manned Orbital Laboratory Program continued and the first eight MOL astronauts were chosen in November. The 36th Annual Meeting of the Aerospace Medical Association was held April 26-29, 1965 at the New York Hilton Hotel in New York City. Other than a progress report on Project Gemini, none of the session titles of the scientific meeting implied content that would include space medicine topics. However, many abstracts applied directly to the aeromedical aspects of the contemporary concerns of space exploration. Presentations from the 1965 meeting that related to aspects of the stresses and environment of the "final frontier" will be briefly reviewed and discussed within the context of the time, with reflections provided from a modern perspective.

Learning Objectives:

1. The audience will learn the space medicine related topics of interest at the 1965 Annual Scientific Meeting of the Aerospace Medical Association.

[312] BIOMEDICAL ASPECTS OF THE GEMINI PROGRAM

C. Berry
Retired, NASA Johnson Space Center, Houston, TX

INTRODUCTION: The year 1965 was pivotal in space biomedical practice and research. NASA's Gemini was extending the demonstrated capabilities of Mercury to provide the foundation for Apollo's manned lunar landings. The Gemini Program demonstrated that humans could function in space for up to two weeks without deconditioning problems.

The Gemini Program made great progress in 1965. Following the 3-orbit Gemini III flight in March of Grissom/Young, flight durations were progressively extended with a 4-day (Gemini IV with McDivitt/White), 8-day (Gemini V with Cooper/Conrad) and then a 14 -day flight (Gemini VII with Borman/Lovell). There was great concern about de-conditioning and resistive exercises using bungee cords were performed on all of the duration extending missions. There was also concern about orthostatic hypotension on landing which had been experienced by Cooper on his last Mercury 34-hour space flight. The orthostatic hypotension on landing was predicted to be especially significant as the Gemini astronauts landed in the water upright and not supine. Medical tests and nutritional studies were conducted on all flights and the final conclusion was that no medical problems were found to prevent long duration (14-day) flights. This paper will review the medical contributions of the Gemini Program and the difficulties in providing operational space medical care in the early days of the U.S. space program.

Learning Objectives:

1. The audience will learn how the Gemini Program made enormous contributions to the early understanding of space physiology and medicine.

[313] NASA MEDICAL OPERATIONS IN 1965

R.A. Scheuring
Space Medicine, NASA-Johnson Space Center, Houston, TX

INTRODUCTION: In contrast to how NASA medical operations have been conducted during the Space Shuttle and International Space Station (ISS) program, crew medical support during the Gemini program was split between flight surgeons at the manned spaceflight center (MSC) in Houston and Cape Canaveral. In January 1965, NASA was in the process of hiring and developing a team of civilian flight surgeons. A few of the project Mercury military flight surgeons elected to resign their commission and become NASA civil servants. There were not any assigned crew flight surgeons during Gemini. Most of the pre-flight medical care was performed by NASA civil servants at the Cape in addition to some of the pre-flight test monitoring. Many of the pre-flight tilt tests and most of exercise tests were monitored by an MSC surgeon from Houston. An additional flight surgeon was assigned the job of "Recovery Flight Surgeon" for landing support. This individual was the only one willing to jump out of the recovery helicopter with the underwater demolition team (UDT) swimmers in case a returning astronaut required medical care or resuscitation. The recovery surgeon also did the post-flight testing on the aircraft carrier. Comprehensive medical exams were performed pre-flight at the Cape and post-flight on the Recovery Carrier by a NASA flight surgeon and a Department of Defense (DoD) specialist team. The DoD medical team consisted of a cardiologist, ophthalmologist, neuro-psychiatrist and otolaryngologist. Sometimes a radiologist was involved. Dental exams were also done pre-flight. A NASA flight surgeon conducted pre-flight medical evaluations before, during and after flight simulations. Lastly, in-flight medical monitoring was done at remote ground tracking stations positioned around the world. The medical monitors stationed at the tracking stations were mainly DoD flight surgeons on temporary assignment who relayed crew medical data to the NASA flight surgeons manning the console in Mission Control Center (MCC) Houston.

Learning Objectives:

1. The audience will learn how Gemini Program medical operations were different than what has evolved for current NASA missions today.

[314] BIOMEDICAL ASPECTS OF THE USAF MANNED ORBITING LABORATORY PROGRAM

J.B. Charles[1], D. Day[2], D. Adamo[1], and L. Abadie[1]
[1]NASA Johnson Space Center, Houston, TX; [2]National Research Council, Washington, DC

INTRODUCTION: The year 1965 was pivotal in space biomedical practice and research. NASA's Gemini was extending the demonstrated capabilities of Mercury to provide the foundation for Apollo's manned lunar landings. In parallel with Gemini, the U.S. Air Force initiated the Manned Orbiting Laboratory (MOL) program, which promised to make a large contribution to space medicine. MOL was planned to use Gemini for crew launch and landing and an expendable cylindrical module for habitation and research during five two-man missions of 30 days each to determine the military value of man in space. When President Johnson authorized MOL in 1965, worldwide human spaceflight experience totaled only 30 days across 14 separate missions (the US total was only 14 days), which MOL promised to duplicate on each mission. But in 1966, MOL's purpose became high-resolution reconnaissance of the Soviet Union from sun-synchronous polar orbit for the still-secret National Reconnaissance Office. The intense month-long missions would still require medical monitoring, but most research was transferred to Gemini, Apollo and the NASA space laboratory later designated Skylab. In 1969, President Nixon canceled MOL when unmanned satellites surpassed its capabilities. MOL seeded Gemini with specific investigations in visual acuity and in extravehicular maneuvering and repair tasks, and it provided Skylab with mature medical monitoring capabilities including body mass measurement and with human factors such as food systems and metabolic waste management. This paper will review the human-centered aspects of MOL's design and intended operations, including extended exposure to weightlessness, use of oxygen-helium atmosphere, and high crew workloads during overflights of target territory. It will also track MOL's contributions to subsequent spaceflight programs in terms of biomedical monitoring and research capabilities and human talent.

Learning Objectives:

1. The audience will learn how requirements for medical monitoring in an extreme environment were met despite significant operational constraints.

[315] CIVILIAN HIGH ALTITUDE BALLOON ATTEMPT - 1965

W. Tarver
Division of Space Medicine, University of Texas, Houston, TX

INTRODUCTION: In 1965 the US and Russia were locked in a Cold War Era space race. The US and the USSR governments were locked in one-upmanship challenges setting new altitude and speed records along the way. The US military branches had manned balloon programs and USAF Capt. Joe Kittinger, Jr., had set a new parachute free fall record of 102,800 feet on August 16, 1960 (Excelsior III). High altitude balloon jumps took extreme effort to accomplish and large funding sources. None-the-less, a US civilian, Nick Piatanida, undertook the task of breaking Kittinger's record jump. By 1965 Nick had organized a team, acquired the equipment and actually made his first attempt to break the world records of altitude and free fall. This is Nick's story of his preparation and first ballooning attempt at breaking Kittinger's record.

Learning Objectives:

1. The audience will learn how preparation for the civilian high altitude balloon ascent and parachute recovery made contributions to the understanding of space physiology and medicine.

[316] THE UNMANNED MARINER IV MISSION AND HOW IT CHANGED MANNED SPACE FLIGHT

M.R. Campbell
Paris Regional Medical Center, Paris, TX

INTRODUCTION: The perception that manned space flight was eventually headed for a long duration Mars mission in the intermediate future can be demonstrated by the articles published in the Journal of Aerospace Medicine in 1965. There are several articles on water reclamation and regeneration, long exposure to enclosed atmospheres, physiological effects of living in a slow rotating room, exercise during four weeks of bed rest, and acceleration tolerance after prolonged bed rest. At that time period, Mars was thought to have lichen like vegetation which underwent seasonal variation and although water was not abundant, it was still present, especially in the

polar-regions. On July 14, the Mariner IV spacecraft made its closest approach to Mars (6,118 miles or 9800 km) on its flyby mission. The data collected radically changed the perception of Mars. Extensive cratering found on the 22 photographs that were taken indicated that weather and water erosion had been minimal for several billion years and that the planet was geologically inactive. The lack of a magnetosphere meant that the surface was not protected from solar radiation. The atmosphere was calculated to be only 4.1-7.0 millibars by radio occulation. This was a tenth of the predicted result and meant that water could not exist in liquid or even solid form. The polar caps therefore were composed of CO2 dry ice and not water ice. It also indicated that the atmosphere was almost all CO2 and without water vapor or nitrogen. The conclusion was that Mars was Moon-like and not Earth-like. Prior to Mariner IV there was wildly speculative talk of a manned Mars mission by 1980, now enthusiasm for the manned exploration of Mars radically decreased.

Learning Objectives:

1. The audience will learn how future plans and enthusiasm for a manned Mars Expedition radically changed after the Mariner IV mission.

Wednesday, May 13 ***10:30 A.M.***
S. Hemisphere 1

[LVI.] SLIDE: THIN AIR AND BUBBLES

Chair: Andrew Woodrow
San Antonio, TX

10:30 a.m.
[317] EFFECT OF NORMOBARIC AND HYPOBARIC HYPOXIA ON FUNDAMENTAL FREQUENCY OF HUMAN VOICE

M. Khan[1], S. Sondhi[1], R. Vijay[4], S. Sharma[2], D.B. Reynolds[3], T. Goswami[3], and A.K. Salhan[2]
[1]Electrical Engineering, Jamia Millia Islamia (A Central University), New Delhi, India; [2]Biomedical Instrument Division, DIPAS DRDO, Timarpur, India; [3]Biomedical Industrial and Human Factor Engineering, Wright State University, Dayton, OH; [4]Electronics, Banasthali University, Jaipur, India

INTRODUCTION: Hypoxia is a significant threat to the health and work efficiency of the native people, war fighters, aircraft pilots and soldiers at high altitude (HA). It affects all levels of tissue organization influencing psycho physiological status of humans. Voice stress analysis has been applied to estimate effects of hypoxia in natural speech. **METHODS:** A number of experiments were conducted to record voice of 18 subjects at sea level (SL) and high altitude (HA). Group-1 consisting 6 subjects was exposed to normobaric hypoxia for four hours at SL and also hypobaric hypoxia at 11500 feet above SL. Group-2 consisting of 12 subjects as control and test subgroups each of 6 subjects. Test subjects did step up and step down exercise for 15 minutes using a low height wooden stool inside the normobaric chamber itself after four hours of normobaric hypoxia exposure at SL. All 12 subjects were then exposed to hypobaric hypoxia at 11500 feet above SL. Mobile instrument was used as a recording device for acquiring voice samples of all 18 subjects at SL and HA. Obtained data was analyzed using PRATT software and statistical analysis done using paired T- test. **RESULTS:** Fundamental frequency (F0) up-shifts were found under normobaric hypoxia at SL and initial exposure to HA. However, it downshifted after 3-4 days at HA as the subjects acclimatized. Normobaric hypoxia at SL along with exercise before going to HA resulted in no significant difference in F0 at HA. **DISCUSSION:** F0 increases under normobaric hypoxic exposure (with and without exercise) at sea level. Percentage rise in the average value of F0 of all subjects with exercise (Group 2) was observed to be slightly more than that without exercise (Group 1). It was also noted that F0 rises during initial two days at HA and then slightly downshifts on days 3 or day 4. It follows the physical acclimatization pattern of exposure to high altitude. No significant difference in F0 was observed at HA after the subjects were exposed to normobaric hypoxia at SL along with exercise before going to HA. Pre-exposure to hypoxia at SL may be beneficial at HA. Analysis of soldiers' voices and conversation of aircraft pilots with the base station may detect early signs of hypoxia and prevent any catastrophic consequences.

Learning Objectives:

1. Human phsiological response to hypoxia.
2. Voice stress analysis.
3. Non-invasive assessment of stress.

10:45 a.m.
[318] MODELLING THE EFFECT OF EXERCISE AT PRESSURE ALTITUDES OF 2450-3650 M (8-12 000 FT) SUGGESTS THAT THE EXAGGERATION OF HYPOXEMIA IS DUE TO PULMONARY END-CAPILLARY DIFFUSION LIMITATION

P.D. Hodkinson[1, 3], A.D. Bretherick[4], S. Gaydos[2], D.K. Menon[3], and N.D. Green[1]
[1]RAF Centre of Aviation Medicine, Henlow, United Kingdom; [2]U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL; [3]Division of Anaesthesia, University of Cambridge, Cambridge, United Kingdom; [4]Department of Anaesthesia, University of Edinburgh, Edinburgh, United Kingdom

INTRODUCTION: Ascent to altitude when breathing air causes a decrease in arterial oxygen-hemoglobin saturation ($HbSO_2$) that is exaggerated by the addition of exercise at pressure altitudes (PA) as low as 1850-2450 m (6-8000 ft). An exercise study at 2450-3650 m (8-12 000 ft) PA found a divergence of pulse oximetry and end-tidal partial pressure of oxygen ($PetO_2$) values that suggested an increased alveolar-arterial oxygen difference. The aim of this study was to assess whether the experimental data are predicted using an established model of pulmonary oxygen transfer. **METHODS:** Cardio-respiratory data from the 150 W condition of the exercise at altitude study were entered into an online model (www.prognosis.org). A small correction was made to convert altitudes in the model to pressure altitudes. Data were from volunteers (n=9) un-acclimatized to altitude with mean hemoglobin of 15.5 g/dL. Based on data from a ground level study with the same exercise challenge V_{O2} was assumed to be 2.210 L/min and the RQ 1. **RESULTS:** The model predicted negligible alveolar-capillary oxygen difference under equivalent exercise conditions at sea level but of 0.42 to 1.02 kPa at 2450-3650 m (8-12,000 ft PA), with associated alveolar-arterial oxygen difference of 0.72 to 1.11 kPa. The model predicts arterial $HbSO_2$ of 88%, 82% and 74% during 150 W exercise at 2450-3650 m (8-12,000 ft) PA compared to the measured values of 85%, 81% and 73%. **DISCUSSION:** These modelling data support the experimental $HbSO_2$ values suggesting $PetO_2$ is no longer representative of arterial oxygenation during 150 W exercise at 2450-3650 m (8-12,000 ft) PA. The model data also indicate pulmonary end-capillary diffusion limitation under these exercise and altitude conditions. These data have implications for the methodology of hypoxia studies and testing of oxygen delivery systems at altitude when an exercise condition is involved. A further human study is planned with invasive monitoring to obtain actual arterial values.

Learning Objectives:

1. To understand the effect of exercise during acute mild hypoxia on physiological measures of hypoxemia.

11:00 a.m.
[319] PHYSIOLOGIC DIFFERENCES BETWEEN NORMOBARIC AND HYPOBARIC HYPOXIA

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

INTRODUCTION: A pilot may suffer hypoxia due to unexpected situations. Without early recognition of hypoxia symptoms, in-flight hypoxia could jeopardize flight safety. To familiarize with hypoxia symptoms, all military pilots have to undergo hypoxia awareness training by exposing themselves to hypobaric hypoxia (HH) in altitude chamber. Alternatively, normobaric hypoxia (NH) training protocol has been developed involving breathing low concentration of oxygen at sea level. The purpose of this study is to compare the physiological responses, performances and hypoxia symptoms between HH and NH hypoxia awareness training protocol. **METHODS:** 16 healthy young male (age29.1±4.6years old), all experienced both HH and NH hypoxia awareness training protocol, separated by at least two days. HH protocol involves exposure to simulated height of 25,000 feet in altitude while NH condition achieved by inhaling 7% oxygen at sea level. Physiologic parameters including blood pressure, heart rate, respiratory rate, heart rate variability, electroencephalography, cerebral blood flow velocity and peripheral blood flow were recorded before, during and after hypoxia exposure. Performance and hypoxia symptoms were also evaluated. **RESULTS:** Hypoxia tolerance time were significantly longer in NH protocol than HH protocol (3.66±0.27 min vs. 3.18±0.22 min, p=0.024). Hypoxia impaired cognition and motor coordination to similar extent in both conditions. Hypoxia symptom scores were similar in both conditions. Hypoxia exposure reduced oxygen saturation, peripheral blood flow and respiratory rate but increased heart rate and blood pressure in both protocols. However, there exist distinct differences in certain physiological responses. Cerebral blood flow velocity increased in NH but decreased in HH protocol. Compared with HH protocol, heart rate variability analysis showed relative parasympathetic dominance in NH protocol. **DISCUSSION:** Subjects who underwent two different hypoxia awareness training protocols revealed certain physiological differences. However, hypoxia symptoms and the effect of hypoxia on performance were similar in NH and HH protocol. The results of this study suggest that NH provided an alternative for hypoxia awareness training.

Learning Objectives:

1. Hypoxia symptoms and the effect of hypoxia on performance were similar in hypobaric hypoxia in altitude chamber and normobaric hypoxia training protocol.
2. Hypoxia tolerance time was significantly longer in normobaric hypoxia training protocol than hypobaric hypoxia protocol.
3. Cerebral blood flow velocity increased in normobaric hypoxia training protocol but decreased in hypobaric hypoxia protocol.

11:15 a.m.
[320] A REVIEW OF INCIDENTS DURING HELICOPTER AIRCREW HYPOXIA TRAINING HAS REVEALED THAT A SUBPOPULATION OF AIRCREW MAY HAVE INCREASED SUSCEPTIBILITY TO HYPOXIA WHEN BREATHING AIR AT 5330 M (17,500 FT) PRESSURE ALTITUDE

S.L. Conway[2, 4], H. Nash[2, 3], and P.D. Hodkinson[1, 3]
[1]RAF Centre of Aviation Medicine, RAF Henlow, United Kingdom; [2]Centre of Aviation Medicine, Royal Air Force, Southampton, United Kingdom; [3]Division of Anaesthesia, University of Cambridge, Cambridge, United Kingdom; [4]Florence Nightingale School of Nursing and Midwifery, King's College, London, London, United Kingdom

INTRODUCTION: Hypoxia continues to be a life-threatening hazard in aviation. Chinook helicopters are unpressurised but can fly up to 4500-6000 m (15-20,000 ft) pressure altitude (PA), requiring aircrew to use supplemental oxygen to prevent hypoxia. A key element of military aircrew training is practical hypoxia training to allow the recognition of hypoxia symptoms in the event of oxygen system failure. The experience of hypoxia at these lower altitudes may differ from that experienced during traditional aircrew hypobaric hypoxia training at 7620 m (25,000 ft) PA. Therefore, the Royal Air Force developed a helicopter aircrew specific hypobaric chamber hypoxia training profile; exposing helicopter aircrew to 5330 m (17,500 ft) PA for 27 minutes. **METHODS:** Helicopter aircrew hypoxia training from June 2006 to December 2012 was reviewed. The aim was to review incident reports and assess the number of aircrew requiring supplemental oxygen before completion of training. Data were gathered from the 'Daily Occurrence Book' and an electronic database of hypobaric training. Early use of supplementary oxygen was defined as at least 60 - 120 seconds before the normal end of each training run. **RESULTS:** 1915 aircrew underwent this hypoxia training profile. There were 122 incidents; mainly otitic barotrauma. Of the 1896 aircrew with hypoxia duration recorded, 97 (5.1%) needed supplemental oxygen early. 5 (5.2%) of the 97 experienced loss of consciousness reportedly due to vasovagal syncope. There was one case of decompression sickness. **DISCUSSION:** Overall these data show this training to be safe. A small proportion of aircrew required supplemental oxygen early, suggesting they may be more susceptible to hypoxia than the general aircrew population. There were a number of limitations to the study including some missing data and inconsistent data reporting between the two sources. A prospective study is recommended to investigate this subpopulation and whether the finding is of relevance to flight safety.

Learning Objectives:

1. To understand the hazards associated with hypobaric hypoxia training for helicopter aircrew.

11:30 a.m.
[321] PHYSICAL ACTIVITY APPEARS TO HAVE A POSITIVE, LINEAR EFFECT ON DECOMPRESSION SICKNESS (DCS) RISK

J.T. Webb[1], T.R. Morgan[2], and S.D. Sarsfield[3]
[1]SARC, LLC, Bandera, TX; [2]711th HPW/HPI, Air Force Research Laboratory (AFRL), San Antonio, TX; [3]Acceleration Physiology Operations, AFMC OL- U.S. Air Force School of Aerospace Medicine / FEEP, Wright-Patterson AFB, OH

INTRODUCTION: Our previous retrospective research described a linear relationship between the highest one minute of oxygen consumption (VO_2) during a repeated physical activity and incidence of DCS during research chamber exposures to 29,500-30,000 ft (230.6-226 mmHg; 4.46-4.36 psi; 8992-9144 m). To determine if an analogous relationship holds true at a lower VO_2 level and altitude, an approved protocol (U.S. Air Force Institutional Review Board) is underway at Brooks City-Base, TX. **METHODS:** The hypothesis states that the reduction in DCS risk with decreased VO_2 during exposure is also evident at a seated resting level of VO_2 more typical of fighter pilots and pilots in aircraft where movement is limited. The control zero-prebreathe exposures to 22,500 ft (314 mmHg; 6.07 psia; 6858 m) for 4 h performing ambulatory rest or simulated extravehicular activity were compared to identical exposures with the exception of activity during exposure. Each subject participated in oxygen consumption measurements while at seated rest, resting metabolism prior to the altitude chamber exposure. **RESULTS:** Twelve of the 38 approved male-subjects have completed the seated, resting exposures. No DCS or venous gas emboli have been observed or observed. **DISCUSSION:** The data, if current results are sustained by additional human subject-exposures, may allow an update to the Altitude DCS Risk Assessment Computer (ADRAC) model by correction of the effect and level of activity during exposure. The data may also help to explain the slightly higher DCS risk for inside observers, due to their higher level of activity, versus the DCS incidence reported by altitude chamber trainees.

Learning Objectives:

1. Understand the relationship between level of activity while decompressed and risk of altitude DCS.
2. Evolution and expansion of nitrogen bubbles in human tissues due to decompression and physical activity may result in altitude DCS.
3. Understand the potential for better clarification of activity level effect on altitude DCS risk to be able to improve altitude DCS risk prediction.

Wednesday, May 13 ***8:30 A.M.***
S. Hemisphere 2

[LVII.] AEROSPACE MEDICINE GRAND ROUNDS: RESIDENT CASE PRESENTATIONS

Co-Chair: Patrick Storms
Wright-Patterson AFB, OH

Co-Chair: Richard Allnutt
Wright-Patterson AFB, OH

PANEL OVERVIEW: INTRODUCTION: This panel will consist of pairs of aerospace medicine residents presenting clinical cases of aeromedical interest or significance. **METHODS:** During their residency practicum years, residents provide evaluations of patients with diverse medical problems. Residents prepare and present a case report based on a patient encounter undertaken during their practicum experience. **RESULTS:** One resident from each pair presents the history of the presented problem. The other resident presents the physical findings and a discussion of the aeromedical policies associated with the condition. **DISCUSSION:** Learning aerospace medicine at the specialist level involves understanding the impact of medical conditions on aircrew health and mission accomplishment. The cases presented will not only be of academic interest but will also illustrate aeromedical decision-making in the operational environment.

Learning Objectives:

1. Improve understanding of clinical aerospace medicine.

Wednesday, May 13 ***10:30 A.M.***
S. Hemisphere 3

[LVIII.] PANEL: FLYING PHYSICIANS ASSOCIATION CLINICAL PANEL

Sponsored by the Flying Physicians Association

Chair: Felix Tormes
Pensacola, FL

PANEL OVERVIEW: This panel is presented by members of the Flying Physicians Association (FPA), an Affiliated Organization of AsMA composed of physicians engaged in clinical practice, who are also licensed pilots. FPA membership represents virtually every medical specialty, with backgrounds as AMEs, prior military and FAA flight surgeons, and Occupational Medicine specialists. The topics presented are clinical in nature and typically related to the specialty of the presenter, with an emphasis on the aeromedical implications of the selected topic. This particular panel is presented by three physician-pilots, one trained as a RAM, and two with career military backgrounds in radiation oncology and orthopaedic surgery. The topics presented on this year's session are "Rethinking Euthyroid", Clinical Management of LBP in aviators, and a report on early work on cost-effective biomarker assays for cancer. The panel further fulfills an informal agreement to continue an exchange speaker program between AsMA and FPA which has been ongoing successfully for the past four years.

[322] CLINICAL MANAGEMENT OPTIONS FOR LOW BACK PAIN (LBP) IN AVIATORS

F. Tormes
Orthopedic Surgery, Tormes Naval Hospital Pensacola, Pensacola, FL

INTRODUCTION: The first report of an association between helicopter flight and LBP dates back over fifty years. Since then, multiple publications have addressed etiology, frequency, corrective and preventive measures to mitigate this problem, which is felt to adversely affect situational awareness and degrade performance. There is general consensus that LBP is more prevalent in rotary than fixed wing aircraft, but no consensus on etiology. Although exposure to vibration has been suspected as the primary cause, more recent studies have implicated postural positioning and ergonomic issues as more important. In clinical practice, most cases of LBP without associated neurological symptoms resolve after cessation of exposure, a course of NSAIDs and a trial of physical therapy. For more recalcitrant cases, flight surgeons often refer to Pain Management consultants for treatment with minimally invasive techniques now available. These options are reviewed and discussed. **METHODS:** The recent Pain Management literature was reviewed and the level of evidence for different specific options noted for patients presenting with LBP without neurologic symptoms. The commonly available treatment options for LBP without neurologic component are (1) spinal injections and (2) ablative techniques. Injections have employed anesthetics, anesthetic/steroid combinations and methylene blue. Ablative techniques include ramus communicans injections, IDET (intradiscal electrothermal therapy), PIRFT (percutaneous intradiscal radiofrequency thermocoagulation) and intradiscal biacuplasty. **RESULTS:** No improve benefits were noted with steroid/anesthetic epidural injections over lidocaine only injections. Both PIRFT and IDET were ineffective for long term management of LBP. Methylene blue injections are unproven for safety and efficacy. Biacuplasty appears effective but further studies are required. **DISCUSSION:** Recent studies suggest postural issues may be more important than vibration exposure as causative factors in LBP without neurologic components. Aviators presenting with LBP should initially be restricted temporarily from exposure and treated non-invasively with Physical Therapy and/or Manipulative Medicine. Minimally invasive techniques should be withheld for more resistant cases.

Learning Objectives:

1. LPB without neurologic components in helicopter pilots is more related to ergonomic issues such as positioning, than to vibration.
2. Initial treatment for pilots with LBP without neurologic symptoms not responding to cessation of exposure and NSAIDs should include physical measures such as PT or Manipulative Medicine.
3. No single minimally invasive ablative technique for LBP has emerged as a gold standard to date.

[323] RETHINKING EUTHYROID

C.C. Nagle
University of Maryland, Baltimore, MD

INTRODUCTION: Thyroid disorder in America is highly prevalent. Serum thyroid stimulating hormone (TSH) is a guiding parameter utilized in clinical decision making to identify a *primary* thyroid disorder. The range of what is considered a normal serum TSH assay value varies greatly by the endorsing professional organization or commercial laboratory. Thyroid disorder, with sub-optimal thyroxine (T_4) and triiodothyronine (T_3) levels, leads to extensive negative health sequelae. Quality of life indices are often negatively impacted in untreated and undertreated thyroid disorder. Current clinical practice guidelines are leading clinicians to erroneously exclude thyroid disorder in affected patients. Commonly, autoimmune thyroiditis (for example, Hashimoto's Thyroiditis) presents with episodes of thyroid dysfunction and subtle alteration in thyroid function testing, in the context of significant symptoms and signs. It is too easy for a clinician to miss the diagnosis with the typical, current serum TSH 'normal' reference ranges. Normal thyroid function must be tailor-defined for the individual, incorporating whenever possible: 1) a baseline of thyroid function testing—during a healthy, symptom free period, ideally earlier in the patient's life; 2) frequent monitoring of thyroid function during episodes of symptoms consistent with thyroid dysfunction; and 3) a narrow range of what is normal thyroid function defined, not for the population, but for the individual. This novel method of screening and diagnosis will yield more optimal management of thyroid disorder in America, inclusive of aircrew communities performing critical flight duties.

Learning Objectives:

1. Recognize the problem of underdiagnosed thyroid disorder in America.
2. Identify an improved methodology for thyroid disorder detection.
3. Consider the aeromedical implications of thyroid disorder.

[324] IS IT "ASMA" OR IS IT LUNG CANCER? YOUR AVIATOR'S BAD BLOOD, BREATH OR SPIT MIGHT TELL THE STORY

D.W. Johnson[1,7], N. Peled[2], H. Haick[3], S.Z. Millstone[4], J.W. Wells[5], L.H. Wilf[6], B. Nisman[8], and M. Abud[3]
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INTRODUCTION: Lung cancer (LC) is the leading cause of cancer mortality worldwide. The NLST demonstrated that low-dose CT (LDCT) scan screening reduced related mortality rate by 20%, albeit with a high false positive rate: 95% of positive findings were benign, and this group underwent costly and morbid unnecessary invasive procedures. Following the NLST, LDCT screening programs for high risk patients are becoming widespread, and evaluating detected small lung nodules will be costly using current methodologies. Cost-effective biomarker assays distinguishing benign from malignant nodules might mitigate that expense, morbidity, and mortality. Several approaches are emerging, and it is currently unclear which hold greater promise for early detection. **METHODS:** We selected for comparison 5 non-invasive tests in patients with recently diagnosed untreated LC: exhaled breath analysis for volatile organic compounds (VOCs) using nanoarray technology, automated 3D sputum cytometry, cancer serum protein markers (TM), serum auto-antibodies (AAB), and PET/CT. Tests were compared for sensitivity, ease of performance (from both patient and clinician standpoint), and convenience. **RESULTS:** Successful test completion rates were 100% for AAB and TM serum studies, 98% for PET/CTs and breath analysis, and 46% for 3D sputum analysis. Of successfully completed tests, PET/CT was the most sensitive (49/49; 100%), followed by breath analysis (46/49; 93.8%), 3D sputum (20/23; 87%), TM (34/50; 68%), and AAB (15/50; 30%). Three patients undetected by breath analysis were all detected on the AAB test, and 3 undetected by sputum analysis were detected by TM assay. Breath and blood tests were most convenient for patients, and the AAB test was easiest in terms of staffing requirements. The most expensive test was the PET/CT, followed by the TM serum test **DISCUSSION:** Serial follow-up and selective PET/CT remain the current standard for CT-detected SPN testing, but breath or 3D sputum analysis coupled with blood studies may prove more cost efficient, practical, and efficacious. Early detection can allow limited surgical treatment (segmentectomy or lobectomy) or radiosurgery for cure, with >75% success rates. Limited treatment should in turn lead to less pulmonary morbidity, and to more aviators returning to duty.

Learning Objectives:

1. Realize that lung cancer accounts for more cancer mortality in the USA than the next 4 most common cancers combined. The 5 year survival overall is only 16%, but if found early is >50%.
2. Non-invasive biomarkers looking to detect lung cancer early include volatile organic compounds in breath, tumor antigens or antibodies detectable in serum, abnormal cells detected in sputum, and hypermetabolism seen on PET/CT scanning.
3. Previously "medically inoperable" patients in poor health who in years past were not eligible for curative lung cancer treatment, are NOW eligible for curative treatment due to the evolution of more limited surgical and radiosurgical techniques.

Wednesday, May 13 ***10:30 A.M.***
S. Hemisphere 4

[LIX.] SLIDE: SAFE AEROMEDICAL TRANSPORT IN UNUSUAL SITUATIONS

Co-chair: Eileen Hadbavny
Charleston, SC

Co-chair: Marian Sides
Grayslake, IL

10:30 a.m.

[325] THE LOCKHEED XC-35 AND DR. HARRY ARMSTRONG; DEVELOPMENT OF THE FIRST PRACTICAL PRESSURIZED CABIN AIRPLANE

A.C. Marchiando
ACC Chief Aerospace Medicine, USAF, Langley AFB, VA

INTRODUCTION: The Lockheed XC-35 aircraft was the first airplane specifically built with a pressure cabin and the first practical airplane with a pressure cabin. It was a heavily modified version of the twin-engine Lockheed 10A with a completely different fuselage; it carried a three man crew consisting of two pilots and a flight engineer controlling cabin pressurization. The XC-35 had room for two passengers in the pressurized cabin, room for one additional passenger and a latrine in the unpressurized aft section. It was built to deliver the cabin pressurization requirements that were developed by Captain Harry Armstrong, M.D., who was the director of the United States Air Corps Physiologic Research Unit at Wright Field, Ohio. The XC-35 first flew in 1937 and was utilized for cabin pressurization and high altitude research. It was equipped with two turbo-supercharged Pratt and Whitney XR-1340 radial engines to deliver the necessary high altitude performance to adequately test the aircraft and cabin pressurization system. Extensive testing of the aircraft and systems were performed by and under the direction of Captain Armstrong, W. Randolph Lovelace II, M.D., Walter Boothby, M.D., and Pvt Ray Whitney as the flight engineer. The tests were so successful that on September 15, 1938, the U.S. Army Corps was awarded the Collier Trophy for the greatest achievement in aviation whose value has been demonstrated in actual use during the previous year. The pressure cabin solved the problem of supplying oxygen to occupants, alleviated most symptoms due to barometric pressure changes, allowed flying above most weather, and offered greater speed and fuel economy. Lessons learned in the XC-35 were utilized in development of the Boeing 307, the first pressurized airliner, the Lockheed Constellation and Boeing B-29 Superfortress, the first U.S. pressurized bomber. The XC-35 was so successful it continued to be used as a VIP passenger aircraft through WWII and was used by the National Advisory Committee for Aeronautics (NACA) for thunderstorm research. In 1948 it was donated to the Smithsonian Institution and is unrestored in long-term storage.

Learning Objectives:

1. Learn about the development of XC-35.
2. Learn about Dr. Harry Armstrong's contribution to the development of pressurized aircraft.
3. Learn about the advantages of pressurized aircraft.

10:45 a.m.

[326] AERO-EVACUATION OF PATIENTS WITH HIGHLY CONTAGIOUS DISEASES: THE ROYAL DANISH AIR FORCE SOLUTION

J. Ferrieux
Air Transport Wing Aalborg, Royal Danish Air Force, Vadum, Denmark

INTRODUCTION: The Danish Defence Force had been tasked in August 2014 to build a capability to transport Danish citizens who have or might have been exposed to Ebola Virus Disease (EVD) from West Africa back to Denmark. **METHODS:** Since the mid-1990s, the Royal Danish Air Force (RDAF) aero-evacuation unit (690SQN) has been using four aero-evacuation modules to perform most of the aero-evacuations of sick or wounded Danish soldiers from war or crisis zones. Each module is a 20ft container equipped to transport up to 12 patients or 3 critical care patients. Our airframe, Lockheed C-130J, can carry two modules in its cargo bay. We decided to modify two of our modules in order to be able to perform aero-evacuation of highly infectious and/or contagious patients. In a first phase, we modified one module in order to be able to transport patients with non-airborne contagious diseases such as EVD. In a second phase, we will modify a module in order to be able to transport patients with a contagious disease, regardless of whether it is airborne or not. We based our concept on a double confinement and a three-colours-zones model where the patient's module is red, the medical crew

room is yellow and the rest of the airframe is green. The confinement is based on the use of a negative pressure filtration system, an airlock and HEPA filters. Furthermore, this module will also be able to be used as a Damage Control Surgery operation room on site when performing Casualty Stage Units' or Catastrophe Help missions. Our concept for transport of patients with contagious diseases relies on a close partnership between the RDAF, the Danish Defence Health Services (FSU), the Danish Health Authority (Sundhedsstyrelsen), civilian teams from the Infectious Diseases units from both Skejby and Hvidovre University Hospitals, our industrial providers and the aircrews.

Learning Objectives:

1. A multidisciplinary partnership is required to produce an efficent model of transport of highly contagious patients.

11:00 a.m.
[327] BIOMEDEVAC EXPERIENCE IN ITALY: LESSONS LEARNED

A. Autore[1], M. Lastilla[2], A. Scagliusi[1], M. Lucertini[1], and P. Manfroni[2]
[1]Aerospace Medicine Department, Italian Air Force, Pomezia, Italy; [2]Logistic Command Medical Service, Italian Air Force, Roma, Italy

INTRODUCTION: Highly Infectious Diseases pose a constant threat and have been a challenge for public health systems within recent years. Air evacuation (AE) of patients with potentially lethal, contagious infections poses unique challenges and risks to air crews and medical personnel. The Italian Air Force has developed the biomedevac capacity to safely transport patients with potentially lethal communicable diseases. **METHODS:** We describe the development of the program for AE of patients with highly infectious diseases. The Aircraft Transit Isolator (ATI) is a sealed container in PVC plastic, under negative pressure maintained by a battery-powered HEPA-filtered ventilation. Integrated gloves with long sleeves, allow patient handling from outside and basic monitoring and treatment interventions. The system is suitable for different aircraft (C-130J, C-27J, KC-767) and the airworthiness was evaluated by the Flight Test Center considering several issues, such as EMC compatibility, power supply, vibrations, weight, and emergency procedures. The AE team is composed of anesthetists, infectious disease specialists, flight surgeons and flight nurses who underwent specific training. All the activities are in coordination with the Ministry of Health. **RESULTS:** After 10 years of activity the Medical Service of the Italian Air Force has successfully developed the biomedevac capacity. Some missions will be described and discussed. **DISCUSSION:** AE of patients with highly infectious disease is possible by proper equipment, procedures and training. In our experience the ATI showed to be effective for in-flight patient care, easy to implement and safe for the operators.

Learning Objectives:

1. To understand the development of the program for the AE of patients with highly infectious diseases.
2. To understand the effectiveness of a closed isolation system for AE of patient with highly infectious diseases.

11:15 a.m.
[328] AE-MISSIONS IN AFRICA: THE ADVANTAGES OF AN UNBROKEN VALUE CHAIN IN THE MISSION

C. Lie
Air Transport Wing, Royal Danish Air Force, Vadum, Denmark

INTRODUCTION: Outcome after trauma is proven related to a narrow timeframe, "the golden hour". The distance to treatment facilities can be the factor that surpasses the time frame, and causes it to transform into "bronze day". In high risk missions, combination of forward aeromedical evacuation (FAE) and a Hercules C130 based FOB carrying AE-modules to be utilized as damage control surgery (DCS) platform and AE platform, fast stabilizing treatment can be initiated and continued en route on the tactical aeromedical evacuation (TAE). Early resuscitation and stabilizing surgery can transform the time frame from "bronze day" to if not "golden hour" then "silver hours." **METHODS:** The Royal Danish Air force (RDAF) 690SQN, AirEvac, participated in a combined exercise in which casualties were evacuated from point of injury (POI) by a Merlin EH101 to a FOB placed on a Hercules C130J in which 2 AE modules were prepared. Each module has the capability to carry 9 litter patients of which 3 can be fully equipped ICU litters. One had the function of DCS module, in which stabilizing surgery was undertaken. Live tissue, which was anesthetized and under constant surveillance of a veterinarian, was used to perform stabilizing surgery by a DCS team. This was equipped as a standard AE module receiving 9 role players mimicking CAT A and B patients. . **RESULTS:** The live tissue had sustained extensive injuries which demanded airway and hemorrhage control. After DCS the "patient" was stabilized in regards of respiration on ventilator and circulation without need of vasoactive drugs, and was placed fixated on a stretcher ready for takeoff. **DISCUSSION:** Performing an AE from POI to final treatment must be established by training. Uniform communication between the FAE helicopter and team leader was essential for fast unloading of patients for urgent DCS. The communication between the team leader and the teams must be well established to ensure timely preparation for takeoff. Training in communication between health professionals and operative flight crew needs to be undertaken. Solutions to secure the surgical equipment during flight and training must be undertaken to perform surgery during flight. Using the modules reduces noise compared to doing the procedures in the open cargo bay.

Learning Objectives:

1. Application of an unbroken value chain in AE can improve outcome of trauma by reducing time to stabilizing treatment.

11:30 a.m.
[329] MANAGEMENT OF A SIMULATED MEDICAL EMERGENCY DURING AN EXTRA- VEHICULAR ACTIVITY (MEVA) IN A MARS ANALOG SIMULATION ENVIRONMENT

S. Jewell[2] and M. Komorowski[1]
[1]Imperial College, London, United Kingdom; [2]MarsWithoutBorders, MWOB, Van Nuys, CA

INTRODUCTION: The large amount of extra-vehicular activities (EVAs) expected during an extended stay on the Martian surface will unavoidably be associated with an increased likelihood of severe accidents and injuries, whose management will represent an unprecedented challenge. The Mars Society Desert Research Station (MDRS) in Utah is an isolated facility built for the express purpose of supporting scientific inquiry necessary for the settlement of humans on Mars. This high-fidelity Mars analog setting was used to assess the ability for a 5-person crew to perform coordinated search & rescue (SAR) operations, initial assessment on the field, prevention and treatment of decompression sickness, evacuation of the injured crewmember and definitive treatment inside the habitat medical including general anesthesia and surgery. The scenario simulated a fall from height occurring during an EVA, in an area of difficult access. The signal from the presumed injured crewmember was lost and his exact location unknown. SAR operations were coordinated by the mission commander from inside the habitat, and made use of an Unmanned Aerial Vehicle fitted with real-time video link and a specifically designed EVA Rover carrying a rescue team of 2 astronauts. Asynchronous tele-medical support was obtained from Earth's Medical Control Center. This integrated scenario enabled to test operational tools and concepts, and to identify critical features that need to be incorporated into the further development of emergency procedures for space exploration missions.

Learning Objectives:

1. Assessment in medical managment and crisis intervention procedures for operational and protocol development during planetary surface SAR simulations in a Mars analog extreme environment.

Wednesday, May 13 ***10:30 A.M.***
S. Hemisphere 5

[LX.] PANEL: EVALUATING AIRCREW-MOUNTED RESPIRATORY SENSORS

Chair: Ryan Mayes
Upper Arlington, OH

PANEL OVERVIEW: Modern high-performance aircraft monitor hundreds of parameters on jet performance but measure few (if any) variables relevant to pilot physiology. However, small sensor technologies have made it possible to collect and evaluate data on the respiration of high-performance aircraft pilots. For example, the Aircrew Mounted Physiologic Sensor Suite (AMPSS) has already been flown on U.S. Air Force test jets, and an improved second generation of AMPSS is being formally evaluated to assess its measurement of several physiologic parameters. Presentations in this panel will compare AMPSS to gold standard measurements (such as a flow-volume simulator or metabolic cart) in capturing several critical variables, all of which are critical to understand pilot performance in high-performance aircraft. Variables measured include tidal volume and minute ventilation, forced vital capacity, metabolic cost, and work of breathing (WOB). Measuring tidal volume and minute ventilation will contribute to an understanding of metabolic cost, WOB, and hypo/hypercapnia and could aid in future mishap investigations. Measurement of forced vital capacity could ultimately allow in-flight measurement of atelectasis, which would lead to understanding the contributors of factors such as high O_2 or Gz to atelectasis. Quantifying metabolic cost will allow an assessment of the cardiorespiratory workload of flight and of associated exercise such as the anti-G straining maneuver. Finally, WOB has been identified by recent U.S. Air Force work as a critical knowledge gap; quantifying WOB in laboratory and operational settings will be invaluable in determining future medical standards for aircraft. AMPSS could also be applied to detect hypoxia, hypocapnia, and hypercapnia. AMPSS is designed to be able to collect data in-flight; future applications of AMPSS could cover numerous airframe and flight regimes, ultimately making in-flight pilot physiologic data available to the aeromedical community.

[330] VALIDITY TESTING OF AIRCREW MOUNTED PHYSIOLOGIC SENSOR SUITE WITH A FLOW/VOLUME SIMULATOR

M.L. Cowgill[1], D. Barrera[2], D. Bryant[1], E.H. Mulagha[2], M. Wade[1], V.A. Wong[1], B.A. Wright[1], R.S. Mayes[1], D. Burch[1], and D.E. Bebout[1]
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INTRODUCTION: Due to several physiologic incidents in recent history, the U.S. Air Force has begun to investigate the possible causes and solutions for these events. Researchers within the U.S. Air Force School of Aerospace Medicine are working with a prototype mask system called the Aircrew Mounted Physiologic Sensor Suite (AMPSS, Orbital Research, Inc., Cleveland, OH) to better understand and quantify the physiologic loads, such as work of breathing, on aircrew. Before the equipment can be used to evaluate aircrew, testing must be completed to validate its effectiveness when compared to other industry standards. **METHODS:** A flow/volume simulator (FVS) (Series 1120, Hans Rudolph, Inc., Shawnee, KS) was used to produce known flow and volume waveforms that were passed through the AMPSS with a direct connection fabricated by the AMPSS manufacturer. These results were compared with previous results collected when the FVS and the AMPSS were connected through a manikin head and mask. **RESULTS:** The output of the FVS was more accurately captured by the AMPSS when they were directly connected rather than when the flow passed through the manikin head and mask. **DISCUSSION:** Removing the manikin head eliminated its effect on the flow created by the FVS. This allowed for a truer reading by the sensors in the AMPSS of the generated flow; this allowed for a more accurate validation and assessment of the AMPSS sensor suite.

Learning Objectives:

1. The elimination of the confounding effect of the manikin on the flow delivered to the sensors allows for a more accurate measurement of the flow.

[331] COMPARISON BETWEEN FLOW VOLUME SIMULATOR AND PROTOTYPE AIRCREW MOUNTED PHYSIOLOGIC SENSOR SUITE MASK SYSTEM USING TRADITIONAL MANIKIN TESTING

D. Bryant[1], M.L. Cowgill[1], D. Burch[1], M. Wade[1], V.A. Wong[1], E.H. Mulagha[2], B.A. Wright[1], R.S. Mayes[1], and D.E. Bebout[1]
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INTRODUCTION: In recent history, several hypoxia-related physiologic events in high-performance fighter aircraft have been reported leading to the U.S. Air Force to begin investigations to better understand the causes and solutions for these events. Orbital Research Inc. was commissioned to develop a prototype Aircrew Mounted Physiologic Sensor Suite (AMPSS) mask system to quantify pilot workloads flying high-performance fighter aircraft. The AMPSS system uses sensors to record pressure, flow, oxygen, and carbon dioxide partial pressures to measure pulmonary and metabolic function. **METHODS:** We will test agreement between the flow volume simulator and the Orbital AMPSS mask system comparing the traditional method of sending calibrated gas flows and volume through a manikin and AMPSS mask against a direct connection between the flow volume simulator and AMPSS. Eighteen representative flow and volume waveforms will be tested. **RESULTS:** We will present a detailed description of testing results collected under the conditions described above using Bland-Altman analysis. **DISCUSSION:** This work will verify the validity of the AMPSS mask system to determine pilot workload. If successful, the AMPSS mask will be validated for further testing and in-flight use to enhance the capability to physiologically monitor pilots during flight and increase pilot safety.

Learning Objectives:

1. To understand the validation process using the flow volume simulator and protoype mask sensor suite system.

[332] EFFECTS OF FULLY PRESSURIZED HIGH-PERFORMANCE AIRCREW FLIGHT EQUIPMENT ON GAS EXCHANGE DURING SUBMAXIMAL CYCLE ERGOMETRY

M. Wade[1], E.H. Mulagha[2], M.L. Cowgill[1], D. Bryant[1], V.A. Wong[3], J. Ordway[1,4], B.A. Wright[4], R.S. Mayes[1], D. Barrera[4], and D.E. Bebout[4]
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INTRODUCTION: Several unexplained hypoxia-related incidents have occurred during flight in high-performance aircraft since 2008. A contributing factor to hypoxia-like symptoms in high-performance aircraft may include physical fatigue resulting from repeated high +Gz maneuvers in fully pressurized aircrew flight equipment (AFE) that restricts chest expansion during heavy cardiorespiratory workloads. This study aims to determine the cardiorespiratory effects of wearing fully pressurized (to a +9 Gz equivalent) AFE during submaximal exercise. **METHODS:** Gas exchange variables were collected from eight subjects while wearing fully pressurized high-performance AFE compared with unpressurized high-performance AFE. Minute ventilation, oxygen consumption, carbon dioxide production, and respiratory exchange ratio were measured at rest, after 3 min of submaximal cycle ergometry at 100 W, and during recovery from exercise. A novel metabolic mask system (Aircrew Mounted Physiologic Sensor Suite (AMPSS), Orbital Research, Inc., Cleveland, OH) was used to collect gas exchange variables and compared with a standard breath-by-breath metabolic cart. **RESULTS:** Results will be used to determine the cardiorespiratory effects of fully

pressurized high-performance AFE during moderate exercise. **DISCUSSION:** If the fully pressurized AFE causes undue fatigue during exercise, improvements could possibly be made to reduce the fatiguing effects of the equipment. Additionally, the results will contribute toward evaluating the feasibility of using the AMPSS system to make metabolic measurements during a wide range of cardiorespiratory workloads.

Learning Objectives:

1. To determine the cardiorespiratory effects of fully pressurized AFE during submaximal exercise.

[333] EFFECTS OF FULLY PRESSURIZED ADVANCED FIGHTER AIRCREW FLIGHT EQUIPMENT ON PULMONARY FUNCTION TESTING

E.H. Mulagha[2], D. Barrera[3], M.L. Cowgill[1], D. Bryant[1], B.A. Wright[3], R.S. Mayes[1], and D.E. Bebout[2]
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INTRODUCTION: Recently, several hypoxia-related physiologic events have been reported by pilots of high-performance fighter aircraft. These reports have led the United States Air Force to begin investigations to better understand the causes and solutions for those events. Our hypothesis is that current configurations of aircrew flight equipment (AFE) contribute to quantitative changes to pulmonary function when fully pressurized to a 9 Gz equivalent **METHODS:** Resting pulmonary function testing (PFT) on 8 subjects was performed with and without standard AFE that included advanced technology anti-G suit, upper pressure garment, life support vest, and the PCU-15/P parachute harness. Standard PFT results were compared to those obtained with a prototype mask system called the Aircrew Mounted Physiologic Sensor Suite (AMPSS, Orbital Research, Inc.) designed for flight that measures pulmonary and metabolic function. Testing was conducted under four conditions: standard PFT (no gear), AMPSS (no gear), standard PFT (gear pressurized to 9 Gz equivalent), and AMPSS (gear pressurized to 9Gz equivalent). **RESULTS:** There was substantial change to PFTs when AFE was fully pressurized to 9 Gz equivalent except for carbon monoxide diffusing capacity. A detailed description of testing results collected under the four conditions described above will be presented. **DISCUSSION:** This work will increase aerospace knowledge of the effects of high-performance fighter aircraft AFE on pulmonary function. Furthermore, AMPSS measurement accuracy will be verified for further testing and in-flight use. Validation of AMPSS may lead to new physiologic information that will better monitor pilots. This would allow advanced fighter aircraft to be used nearer to its design envelope limits with increased pilot safety, enhancing the potential air battle advantage of this aircraft.

Learning Objectives:

1. Understand and define pulmonary function testing parameters.
2. Describe the role of chest wall restriction on breathing.
3. Become familiar with acceleration atelectasis.

[334] EFFECTS OF HIGH PERFORMANCE FIGHTER AIRCREW FLIGHT EQUIPMENT ON WORK OF BREATHING AND PULMONARY GAS EXCHANGE DURING SUBMAXIMAL CYCLE ERGOMETRY

D.E. Bebout[1], M. Wade[1], V.A. Wong[2], D. Burch[4], M.L. Cowgill[2], D. Bryant[2], D. Barrera[4], J. Ordway[4], E.H. Mulagha[3], B.A. Wright[4], and R.S. Mayes[1]
[1]Department of Aeromedical Research, U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH; [2]FHC, U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH; [3]Aerospace Medicine, U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH; [4]U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: Several unexplained hypoxia-related physiologic events have occurred in high-performance fighter aircraft pilots since 2008. One possible contributing factor causing hypoxia-related symptoms may include increased work of breathing (WOB) and physical fatigue resulting from high +Gz maneuvers in fully pressurized aircrew flight equipment (AFE). Thus, the primary objective of this study is to evaluate the effects of various configurations of fully pressurized AFE on WOB and metabolic function at rest and during submaximal exercise. **METHODS:** Following IRB approval and informed consent, eight subjects were studied. Each subject was instrumented with an esophageal balloon catheter for estimation of pleural and transpulmonary pressures and WOB. Gas exchange variables (e.g., ventilation, O_2 uptake and CO_2 output) were measure using a metabolic cart (MGC Diagnostics, St. Paul, MN) and a novel metabolic mask system designed for measurements during flight (Aircrew Mounted Physiologic Sensor Suite (AMPSS), Orbital Research Inc., Cleveland, OH). Measurements were made without AFE and with AFE fully pressurized to a +9Gz equivalent at rest and during 100 W exercise on a recumbent cycle ergometer (Lode, Groningen, Netherlands). **RESULTS:** Results will be presented to determine the cardiorespiratory effects of fully pressurized high-performance AFE during submaximal exercise. **DISCUSSION:** If the fully pressurized AFE causes increased WOB and physical fatigue during exercise, improvements could possibly be made to reduce WOB and the fatiguing effects of the equipment. Additionally, the results will contribute toward evaluating the feasibility of using the AMPSS system to make metabolic measurements during the extreme conditions of high performance flight.

Learning Objectives:

1. To better understand the effects of fully pressurized high performance aircrew flight equipment on work of breathing and metabollic function.

[335] IN-FLIGHT HYPOXIA: FROM SENSOR TO BIOMARKERS

J.B. Phillips[1], C. Grigsby[2], L. Tripp[2], and R.S. Mayes[3]
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INTRODUCTION: The problem of in-flight hypoxia still plagues the aviation community and requires the aviator to be ever vigilant for its symptoms. Hypoxia is not a service centric problem as both the Navy and Air Force have lost aircrew and aircraft to this insidious killer. In response to this issue, a bi-service collaborative approach is currently underway at Wright-Patterson AFB at the Navy Medical Research Unit Dayton, USAF 711 Human Performance Wing School of Aerospace Medicine, and Human Effectiveness Directorate. **METHODS:** The group's approach to hypoxia detection has evolved over the past 4 years from helmet mounted pulse oximetry to assessing the effectiveness of oxygen system by measuring the oxygen concentration being provided to the aviator at the oxygen mask, and exhaled oxygen and carbon dioxide. Efforts are underway to identify biomarkers associated with hypoxia, hyperventilation, hypocapnea, and contaminant exposure. The goal of these collaborative efforts is to bring a multifaceted approach to provide the aviator with timely information on their physiological state and to facilitate accurate diagnosis of future in-flight hypoxia-like incidents. **RESULTS:** Technical challenges associated with environmental extremes such as, fluctuating barometric pressure, extreme temperatures, high oxygen concentrations, and humidity, make acquiring accurate data in-flight a challenging engineering endeavor. **DISCUSSION:** The general methodology will be described, as well as results and technical challenges encountered to date. Approaches that have been developed to mitigate these technical challenges will also be presented.

Learning Objectives:

1. The primary objective is to understand the true nature of life-support system malfunctions in modern tactical aviation and the most promising method of mediation.

Wednesday, May 13 ***10:30 A.M.***
S. Hemisphere E3

[LXI.] PANEL: U.S. NAVY, U.S. AIR FORCE, U.S. ARMY, FAA COLOR VISION WORKING GROUP PANEL

Co-Chair: Nelda Milburn
Oklahoma City, OK

Co-Chair: Matthew Rings
Pensacola, FL

Co-Chair: Michael Reddix
Springboro, OH

PANEL OVERVIEW: Presentations will cover recent advancements in research evaluating color vision screening tests and their relationship to operational and occupational color-coded tasks.

[336] USING HUMAN PERFORMANCE METRICS TO DETERMINE AVIATION COLOR VISION PASSING CRITERION

M. Rings
Ophthalmology, NAMI, Pensacola, FL

INTRODUCTION: The Naval Medical Research Unit-Dayton tested reaction-time and accuracy performance for PAPI and color display icon identification of both normal and various degrees of color vision deficient subjects. The resulting normal and abnormal patient color vision scores for three computer-based tests, (CCT, WCCVT and CAD) were compared, analyzed and used for proposing passing score cut-offs for Naval aviation special duty. Mildly color deficient persons were found to perform within reasonable normal performance limits for correctly and efficiently recognizing PAPI lights and colored cockpit display symbology, while moderate and severely color vision deficient persons fell far outside the range of normal response time and accuracy.

Learning Objectives:

1. Most Mildly color vision deficient persons perform within the same range of speed and accuracy as normal subjects whilst recognizing PAPI and cockpit color display icons.
2. Computerized color vision testing allows fine gradation of color vision deficiency severity, allowing reliable passing criterion scores for aviation duties.

[337] CAN OPERATIONALLY-RELEVANT ACCURACY AND REACTION-TIME METRICS GUIDE THE DEVELOPMENT OF COLOR-VISIOIN STANDARDS?

H. Gao[1], M.D. Reddix[2], and C.D. Kirkendall[3]
[1]Ophthalmology, Naval Medical Center San Diego, San Diego, CA; [2]Acceleration & Sensory Sciences, Naval Medical Research Unit-Dayton, Wright-Patterson AFB, OH; [3]Personnel Assessment Research Unit, U.S. Army Research Institute, Fort Belvoir, VA

INTRODUCTION: Three computer-based color-vision tests (CVTs) were evaluated to determine their sensitivity in detecting both type and severity of color-vision deficiency (CVD), and the degree to which their scalable results predicted color-vision normal (CVN) and CVD performance in operationally-relevant color symbol discrimination tasks. CVTs included the USAF Cone Contrast Test (CCT), Waggoner Computer Color Vision Test (WCCVT), and City University Colour Assessment and Diagnosis test (CAD). Relating CVD type and severity to operational performance represents an important metric for use in assessing candidates for special-duty occupations involving color-rich displays. **METHODS:** The three computer-based color-vision tests were administered to 18-35 year-old male and female participants. Reaction time (RT) and accuracy was recorded for two operationally-relevant aviation tasks that required color discrimination: an out-of-cockpit red- and white-light precision approach path indicator (PAPI) task, and in-cockpit red, green, and yellow display-icon symbol discrimination task. CVN and CVD were classified based on each individual CVT passing criterion. The results of each CVT score were plotted against accuracy and reaction-time scores for each human performance task. **RESULTS:** Over half of the CVDs performed within 95% confidence interval (CI) of the color normal participants on the PAPI task. For the in-cockpit display icon task, however, only 2 mild deutans and none of the protans, classified by CCT or CAD, performed within the 95% CI. WCCVT classified one of these two deutans as protan and the other as CVN. **DISCUSSION:** These preliminary results show that operationally relevant color symbol discrimination reaction-time performance scores can reliably differentiate color normal and color defective performance. The combined use of color symbol discrimination performance and computer-based CVT scores may also provide an operationally relevant metric for establishing color-vision selection criteria.

Learning Objectives:

1. Understand how the relationship between severity of color-vision deficiency and operationally relevant human performance can guide the development of color-vision selection standards.

[338] THE U.S. ARMY COLOR VISION STUDY: FINAL RESULTS

D.V. Walsh[1], J. Robinson[3], G.M. Jurek[1], and J.E. Capo-Aponte[2]
[1]Vision Protection and Performance Division (VPPD), U.S. Army Aeromedical Lab (USAARL), Fort Rucker, AL; [2]Optometry Department, Womack Army Medical Center, Fort Bragg, NC; [3]Aviation Optometry Clinic, Russell Collier Health Clinic, West Fort Hood, TX

INTRODUCTION: Having optimum color vision (CV) has become increasingly vital in today's Army where more complex colored displays are used in both aviation and non-aviation specialties. Current U.S. Army color vision tests used for Aviation screening (Dvorine PIP and FALANT) only provide pass-fail criteria, and previous studies have shown variable sensitivity and specificity. The purpose of this study was to evaluate ten tests to determine an optimal CV test screener that could be implemented by the U.S. Army. **METHODS:** 140 subjects were recruited [(70 Color Vision Deficits (CVD), 70 Color Vision Normal (CVN)] and performed all tests in one setting. CVD and CVN determination was initially assessed with the Oculus anomaloscope. Each test was administered monocularly, and according to the test protocol. The main outcome measures were tests' sensitivity, specificity and administration time. **RESULTS:** All PIP tests had a sensitivity/specificity greater than 0.80 in each eye, except the Hardy-Rand-Rittler (HRR) specificity (mean = 0.66). The FALANT had greater than 0.80 sensitivity and specificity in both one- and three-test administration. The Cone Contrast Test (CCT) demonstrated sensitivity/specificity greater than 0.90 in each eye (mean = 0.97 sensitivity; mean = 0.95 μ specificity), whereas the CAD demonstrated sensitivity greater than 0.90 in each eye (mean = 0.97) and specificity greater than 0.80 in each eye (mean = 0.85). Comparison with the anomaloscope (gold standard) revealed no significant difference of sensitivity/specificity in both eyes with the CCT, Dvorine PIP, and PIPC tests. Finally, the CCT administration time was significantly faster than the CAD test (6 min vs. 14 min; $p<0.001$), but significantly slower than the PIP tests (6 min vs. 3 min; $p<0.001$). **DISCUSSION:** The current U.S. Army color vision screening tests demonstrated good sensitivity and specificity, as did the automated tests. In addition, some current PIP color vision tests (Dvorine,PIPC), and the CCT performed no statistically worse vs. the "gold standard" anomaloscope with both sensitivity and specificity. However, the CCT has the advantage of both classifying and quantifying color vision deficits, is less dependent on user experience and technician turnover.

Learning Objectives:

1. To identify a color vision screening test that could be implemented by the U.S.Army.

[339] CURRENT EVENTS IN AUTOMATED COLOR VISION TESTING

S. Wright
Ophthalmology, U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: Occupational assessment of color vision traces its roots back to a railroad mishap in Sweden in 1875. Over the next 125+ yr, various forms of color vision testing have been implemented within the industry to screen individuals who are tasked with interpretation of colored symbologies as a routine part of their job. Traditional methods of screening for color vision (e.g., pseudo isochromatic plates, lantern tests, D-15) are well known to most people and, for the most part, are effective. However, they have inherent liabilities, including administrator error or bias, the need for specialty lighting to be valid, and they typically do not quantify the severity of color vision loss. In recent years, interest has turned to the development of computer-based methods of evaluating color vision status that eliminate many of the shortcomings of traditional tests. Three of the more widely used devices include the Colour Assessment and Diagnosis, the Rabin Cone Contrast Test, and the Waggoner Computerized Color Vision Test (now marketed as ColorDx). While these are all automated, computer-based systems, they vary widely on their underlying scientific principles, user interface, and reporting of results. In this discussion we will compare and contrast these devices, discuss interpretation of results with case examples, and review which devices are approved by military and civilian aviation authorities.

Learning Objectives:

1. Compare and contrast three automated tests of color vision.
2. Discuss interpretation of results from three automated tests of color vision.

[340] HUMAN VITAMIN A-LINKED CHROMOPHORE SPECTRAL SENSITIVITY

M.R. Lattimore
Visual Protection & Performance Division (VPPD), U.S. Army Aeromedical Research Laboratory (USAARL), Fort Rucker, AL

INTRODUCTION: Mammalian vitamin A-based chromophores are the wavelength-specific sensors modulating color vision sensitivity. Humans possess three separate photopigments displaying unique spectral sensitivities. All share the same base chromophore (11-cis-retinal), but differ in their associated/covalently-linked heptahelical transmembrane protein or "opsin." However, both the red and the green photopigment genes each possess a translated region of six possible exons, differing in 15 amino acids, with countless genotypic coding combinations. However, only the first two exons combine to determine phenotypic color spectral sensitivity, making the task of color screening much simpler than once thought. **METHODS:** This is a basic science review of the underlying mechanisms that may emerge when attempting to establish a standardized clinical screening program. Current visual performance viewing of LED-based flat panel and heads-up displays can be unpredictable, potentially endangering the aircraft, pilot and crew. Color sensitivity can be accurately measured against a standardized wavelength-based continuum. The purpose of the reported research is to identify a standardized color vision testing procedure which could predictably identify all performance characteristics. **RESULTS:** The apparent simplicity of the standardized applied clinical color vision assessments belies the complexity of the underlying chromophore specialization. The data from the preceding panel presentations will be summarized, highlighting each of their apparent methodological difficulties. **DISCUSSION:** Procedural variability is a common problem associated with all aspects of color sensitivity testing. Such difficulties may arise when binocular sensitivity testing methods are applied monocularly, and vice-versa. Some applied testing protocols can be inadvertently used as screening protocols, while others can mis-apply absolute sensitivity testing protocols. The end result is highly varying individual responses, undermining testing credibility. Two methods may typically agree, but the underlying chromophore architecture may examine distinctly separate visual sensitivity performance characteristics, thus requiring the use of supplemental tests, increasing the testing time and subject variability.

Learning Objectives:

1. Articulate the challenges behind color vision testing standardization.
2. Identify when chromophore genetic variance can lead to unpredictable visual performance.

[341] ESTABLISHING COLOR VISION SCREENING TEST CUT-POINTS BASED ON AVIATION OCCUPATIONAL TASK PERFORMANCE

N. Milburn and T. Chidester
FAA-CAMI, Oklahoma City, OK

INTRODUCTION: Previous research has shown that some individuals with color vision deficiencies (CVD) are capable of performing some aviation occupational tasks as well as those with normal color vision (NCV); implying that passing a screening test with a diagnosis of NCV may not be necessary for all aviation occupations. Our goal was to find *outcome consistency* between performance on occupational tasks and several screening tests; further, to compare those pass/fail outcomes to the Colour Assessment and Diagnosis (CAD) test for aviation certification. **METHODS:** The strategy involved establishing a pass/fail cut-point separately for four occupational tasks at the 5th percentile of the NCV group and requiring that all four tasks be passed. A scatterplot was constructed displaying the sum of correct screening test trials on the x-axis and the red/green threshold of the CAD test on the y-axis. By defining the markers according to pass/fail status on the occupational tasks, it was easy to evaluate multiple factors to arrive at an appropriate cut-point for each screening test. New pass/fail variables for each screening test were created based on this procedure for use in calculating Kappa scores. Data were available from two separate studies that included approximately equal proportions and equal distributions of NCV and types of CVD participants. **RESULTS:** Using two independent datasets, the first to *establish* proposed cut-points and the second to *validate* the cut-points, we found that agreement with the new cut-points, on average: a) improved between occupational performance and screening test pass/fail from K=.683 to K=.721 compared to the manufacturer's criterion, b) improved from K=.701 to K=.721, compared to the FAA's criterion for pilots, and c) was not significantly different from the CAD certification criterion for either Study 1 or Study 2, showing a close alignment of the new cut-points on the screening tests with the CAD certification criterion.

Learning Objectives:

1. Students will learn a novel approach to setting screening test cut-points based on multiple factors.

Wednesday, May 13 ***10:30 A.M.***
S. Hemisphere E4

[LXII.] PANEL: 2014 AVIATION SAFETY YEAR IN REVIEW AND JOINT SERVICES SAFETY COUNCIL

Co-Chair: Dwayne Porter
Rio Rancho, NM

Co-Chair: Tyler Brooks
Ottawa, Ontario, Canada

Co-Chair: Robert Frick
Norfolk, VA

Co-Chair: Kirsten Carlson
San Diego, CA

PANEL OVERVIEW: 2014 Joint Safety Year in Review: Representatives from military and civil aviation will present information on aviation safety and adverse aviation events from FY 2014. Discussion will focus on mishap analysis of mechanical and human causal factors. Hazard trends will be discussed and compared with previous years. Current emerging topics of discussion within the aviation safety groups will be presented. Additionally, in May of 2014 the Joint Services Safety Council chartered the Human Factors Working Group. The panel includes a brief presentation of the updated DoD Human Factors Analysis and Coding System. It goes on to present data on the development of joint safety climate surveys. The Air Force will present a safety culture assessment program that has yielded very positive outcomes.

[342] NAVAL AVIATION SAFETY: 2014 YEAR IN REVIEW

R.A. Frick, D. Unger, L. Finlayson, and K. Carlson
Aeromedical Division, Naval Safety Center, Norfolk, VA

INTRODUCTION: The Naval Safety Center analyzes Navy and Marine Corps aviation safety investigation reports in order to identify mishap causal factors. **METHODS:** All Class A flight mishaps involving US Navy and Marine Corps aircraft during fiscal year 2014 (FY14) were reviewed using the Human Factors Analysis and Classification System (HFACS). **RESULTS:** During FY 14 there were 14 Class A mishaps in the U.S. Navy (1.69 per 100,000 flight hours) and 5 Class A mishaps in the US Marine Corps (1.94 per 100,000 flight hours). A review of Class A flight mishaps over the past 10 years demonstrated that human factors were the predominant causal factors. Current emerging topics of discussion related to Naval Aviation Safety will also be presented. **DISCUSSION:** HFACS is a useful tool in safety investigation analysis and assists in identifying causal factors to focus mitigation strategies to prevent future mishaps. It is becoming more standardized across the Department of Defense. Regulation of remotely piloted vehicles, the increase in aircraft laser exposure incidents, correctly defining causes in physiologic event reporting, LED obstruction lighting and the implementation of the Naval Safety Management System are a few emerging topics of discussion

Learning Objectives:

1. Review the overall trend in US Navy and Marine Corps flight mishaps and the most common human factors identified as causal factors.
2. Identify the most common Human Factors Analysis and Classification System (HFACS) categories for Naval Aviation mishaps.
3. Review the trends in Naval Aviation mishap HFACS causal factors over the last decade.

[343] U.S. CIVIL AVIATION IN 2014

C.A. DeJohn, W.D. Mills, and J. Larcher
FAA-CAMI, Oklahoma City, OK

INTRODUCTION: The National Transportation Safety Board investigates all civil aviation accidents and reports current and historical accident data. We analyzed trends in accident rates and performance data for all types of civil aviation with emphasis on 2014 data. **METHODS:** U.S. civil aviation accident data was analyzed to determine trends from 1990 to 2014, whereas safety performance measures were analyzed for various time periods depending on available data. **RESULTS:** Fatal accident rates for all types of operations significantly decreased for the period 1990 to 2014 ($p<0.05$). In addition, the mean accident rate for all accidents was significantly greater than the mean fatal accident rate for all types of operations ($p<0.05$). Air taxi and general aviation all accident rates decreased more rapidly than their respective fatal accident rates ($p<0.01$). Safety performance measures for commercial air fatalities, runway incursions and general aviation fatal accidents all showed decreasing, though non-significant, trends. **DISCUSSION:** An analysis of accident rates between 1990 and 2014 and safety performance measure trends for all types of operation indicated steady improvements in civil aviation safety.

Learning Objectives:

1. Understand the trend in U.S. civil aviation accident rates over recent years.
2. Gain a knowledge of the relative differences in aircraft accident rates for different types of U.S. civil operations.
3. Have an understanding of what safety performance measures are and what the recent trend has been for different types of operations.

[344] ROYAL CANADIAN AIR FORCE FLIGHT SAFETY: 2014 YEAR IN REVIEW

T. Brooks
Director of Flight Safety, Canadian Armed Forces, Ottawa, ON, Canada

INTRODUCTION: The Royal Canadian Air Force (RCAF) operates all Army, Navy and Air Force aircraft in the Canadian Armed Forces. The Director of Flight Safety (DFS) investigates aviation occurrences with the goal of preventing accidental loss of aircraft and personnel. Contributory or causal human factors are identified using the Canadian Forces Human Factors Analysis and Classification System (CF- HFACS). Statistics and analysis from fiscal year (FY) 14 are discussed. **METHODS:** Class A and B accidents in FY14 were reviewed to identify human factors which may have caused or contributed to these occurrences. These factors were reviewed in the context of previously identified hazards which have been prioritized by DFS and include: fatigue, culture, and substances hazardous to aviation. **RESULTS:** Fatigue, culture and substances hazardous to aviation continue to be relevant hazards in the RCAF. **DISCUSSION:** DFS has undertaken several initiatives specifically aimed at mitigating these factors.

Learning Objectives:

1. Review the overall trends in RCAF flight occurrences in FY 14.
2. Review the common human factors identified as contributing to flight occurrences and the mitigating initiatives being undertaken by DFS.

[345] U.S. AIR FORCE AVIATION SAFETY: FY 2014 YEAR IN REVIEW

T. Strongin
Safety Center, U.S. Air Force, Albuquerque, NM

INTRODUCTION: Reviews FY 2014 statistics and analysis for USAF Class A Aviation mishaps including classification under the DoD Human Factors Analysis and Classification System (DoD HFACS). **METHODS:** FY14 data was obtained from the USAF Safety Center database for Class A Aviation mishaps and reviewed for human factors as determined by the associated Safety Investigation Board. **RESULTS:** The U.S. Air Force experienced 7 Class A rate producing aviation mishaps in FY14 with 2 destroyed aircraft and 5 fatalities (mishap rate of 0.44 per 100,000 flying hours, not including remotely piloted aircraft). A review of finalized FY14 Class A mishaps with report data available demonstrated that human factors were cited as causal or contributory in more than 90% of the total. The most frequently occurring human factors will be reviewed. **DISCUSSION:** FY14 saw a dramatic decrease in the number of destroyed aircraft and fatalities compared to the previous year (14 destroyed aircraft and 11 fatalities in FY13) and is noted as the safest year for aviation mishaps in U.S. Air Force history. Human factors continue to negatively impact aviation safety and remain generally consistent in proportion and type regardless of the mishap rate.

Learning Objectives:

1. The audience will understand the overall trend in USAF Class A Aviation mishaps and associated human factors.

[346] AIR FORCE HUMAN FACTORS SUPPORT OF SAFETY

T. Strongin
Safety Center, U.S. Air Force, Albuquerque, NM

INTRODUCTION: Human factors cause between 60 and 90 percent of Air Force mishaps. The Air Force Safety Center has developed two safety culture surveys and an organizational safety assessment technique to acquire and communicate actionable safety intelligence to operational commanders. **METHODS:** The web-based Air Force Combined Mishap Reduction System survey was administered to four, large AF organizations. An additional, in-person survey was conducted at each base. Focus groups were conducted, during which approximately 2/3 of the Airmen assigned to each location offered personal insights and opinions concerning safety at their duty station. Results were consolidated and presented to the local commander. The number and severity of mishaps were compared for the 18 months before and after the information was reported to the commander. **RESULTS:** A comparison of number and severity of

mishaps for the 18 months before and after the presentation of safety findings and recommendations demonstrated consistent reductions of 15-29% in the number of mishaps of all severities. **DISCUSSION:** Human factors cause most mishaps. Surveys and interviews of the Airmen who accomplish the mission on a daily basis revealed a wide range of actionable safety intelligence. When informed in a succinct and actionable format, commanders consistently achieved significant reductions in the number and severity of mishaps. Future developments in the acquisition and communication of safety climate information will be discussed.

Learning Objectives:

1. Understand the potential value of automated safety climate surveys.
2. Understand the potential value of organization-specific safety climate surveys.
3. Understand the value of integrating observations from multiple sources in assessing organizational safety climates.

[347] EVALUATING SAFETY CULTURE IN THE USN & USMC

K. Carlson[1], P. Fatolitis[2], and J. Natividad[1]
[1]Naval Safety Center, Norfolk, VA; [2]Naval School of Aviation Safety, Pensacola, FL

INTRODUCTION: Human factors are causal in approximately 80% of naval mishaps. The Naval Safety Center (NSC) conducts mandatory safety surveys and voluntary culture workshops as a means of assessing and improving the overall safety climate of a unit. **METHODS:** In FY14, in-person safety surveys were administered at 110 units. Additionally, over 100 culture workshops were completed. These techniques allowed for unit-level intervention of unsafe practices and perceptions as well as provided a forum to address the concerns of unit personnel given the underlying cultural foundations of a unit. **RESULTS:** A comparison of mishap occurrence both prior to and following safety survey/culture workshop implementation revealed a subsequent reduction in mishaps. **DISCUSSION:** Safety surveys and culture workshops are just two components of USN/USMC safety assurance programs. Also included are the Command Safety Assessment (CSA) survey which assesses an organization's operational practices from a safety perspective, and the Maintenance Climate Assessment Survey (MCAS). All of these tools are designed to identify human factors risks, promote organizational effectiveness, and facilitate unit individuals' buy-in/ownership of a positive safety culture.

Learning Objectives:

1. Review of NSC safety assurance programs, including in-person and automated safety surveys, and culture workshops. Understand the role of NSC safety assurance programs in reducing mishap trends.

Wednesday, May 13 ***2:00 P.M.***
S. Hemisphere 1

[LXIII.] SLIDE: STIMULATING LOOK AT COGNITIVE PERFORMANCE

Co-Chair: Andrew Woodrow
San Antonio, TX

Co-Chair: Frederick Bonato
Montclair, NJ

2:00 p.m.

[348] TIME OF USEFUL COGNITION: A COMPLEMENT TO THE TIME OF USEFUL CONSCIOUSNESS

J.B. Phillips[2], M. Funke[1], F.E. Robinson[1, 2], and L. Drummond[1, 2]
[1]NAMRU-Dayton, Wright-Patterson AFB, OH; [2]Biomedical Sciences, Naval Medical Research Unit-Dayton, Wright-Patterson AFB, OH

INTRODUCTION: Previous work has demonstrated that hypoxia leads to significant cognitive decrements before loss of consciousness, but the Time of Useful Consciousness (TUC) table does not address these more subtle breakdowns in performance. The TUC table estimates the amount of time a person can remain at a given altitude without supplemental oxygen prior to becoming incapacitated. Pilots are assumed to be able to perform their flight duties up to the point of incapacitation, but little research has assessed the quality of that performance. The aim of the current research was to complement the TUC table by modeling the onset of impairment and the rate of cognitive decline in the minutes leading up to incapacitation due to hypoxia. **METHODS:** Participants received a placebo altitude exposure and one of three normobaric altitude exposures: 6100 m, 6700 m, or 7620 m (20,000 ft, 22,000 ft, or 25,000 ft). Exposure duration was based on the TUC estimates for the particular altitude. Cognitive performance was assessed at one minute intervals using simple reaction time (SRT) and choice reaction time (CRT) tasks. **RESULTS:** The third quartile of reaction times was analyzed in order to account for the skewedness of reaction time data. At 6100-m equivalent exposure, the SRT showed effects at minute 3 of the exposure while the CRT showed effects at minute 10. For the 6700-m exposure, the SRT showed effects at minute 5 and the CRT showed effects at minute 6. At the equivalent of 7620 m, the SRT showed effects at minute 3 and the CRT showed effects at minute 2. **DISCUSSION:** All of the effects found in the analysis of third quartile reaction time data occurred at or below the minimum times specified in the TUC table. This performance decline should be accounted for in order to better mitigate the safety risks posed by hypoxia in the cockpit.

Learning Objectives:

1. To be able to demonstrate the limits of existing performance prediction tools and better understand the rate of cognitive decline due to hypoxia.

2:15 p.m.

[349] DETERMINING THE EFFECT OF TWO LEVELS OF EXERCISE ON COGNITIVE PERFORMANCE AND PHYSIOLOGIC RESPONSE DURING NORMOBARIC HYPOXIA EXPOSURES

B.S. Shender[1], C. Mattingly[2], M. Warren[2], S. Coleman[2], and G. Askew[2]
[1]Human Systems, NAVAIR, Patuxent River, MD; [2]NAWCAD, Patuxent River, MD

INTRODUCTION: In order to develop a warfighter physiologic state monitor, it is necessary to characterize how exercise affects physiologic and cognitive responses to hypoxia. **METHODS:** Five male (30±11yr;184±5cm;85±4kg) volunteers gave informed consent and trained on the SYNWIN multitask cognitive battery (Ver:1.2.39). Mean composite scores (CS) were determined every 20s and percent change (△CS) from sea level (SL) calculated. Two cycle ergometry exercise groups were formed: Anaerobic pre-load (ANA, N=2) (3 cycles of 2min at 75% VO2max/1min at no load) followed by a series of 10min plateau exposures from 3048 to 7620m at rest (2 repetitions on separate days) and Aerobic (AER, N=3) interval exercise (1.5min work/1min rest) performed throughout 10min plateaus from 3048 to 5486m (1 trial at 25% VO2Max (AER25), 1 at 33% (AER33)). Control trials without exercise were also conducted. SYNWIN was performed continuously, including 10min recovery at SL, except during ANA exercise. A Reduced Oxygen Breathing Device (Environics) generated the normobaric profiles. Pulse oximetry (finger: $SpO2_f$ Respironics; forehead: $SpO2_h$, Masimo RAD87) was recorded. Regional cerebral tissue oxygenation was measured (Nonin Equinox) and percent change relative to SL determined (△rSO2). Exposures were terminated and 100% O2 provided (O2) if $SpO2_f$=60%. **RESULTS:** Responses were evaluated separately at each plateau. At AER 5486m, two subjects completed 10min during control, one at AER25 and none at AER33. Decreases in $SpO2_h$, $SpO2_f$ and △rSO2 were greatest during AER33. Mean drop in AER33 △CS was double compared to AER25. Preliminary indications are that the relative drop in △CS closely mirrors △rSO2. During ANA no subjects completed 10min at 7620m and the fall in $SpO2_h$ and $SpO2_f$ were greater than control, whereas △rSO2 was essentially equivalent. Decreases in ANA △CS were larger than control at 7620m and did not return to baseline after the 10 min recovery

period. **DISCUSSION:** These preliminary results can be used to help calibrate a relation between easily measured physiologic responses with cognitive performance impairment.

Learning Objectives:

1. To understand the impact of two levels of exercise on hypoxia-induced cognitive impairment and physiologic response.

2:30 p.m.
[350] THE EFFECT OF LIGHT EXERCISE ON PSYCHOMOTOR PERFORMANCE MEASURED USING COGSCREEN HE

J.K. Britton[1,3], P.D. Hodkinson[1,2], N.D. Green[1], and D.A. Green[3]
[1]Royal Air Force Centre of Aviation Medicine, Henlow, United Kingdom; [2]Division of Anaesthesia, University of Cambridge, Cambridge, United Kingdom; [3]Centre of Human & Aerospace Physiological Sciences (CHAPS), King's College London, London, United Kingdom

INTRODUCTION: Aircrew are not at rest whilst flying. Light to moderate activity (exercise) exaggerates hypoxemia as low as 1800-2400 m (6-8000 ft) pressure altitude (PA) but the effect upon psychomotor performance is unclear. To avoid significant performance decrements induced by hypoxia, aircrew typically use supplemental oxygen above cabin pressure altitudes of 2400-3000 m (8-10,000 ft). However, these altitude limits when breathing air do not incorporate adjustment for activity. The aim of this study was to assess, via the use of Cogscreen Hypoxia Edition (HE), whether psychomotor performance is affected by light exercise when breathing air at 5300 m (17,500 ft) PA. **METHODS:** 11 unacclimatized volunteers (6 male, age range 20-25, 22.2±1.33 yr) performed the CogScreen HE whilst at rest and with 30 W exercise (to represent pilot workload) on a recumbent cycle ergometer at both ground and 5300 m PA in a hypobaric chamber. Response time, mean error rate and a derivative of these, throughput (correct responses/min), were measured and compared across the four conditions with a 2x2 way ANOVA with post-hoc t-tests conducted between rest and exercise at a given altitude. **RESULTS:** Throughput decreased with both altitude [$F(1, 20)=4.763$; $p=0.041$] and exercise [$F(1, 20)=23.692$; $p= <0.001$]. The addition of 30 W exercise had no effect on throughput at ground level whilst there was a significant interaction effect between exercise and altitude [$F(1, 20)=4.931$, $p=0.038$]. Throughput fell by 14.2% ($p=0.001$) with exercise compared to rest at 5300 m (17,500 ft) PA. **DISCUSSION:** Cogscreen HE detected a significant decrement in psychomotor performance due to light exercise when breathing air at 5300 m (17,500 ft) PA. This suggests that even low levels of activity can negatively affect psychomotor performance during hypoxia. Re-evaluation is recommended at lower altitudes with flight relevant workloads to inform considerations of altitude and physical exertion limits for aircrew whilst breathing air at 2400-3000 m (8-10,000 ft) PA.

Learning Objectives:

1. To increase understanding about the impact of exercise at altitude on psychomotor performance.

2:45 p.m.
[351] ISOLATION OF URINARY MARKERS OF COGNITIVE PERFORMANCE UNDER CONDITIONS OF SLEEP DEPRIVATION-INDUCED FATIGUE USING METABOLOMICS

N. DelRaso[2], D. Harville[1], M. Chamberlain[5], P. Anderson[3], I. Sibomana[4], M. Raymer[4], and N. Reo[4]
[1]711 HPW/RHCP, U.S. Air Force, Wright-Patterson AFB, OH; [2]711 HPW/RHDJ, U.S. Air Force, Wright-Patterson AFB, OH; [3]College of Charleston, Charleston, SC; [4]Wright State University, Dayton, OH; [5]88th DTS/SGQD, U.S. Air Force, Wright-Patterson AFB, OH

INTRODUCTION: Continuous and sustained actions in military and civilian operational environments typically lead to reduced sleep and fatigue. Because fatigue is an occupational hazard leading to cognitive deficits in performance and decision making, there is a need for real-time detection technologies that minimize fatigue-induced performance and mission degradation. This study used nuclear magnetic resonance (NMR)-based metabolomics to identify urinary biomarkers predictive of mission performance ability under conditions of sleep deprivation-induced fatigue that could be used for mission selection. **METHODS:** Subjects (23) were subjected to 36 h sleep deprivation, and cognitive psychomotor vigilance and automated neuropsychological assessment metric tests conducted over the last 24 h of sleep deprivation. Urine was collected prior to and over the course of the cognitive testing period for metabolite analysis using NMR spectroscopy. Proton NMR spectra were acquired using a 600 MHz Varian INOVA NMR instrument and data analyzed using in-house developed software. **RESULTS:** Bioinformatics analysis of NMR data showed that temporal changes in subsets of urinary metabolite profiles mirrored cognitive performance. Subjects identified as fatigue-resistant (n=6) and fatigue-sensitive (n=6) could be classified with statistical confidence ($p<0.01$) using these urinary metabolite profiles. Twenty urinary metabolites were identified that could be used to classify fatigue susceptibility early and late during the 36-h sleep deprivation period. A majority of these metabolites suggested pre-study dietary composition may be linked to later cognitive performance ability. **DISCUSSION:** Currently, few objective biomarkers of fatigue exist and are difficult to interpret such as electrophysiological or behavioral tests. These test applications are difficult to use in the field and their data provides little useful application in occupational or military operational environments. The present study generated evidence that there may be a diet-related component associated with fatigue susceptibility, and found NMR metabolomics as a useful tool for identifying potential urinary biomarkers predictive of cognitive performance ability when sleep deprived.

Learning Objectives:

1. Understanding NMR metabolomics and identification of urinary biomarkers specific for sleep-deprivation induced fatigue are described for assessing cognitive performance ability on demanding missions.

3:00 p.m.
[352] EFFECTS OF GALVANIC VESTIBULAR STIMULATION ON THE PERCEPTION OF HORIZONTAL

Y. Yang[1], F. Pu[1], X. Lv[2], J. Li[2], D. Li[1], M. Li[2], and Y. Fan[1]
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INTRODUCTION: Vestibular illusions are the most common illusions that can cause spatial disorientation in flight. Galvanic vestibular stimulation (GVS) is a safe and convenient way to induce vestibular illusions. This study aimed to investigate whether and how the perception of horizontal is affected by the vestibular illusions induced by GVS. **METHODS:** Sixteen pilots with about 600-hour flying experience participated in this experiment. Before the test, pilots were seated in a comfortable chair and their heads and trunks were firmly fixed to keep vertical. Seven kinds of lines (one horizontal line and six oblique lines rotated clockwise or counterclockwise at 0.5°, 1.0° or 1.5° from the horizontal) were controlled through E-prime software to randomly display on a 52-inch LCD screen. Subjects were required to judge the line horizontal or not as soon as possible. During each test block, seven lines were appeared five times. Two blocks without GVS and four blocks with GVS were randomly tested. Suprathreshold level (1.0 mA) GVS was applied to the subjects via two electrodes placed over the mastoid processes, and the polarity of GVS was switched every two trials. **RESULTS:** The total error rate for the perception of seven lines was 21.2% in controls, and the rate was significantly increased by 29.5% ($p<0.001$) when GVS was applied. The rate for mistakenly perception of the horizontal line as oblique line was low and similar between normal and GVS conditions. Pilots usually mistook 0.5° rotated line for horizontal and the error rate is highest (Normal: 59.1±22.2%, GVS: 64.7±14.3%). But the difference was not significant ($p=0.154$). In addition, the perception error rate was significantly increased for 1.0° ($p<0.001$) and 1.5° rotated line ($p=0.096$) when GVS was applied. **DISCUSSION:** Vestibular illusion induced by GVS would cause pilots more easily perceive the horizontal by mistake, especially perceive the larger rotated angle line as horizontal.

Learning Objectives:

1. Evaluate the perception of horizontal during the vestibular illusions.

3:15 p.m.
[353] COMPARISON OF ELECTROENCEPHALOGRAM (EEG) POWER SPECTRA BETWEEN NON-VECTION AND VECTION: A PRELIMINARY STUDY

S. Sun, H. Yu, F. Pu, Y. Li, S. Bao, Y. Yang, and Y. Fan
School of Biological Science and Medical Engineering, Beihang University, Beijing, China

INTRODUCTION: Vection is a typical type of spatial disorientation (SD) related to cognition. However, there are few studies have investigated the mechanism of vection by means of EEG spectral analysis. This study is aimed at finding out the difference between non-vection and vection in EEG power spectra. **METHODS:** 9 subjects were required to stand in front of the screen and watch the grating stimulus. Grating stimulus was presented on the screen for 30s to induce vection, which repeated 10 times. EEG signals were measured throughout the testing. Subjects were instructed to press a designated button when self-motion was perceived. The key press (trigger) time was recorded, and according to which the EEG signals were divided into non-vection part and vection part. Data length of 5 seconds before and after trigger was selected. The mean values of the log of the power spectra in different bands between non-vection and vection were analyzed by Paired t test. **RESULTS:** δ band showed a significant difference ($P<0.05$) between non-vection and vection on almost all leads (except CZ, M1, and M2). Obvious changes in θ band were in the forehead and sides of the brain (including F7, F3, C4, T8, M1, M2, P7, and P8), and the leads (FZ, CZ, PZ, and PQZ) which were located in central sulcus showed no significant change. Low α band significantly changed merely on FPZ and P8. However, there is no significant change in high α, β and γ band ($P>0.05$). **DISCUSSION:** Statistically significant differences are found in the power spectra of EEG between non-vection and vection for some leads, especially with the slow waves.

Learning Objectives:

1. Contrast the electroencephalogram between before and during vection perception.

Wednesday, May 13 ***2:00 P.M.***
S. Hemisphere 2

[LXIV.] AEROSPACE MEDICINE GRAND ROUNDS: RESIDENT CASE PRESENTATIONS

Co-Chair: Patrick Storms
Wright-Patterson AFB, OH

Co-Chair: Richard Allnutt
Wright-Patterson AFB, OH

PANEL OVERVIEW: INTRODUCTION: This panel will consist of pairs of aerospace medicine residents presenting clinical cases of aeromedical interest or significance. **METHODS:** During their residency practicum years, residents provide evaluations of patients with diverse medical problems. Residents prepare and present a case report based on a patient encounter undertaken during their practicum experience. **RESULTS:** One resident from each pair presents the history of the presented problem. The other resident presents the physical findings and a discussion of the aeromedical policies associated with the condition. **DISCUSSION:** Learning aerospace medicine at the specialist level involves understanding the impact of medical conditions on aircrew health and mission accomplishment. The cases presented will not only be of academic interest but will also illustrate aeromedical decision-making in the operational environment.

Learning Objectives:

1. Improve understanding of clinical aerospace medicine.

Wednesday, May 13 ***2:00 P.M.***
S. Hemisphere 3

[LXV.] PANEL: THE VISUAL IMPAIRMENT/ INTRACRANIAL PRESSURE (VIIP) SYNDROME—PROGRESS TO DATE (PART I)

Co-Chair: Christian Otto
Houston, TX

Co-Chair: William Tarver
Houston, TX

PANEL OVERVIEW: In the two years that have elapsed since the last Visual Impairment/Intracranial Pressure (VIIP) panel at AsMA, advances have been made in defining and managing this recently identified risk to human health in space. This panel session will share new insights gained from research studies conducted on the International Space Station, in the analogue environment of head-down tilt bedrest, and via modeling of ocular and cerebrovascular changes associated with exposure to spaceflight or analogue conditions.

[354] CLINICAL UPDATE ON VISION IMPAIRMENT INCRACRANIAL PRESSURE (VIIP)

W. Tarver[1] and M. Van Baalen[2]
[1]Division of Space Medicine, University of Texas, Houston, TX; [2]Space Medicine, NASA, Houston, TX

INTRODUCTION: NASA's space medicine team first identified the condition now called "VIIP" around 2008. Occupational monitoring was formally in place by 2010. Improvements to the monitoring have been ongoing based upon current available technology, medical knowledge, and epidemiologic evaluation of the data being gathered. In this presentation you will see the epidemiologic findings acquired since the institution of the occupational monitoring for VIIP. **METHODS:** Epidemiologic data is collected before, during and after space missions. The data is continually reviewed and updated looking for significant trends.

Learning Objectives:

1. Identify the "VIIP" parameters being monitored in JSC's astronaut occupational health monitoring program.
2. Relate the current concepts of space induced physiologic changes and how they may result in "VIIP".
3. Know the most common VIIP related findings attributed to space flight.

[355] ASTRONAUT PREFLIGHT CARDIOVASCULAR HEALTH IS HIGHLY CORRELATED WITH POSTFLIGHT EYE OUTCOME MEASURES IN THE VISUAL IMPAIRMENT INTRACRANIAL PRESSURE (VIIP) RISK

C. Otto[1], R. Ploutz-Snyder[1], S. Mason[4], W. Taiym[2], J. Garcia[4], and M. Van Baalen[3]
[1]Division of Space Life Sciences, Universities Space Research Association, Houston, TX; [2]Wyle Integrated Science and Engineering, Houston, TX; [3]Lifetime Surveillance of Astronaut Health, NASA Johnson Space Center, Houston, TX; [4]M.E.I. Technologies, Houston, TX

INTRODUCTION: Seventy percent of tested ISS astronauts demonstrate changes in ocular structure and function; 32% with disc edema, and five with elevated CSF pressure. Increased vascular compliance may predispose astronauts to VIIP. The purpose of this study was to determine if astronauts with higher preflight cardiovascular risk profiles demonstrated worse postflight eye outcomes. **METHODS:** A preflight "cardiovascular profile" for 31 ISS astronauts

was compiled using twelve parameters: systolic blood pressure, pulse pressure, body mass index, percentage fat, LDL, HDL, triglycerides, anti-lipid medication use, fasting glucose, maximal oxygen uptake, age, and salt intake. This profile was compared with seven postflight eye outcome variables: globe axial length; optic nerve sheath diameter, optic nerve diameter, optic nerve to sheath ratio, intraocular pressure, change in manifest refraction, and circumpapillary retinal nerve fiber layer. Twenty-two percent of the eye outcome data were missing; consequently, a multivariate multiple imputation technique with predictive mean matching methods was employed. Rubin's rules for collapsing the statistical results across the multiply imputed data sets were applied to assess the canonical correlation. **RESULTS:** A highly significant canonical correlation of .97 ($p<.00001$) indicated a strong association between preflight cardiovascular health and postflight eye outcomes. The "joint test" revealed a significant difference in cardiovascular profile between male and female astronauts (Prob > F = 0.00001); female astronauts demonstrating a healthier cardiovascular profile. **DISCUSSION:** The presence of multiple cardiovascular risk factors is a known independent predictor of decreased vascular compliance. Preflight cardiovascular profile was strongly associated with VIIP eye outcome. Female astronauts had a significantly healthier cardiovascular profile than the males. Notably, no female astronaut has developed optic disc edema. We speculate that astronauts with poorer cardiovascular health have decreased vascular compliance resulting in: a higher 24 hour mean central venous pressure, cerebral venous congestion, decreased CSF resorption, and elevated ICP in space.

Learning Objectives:

1. Recognize that higher cardiovascular risk in ISS astronauts, preflight, is strongly associated with worse eye outcomes postflight.
2. Understand that decreased vascular compliance and its effects on 24 hour mean central venous pressure; and consequently intracranial pressure, are speculated to be causative in the worsened eye outcomes.

[356] LONG-TERM, AMBULATORY MONITORING OF INTRACRANIAL PRESSURE IN ASTRONAUTS USING IMPLANTABLE PROBES - UNDERSTANDING THE IMPACT OF INTRACRANIAL PRESSURE IN THE VISUAL IMPAIRMENT/ INTRACRANIAL PRESSURE SYNDROME

Y.R. Barr[1], C. Otto[2], and R. Brady[3]
[1]University of Texas Medical Branch / NASA Bioastronautics Contract, Houston, TX; [2]Universities Space Research Association, Houston, TX; [3]Wyle Science, Technology & Engineering Group, Houston, TX

INTRODUCTION: Determining in-flight intracranial pressure (ICP) dynamics is essential for understanding the etiology of the visual impairment/intracranial pressure (VIIP) syndrome. Leading noninvasive ICP measurement technologies provide only qualitative measurements and quantitative devices have a low technology readiness level at present. Therefore, in the near future accurate in-flight measurement of ICP may require invasive measurement. Conducting a lumbar puncture (LP) during flight is feasible with sufficient preparation; however, LPs measure ICP at a discrete time point and would provide limited information on ICP dynamics. Telemetric implantable parenchymal ICP probes are a clinically proven method of obtaining highly accurate ambulatory ICP measurements in real time. **METHODS:** An evaluation was conducted, including review of published data and consultation with the neurosurgical groups with the most experience with this technology. Discussions were held with the VIIP advisory neurosurgeons, the NASA operational and clinical communities, representatives of the astronaut office, and NASA management. Modeling based on NASCAR data was performed to evaluate risk of probe movement during impact loads of a Soyuz landing. **RESULTS:** Hundreds of patients have been implanted with the telemetric ICP probes in Europe, providing long-term outpatient ambulatory monitoring. The main risks reported include subclinical peri-probe edema (46.9%), localized peri-probe bleeding (0-15.6%), perioperative seizure (0-3.2%), and cellulitis (1.1%). These risks appear to be far greater in patients with neurological disease vs. those without. Therefore astronauts would be expected to have a low risk of complications (<1%). Modeling shows that probe movement during a Soyuz landing would be 0.2 mm or less, considered clinically insignificant. **DISCUSSION:** The ICP probes can be implanted before flight in a limited number of astronauts as part of consented research and removed postflight. Intermittent ambulatory monitoring during spaceflight would provide more robust data than sporadic LP measurements, including response to different in-flight stressors and interventions. This would determine conclusively whether ICP increases during spaceflight and its influence on the VIIP syndrome.

Learning Objectives:

1. Understand the need for in-flight ICP measurements as part of the effort to understand and mitigate VIIP.
2. Describe the risks and benefits of using telemetric implantable ICP probes for in-flight ICP monitoring.

[357] VISUAL IMPAIRMENT/INTRACRANIAL PRESSURE (VIIP) RISK CLINICAL CARE DATA TOOLS

M. Van Baalen[2], S. Mason[1], W. Taiym[3], M. Wear[3], S. Moynihan[2], D. Alexander[2], S. Hart[2], and W. Tarver[2]
[1]LSAH, MEI Technology, Houston, TX; [2]NASA, Houston, TX; [3]LSAH, Wyle Science, Technology and Engineering, Houston, TX

INTRODUCTION: Prior to 2010, several ISS crewmembers returned from spaceflight with changes to their vision, ranging from a mild hyperopic shift to frank disc edema. As a result, NASA expanded clinical vision testing to include more comprehensive medical imaging, including Optical Coherence Tomography and 3 Tesla Brain and Orbit MRIs. The Space and Clinical Operations Division (SCO) developed a clinical practice guideline that classified individuals based on their symptoms and diagnoses to facilitate clinical care. For the purposes of clinical surveillance, this classification was applied retrospectively to all crewmembers who had sufficient testing for classification. This classification is also a tool that has been leveraged for researchers to identify potential risk factors. **METHODS:** In March 2014, driven in part by a more comprehensive understanding of the imaging data and increased imaging capability on orbit, SCO revised their clinical care guidance to outline in-flight care and increase post-flight follow-up. The new clinical guidance does not include a classification scheme. To support clinical care post-flight for each ISS crewmember, Lifetime Surveillance of Astronaut Health (LSAH) coordinates a meeting with JSC Clinic and NASA Flight Surgeons approximately 30 days prior to landing to review the crewmember's individual vision data and imagery. **RESULTS:** A chart review is conducted to determine the crewmember's post-mission VIIP status based on changes observed from preflight to inflight test results and to ensure a smooth transition from flight to ground for clinical care. The data tools that have been developed to facilitate these chart reviews will be described. Previous Clinical Practice Guidelines and the transition to the new clinical care guidance will be presented. **DISCUSSION:** This transition in the clinical care paradigm highlights the need for LSAH and the research community to develop an independent stratification of the outcomes related to the Visual Impairment and Intracranial Pressure risk.

Learning Objectives:

1. The changes to the clinical care and surveillance tools employed by The Space and Clinical Operations (SCO) Division for VIIP are described.

[358] EYE AND ORBIT ULTRASOUND: EVOLUTION OF A FOCUSED EMERGENCY TECHNIQUE INTO A ROUTINE MONITORING TOOL FOR LONG DURATION SPACE FLIGHT

A.E. Sargsyan[3], W. Tarver[2], K. Garcia[3], M. Wear[3], M. Van Baalen[2], S. Mason[1], M. Foy[3], R.D. Ernst[4], and D.G. Bedi[4]
[1]Epidemiology/LSAH, MEIT/NASA, Houston, TX; [2]NASA Lyndon B. Johnson Space Center, Houston, TX; [3]Wyle Science, Technology and Engineering, Houston, TX; [4]University of Texas MD Anderson Cancer Center, Houston, TX

INTRODUCTION: Emergency medicine physicians use ultrasonography (US) to quickly compare the optic nerve sheath diameter (ONSD)

value with the "cut-off" reference level sensitive to increased intracranial pressure (ICP). We attempted optimizing and re-scoping the technique for long-term monitoring purposes. NASA Space and Clinical Operations Division has been using US capabilities on the ground and aboard the International Space Station since 2009 for routine structural and hemodynamic evaluation of the eye and orbit throughout all phases of long-duration missions. ONSD measurements are reliable based on excellent inter-rater concordance. Good-to-excellent concordance is also shown between US and Magnetic Resonance Imaging (MRI) data that are obtained in mutually blinded fashion. US allows monitoring the crewmembers for trends in ONSD as well as in the structure of the arachnoid space surrounding the optic nerve. The increased accuracy and systematic approach to US imaging allow monitoring individual astronauts for trends likely associated with intracranial pressure and circulatory factors. ONSD values are also considered against the cohort distribution data, as opposed to the binary (ICP elevation Present/Absent) approach to ONSD values in emergency medicine. We will present and discuss the distribution of baseline ONSD and other measures in the astronaut cohort, longitudinal trends in-flight, and the predictive power of the US measures for vision or ICP-related outcomes. Our eye and orbit US equipment, protocol and data analysis techniques appear to satisfy the desired purpose of routine clinical monitoring in long-duration space flight. Trends in the US-derived measures suggest the influence of ICP and circulatory factors.

Learning Objectives:

1. To recognize key ultrasound imaging capabilities available to monitor structural and functional changes in the eye and orbit in long-duration space flight.
2. To recognize and understand the use of occupational cohort-specific distribution data for parameters such as the Optic Nerve Sheath Diameter (ONSD).
3. To be familiar with the US-derived structural and functional trends observed in astronaut eye/orbit anatomical area in long-duration (~6 months) space flight.

[359] EVIDENCE BASED MEDICINE IN SPACE FLIGHT: EVALUATION OF INFLIGHT VISION DATA FOR OPERATIONAL DECISION-MAKING

M. Van Baalen[2], S. Mason[1], M. Foy[3], M. Wear[3], W. Taiym[3], S. Moynihan[2], D. Alexander[2], S. Hart[2], and W. Tarver[2]
[1]LSAH, MEI Technologies, Houston, TX; [2]NASA, Houston, TX; [3]LSAH, Wyle Science, Technology and Engineering Group, Houston, TX

INTRODUCTION: Due to vision changes associated with space flight, JSC Space and Clinical Operations (SCO) implemented broad mission-related vision testing starting in 2009. Optical Coherence Tomography (OCT), 3 Tesla Brain and Orbit MRIs, and Optical Biometry were implemented terrestrially for clinical monitoring. While no inflight vision testing was in place, already available on-orbit technology was leveraged to facilitate in-flight clinical monitoring, including visual acuity, Amsler grid, tonometry, and ultrasonography. In 2013, on-orbit testing capabilities were expanded to include contrast sensitivity testing and OCT. As these additional testing capabilities have been added, resource prioritization, particularly crew time, is under evaluation. **METHODS:** We used descriptive statistics to assess the clinical value of tonometry and contrast testing, which occurs preflight and on flight days 30, 90, 30 days prior to landing, and post-flight. We compared intraocular pressure (IOP, mmHg) and threshold contrast (%) to clinical normal ranges. We also compared absolute and change in IOP and threshold contrast measures to clinical outcomes--refractive error change, anatomical changes, and disc edema. **RESULTS:** In ISS crewmembers, IOP and threshold contrast on orbit are within normal clinical ranges. Visualizations of trends in IOP and threshold contrast measures do not reveal any obvious relationships with vision outcomes, but formal statistical analyses will be conducted. **DISCUSSION:** SCO has discontinued routine in-flight tonometry and contrast testing as part of the medical requirement, effective with Expedition 40, although these capabilities will continue to be available as needed for clinical care. Future evaluation of routine on-orbit ultrasound, OCT, and fundoscopy testing is planned in order to maximize medical resources and crew time.

Learning Objectives:

1. To understand how evidence based medicine using "small" data can be used to make operational decisions.

Wednesday, May 13 ***2:00 P.M.***
S. Hemisphere 4

[LXVI.] PANEL: PERSPECTIVES IN IN-FLIGHT MEDICAL EVENTS IN COMMERCIAL AVIATION - PART 1 - PRE-FLIGHT ASPECTS

Sponsored by the AsMA Air Transport Committee

Chair: Steffen Lyduch
Kastrup, Denmark

PANEL OVERVIEW: In-flight medical events (IFMEs) pose frequent disruptions to commercial airlines operation. Medical diversions could cause significant costs and there is always the risk of litigation and bad publicity when the outcome of a case is not ideal. The prevention of in-flight medical events starts before the actual flight. This panel will discuss the status of medical guidelines for commercial air travel as well as best practices on how to assess passengers prior to the flight.

[360] AEROSPACE MEDICAL ASSOCIATION MEDICAL GUIDELINES

M.F. Hudson
Medical Adviser, Thomas Cook Airlines, Crewe, United Kingdom

INTRODUCTION: The Aerospace Medical Association is one of the major international organizations devoted to education and research in Aerospace Medicine as it affects commercial and general aviation, military aviation and space exploration. Among its publications which are available to the medical profession as well as to the general public is a comprehensive document called 'Medical Guidelines for Airline Travel. The second edition of this publication was published in the Journal of the Aerospace Medical Association in May 2003. The Air Transport Medicine Committee has been tasked to update the guidelines and has decided to make the document a more accessible 'living' web-based publication; which can be updated regularly. The document will be appropriately referenced. At the time of writing chapters on Stresses of Flight, Airline Special Services, In-flight Medical Care and reported In-flight Illness and Death have been updated and are ready for uploading. In the chapter on 'Fitness to fly and medical clearance' the following parts have been completed; Cardiovascular Disease, Pulmonary Disease, Pregnancy and Air Travel and Neurology. As expert bodies in cardiology, pneumonology, and gynecology had already published excellent up-to-date guidelines, it was decided that there was no advantage to re-write these. Contact was therefore made with the British Cardiovascular Society, The British Thoracic Society, The British Royal College of Obstetricians and Gynaecologists who have agreed to allow their guidelines to be incorporated as a reference point in the AsMA Guidelines. The neurology chapter has been re-written by a colleague aviation neurologist but so far no professional neurological societies have agreed to participate. The remaining chapters will be updated as time permits and then once completed the whole document will be constantly updated to ensure it is always contemporary.

Learning Objectives:

1. To remind AsMA members about the existence of the Medical Guidelines for Air Travel and that these are being published as a living web-based document which will be constantly updated.
2. To assist doctors to be able to give their patients the best possible and contemporaneous medical advice concerning airline travel.

[361] PRE-FLIGHT SCREENING BY THE MEDA CASE SYSTEM: PROCESSING PATHWAYS AND EPIDEMIOLOGY IN AN ELEVEN-YEAR SAMPLE IN AN AIRLINE

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

INTRODUCTION: The INCAD system for so-called MEDA Cases or Medifs ensures that specific in-flight equipment or services will be available on ramp and on board, in order to minimize possible adverse health effects and incidents at any stage of airline passenger carriage. MEDA cases are an advance pre-flight, semi-proactive medical screening process. We characterize the MEDA case clearance pathway and the cases processed by the medical department of a medium-sized European airline with an extensive route network. **METHODS:** The INCAD forms of all MEDA case requests made to TAP Portugal between 2003 and 2013 were analyzed and a subsample studied for diagnostic data, equipment requested, and case processing indicators. Indicators of impact of MEDA cases in the flow of flight operations were also analyzed. **RESULTS:** Within the eleven-year period, a total of 7,883 MEDA cases were processed. In 2013 a mean 84 cases were cleared per month. The rate of requests made reached 3.9 cases per 1,000 flight hours or 1.3 cases per 100 departures. Musculoskeletal conditions were the conditions that presented most frequently, followed by neuropsychiatric, cardiovascular and respiratory. Reasons for denial or cancellation are presented, as well as the equipment requested for cleared cases and outcomes until disembarkation. FREMEC and emotional support animal cases are also briefly discussed. The complete MEDA case processing pathway and efficiency indicators are presented. **DISCUSSION:** This sample of nearly eight thousand MEDA cases over eleven years provides an in-depth insight into their relevance for airline operations . The epidemiology of the conditions logged seems to support the view that advance pre-flight medical clearance through the MEDA case system can be a relevant tool to prevent the occurrence of potentially disruptive in-flight medical incidents and complications.

Learning Objectives:

1. To describe how the MEDA case processing system worksand its relevance for airline operations.
2. To describe the expected epidemiology of presenting cases MEDA cases.

[362] PERSPECTIVES IN IN-FLIGHT MEDICAL EVENTS. PART 1 - PRE-FLIGHT ASPECTS - OVER VIEW ON MEDICAL TOURISM

S. Sodhi
Civil Aero Medical Centre, India, Mumbai, India

INTRODUCTION: Medical Tourism is travel of people to another country for purpose of obtaining medical treatment or other health related measures. It started in ancient times with Greek travelling to health spas and sanitariums. Today it has evolved into multibillion dollar industry with ever increasing potential. Traditionally people from less developed country would travel to developed countries to obtain better medical treatment. but over last few decades the trend has reversed. The reasons are manifold from cheaper medical treatment, to quicker appointments and to obtain certain medical treatment which is not available in their own country. This paper will outline the drivers of this industry and its implications on air travel. It will discuss the potential medical problems associated with travel of 'sick passengers' and its impact on airlines. It will make recommendations on how the airlines need to cope with this ever increasing passenger diaspora.

Learning Objectives:

1. To make the medical community aware of medical problems that can be associated with medical tourism.
2. To make the Commercial Airlines aware of the problems and suggest measures to be adopted to cope with such passengers in future.

[363] AIRPORT PASSENGER FIT TO FLY ASSESSMENT: CAUSES, DISPOSITIONS AND OUTCOMES

D. Oscislawski[3], M. Braida[1], P.M. Alves[2], and N. Nerwich[4]
[1]International SOS, London, United Kingdom; [2]MedAire Inc., Tempe, AZ; [3]Global Response Center, MedAire, Tempe, AZ; [4]Interenational SOS, Sydney, NSW, Australia

INTRODUCTION: The advent of on-line booking and check-in procedures along with an increased access to air transportation has introduced new demands for airline operators. Instead of contacting the airline for medical advice, many passengers with medical conditions would present directly at the airport where a decision should be made in regards to the safety of their flight. Passenger fit to fly assessments are an initial layer to prevent in-flight medical events from happening. Quick, accurate and consistent remote evaluations should be done in order not to cause flight delays and to avoid unnecessary boarding denials. Over the last few years we have been witnessing a significant growth in the number of calls directed to a company specialized in remote medical advice. The absolute growth could be at least partially explained by the overall increase in passenger traffic, but it persists after the figures are normalized, implying additional factors are playing a role. Pre-flight airport screening assumes particular importance in times of threats to international public health. This presentation would describe the experience of a company performing passenger fit-to-fly assessments for many international airlines from different regions of the world.

Learning Objectives:

1. Participants should be able to describe most common causes for pre-flight passenger assessments at the airport level and the associated outcomes.

Wednesday, May 13 ***2:00 P.M.***
S. Hemisphere 5

[LXVII.] SLIDE: CLINICAL AEROSPACE MEDICINE

Co-chair: John Darwood
Kennedy Space Center, FL

Co-chair: Denise Baisden
Ft. Worth, TX

2:00 p.m.

[364] IS ASTHMA OVERDIAGNOSED IN MILITARY PERSONNEL

T.A. Kanu and J. Zhang
Aerospace Medicine, Tinker Air Force Base, Oklahoma City, OK

INTRODUCTION: The pathophysiology of asthma is characterized as chronic inflammation and hyper-responsiveness of the airways with transitory, yet reversible, airway obstruction. It is recommended that objective measures such as spirometry and bronchoprovocation be used to diagnose asthma, but many clinicians are dependent only on the clinical history & physical or patient self-reporting, which is subject to recall bias, to reach the diagnosis. One of the major dilemmas in using such a subjective criteria is that asthma gets overdiagnosed and unnecessarily treated with unwanted side effects. This not only affects the Air Force's readiness ability via mobility restrictions, but this approach is also costly, with millions of dollars consumed in referral fees and VA disability claims. One must also take into account the decreased revenue secondary to lost duty hours. The purpose of this case report is to analyze the diagnosed asthma cases during the 2014 calendar year at Tinker AFB, OK, with emphasis on identifying objective data used to make the diagnoses. **METHODS:** 21 AD patient charts (with diagnosis of asthma) were reviewed. **RESULTS:** Out of these 21 cases, 11 had documented PFTs and/or bronchoprovocation test. Of those with documented testing, 4 actually showed normal PFTs and/or negative methacholine challenge test. The other10 patients actually had no record of objective data to confirm a dx of asthma. Only 33% of diagnosed asthmatics had testing consistent with this diagnosis. 67% of all diagnosed asthma cases from this cohort have no supporting objective data to support the diagnosis. 20% of patients carry the diagnosis of asthma, but have normal PFTs. **DISCUSSION:** Although it is possible to have asthma in the presence of normal PFTs and bronchoprovocation, the guidelines of the National Asthma Education and Prevention Program (NAEPP) state that the clinical diagnosis of asthma should be validated with objective data. A more standardized diagnosis criteria, with required objective data, and proper interpretation, will lead to higher sensitivity and specificity in asthma diagnosis and treatment. This in turn will effect healthcare cost and help eliminate unnecessary work-ups and treatment side effects.

Learning Objectives:

1. Understand the relationship between asthma prevalence and diagnosis and how this translate into mobility restrictions.

2:15 p.m.
[365] CONTROVERSIES OF AEROMEDICAL CERTIFICATIONS OF OSA AMONG OBESE PILOTS

N. Mahmoud
Roosevelt Warm Springs Regent Hospital, Dayton, OH

INTRODUCTION: Untreated Obstructive Sleep Apnea (OSA) is a disqualifying medical condition for airmen and air traffic controllers (ATC) in the United States, and obesity is highly correlated with OSA. The U.S. National Sleep Foundation estimates that 40 million Americans have a chronic sleep disorder and 30 million have intermittent sleep related problems. Untreated OSA patients show impairments both in memory functions and in attention and executive functions. Even after successful treatment with Continuous Positive Airway Pressure (CPAP), impairments in memory and executive functions may persist. Cognitive function is crucial in aviation to maintain attention and effective performance in the cockpit and in the control tower. Eliminating OSA from individuals with sensitive aviation related work significantly improves their daytime function with regard to daytime vigilance and cognitive function. Due to controversies, the FAA has not yet implemented routine aeromedical screening programs for OSA. **METHODS:** We conducted a worldwide literature review of aeromedical certifications and guidelines of OSA and obesity and also reviewed many screening programs that were implemented in the transportation sectors in a variety of countries. Comparative descriptions of advanced oral appliances/devices, surgical treatments, and CPAP is presented. **RESULTS:** As in the general population, the rate of obesity - and therefore of OSA - is rising among aviators and ATC workers. OSA treatment and its aeromedical applications are important considerations in aviation safety. **DISCUSSION:** Many issues regarding OSA and aviation safety need to be addressed. This includes decisions as to how to appropriately screen pilots and ATC workers for OSA, and also how and whether to measure sleep quality, anthropometrics, and neurocognitive functioning in relation to higher body mass index. Such empirical and evidence-based medicine should be the basis by which to develop aeromedical standards for determining fitness to fly.

Learning Objectives:

1. Discussion regarding obstructive sleep apnea and its correlation to fatigue in aviation.
2. To serve as a guide for AMEs when they encounter airmen with markedly elevated BMI.

2:30 p.m.
[366] THE RISK OF PROSTATE CANCER IN PILOTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

D. Raslau[1], D. Summerfield[2], A. Abu Dabrh[2], L. Steinkraus[2], and M. Murad[2]
[1]Internal Medicine, Mayo Clinic, Rochester, MN; [2]Mayo Clinic, Rochester, MN

INTRODUCTION: Aviation exposes pilots to various occupational-related hazards, including ionizing radiation and chemical combustion. The possible increased risk of prostate cancer among pilots in comparison to the general population is a subject of debate. This systematic review and meta-analysis aims to determine the quality of supporting evidence and magnitude of this association. **METHODS:** All studies pertaining to prostate cancer in pilots were retrieved from multiple databases and from a manual search. Any study that assessed the incidence of prostate cancer relative to the incidence in the general population was included regardless of language or size. A random effect model was used to pool relative risks (RR) across studies. Heterogeneity was assessed using the Q statistic and I^2. **RESULTS:** Eight studies with low risk of bias were included in the meta-analysis. Pilots had an increased risk of developing prostate cancer compared to the general population (RR 2.0; 95% confidence interval [CI], 1.5-2.7). The analysis was associated with substantial heterogeneity (I^2 = 79%). Several subgroups had significantly increased risk, such as African American pilots (RR 10.00; 95% CI, 5.04-19.86) and military pilots (RR 3.30; 95% CI, 2.03-5.39). **DISCUSSION:** Pilots are at least twice as likely to develop prostate cancer compared to the general population. The implications of these findings are important considering the high prevalence of prostate cancer and the large number of pilots in the workforce.

Learning Objectives:

1. Pilots are at in increased risk of developing prostate cancer compared to the general population.
2. Screening guidelines apply to normal risk populations, therefore current PSA guidelines may not be applicable to our pilot population.

2:45 p.m.
[367] ASSESSMENT OF THE VALUE OF STATIN THERAPY IN HEALTH AVIATORS WITH ISOLATED HYPERCHOLESTEROLEMIA

A.P. Tvaryanas[2], G. Maupin[1], and H. Lysfjord[1]
[1]U.S. Air Force School of Aerospace Medicine/FHC, 711th Human Performance Wing, Wright-Patterson AFB, OH; [2]HP, 711th Human Performance Wing, Wright-Patterson AFB, OH

INTRODUCTION: Data demonstrate elevated cholesterol levels are associated with increased risk for coronary heart disease (CHD); thus reducing LDL-C lowers the risk of cardiac events. The study purposes were to determine in U.S. Air Force aviators (aviators): 1) whether statins were overprescribed, 2) whether statin therapy was effective in reducing LDL-C and calculated 10-year CHD risk, 3) which statin was most clinically effective, 4) which statin was most cost effective, and 5) whether statins have adverse effects on physical performance. **METHODS:** This was an 8-yr retrospective cohort study (statin group, no statin group) of 3176 aviators with isolated hypercholesterolemia. Statistical analysis using chi-square and Fisher's exact tests determined whether statins were overprescribed, *Z* distribution and *t* distribution determined statin therapy effectiveness, one-way analysis of variance determined the most clinically effective statin, cost-effectiveness ratio determined statin therapy value, and multiple linear and logistic regression analyses assessed statin effects on physical performance. **RESULTS:** Aviators with a 10-yr CHD risk of <10% were three times more likely to be on statins than expected based upon National Cholesterol Education Program ATP III guidelines ($x_1^2 = 99.592$, $p < 0.001$), supporting the hypothesis that aviators were overprescribed statins. Statin therapy was effective in reducing LDL-C and calculated 10-yr CHD risk (<10% CHD risk mean = 26.58 mg/dl, 95% confidence interval = 23.53, 29.64; 10-20% risk mean = 61.00 mg/dl, 95% confidence interval = 26.22, 95.78) in aviators with isolated hypercholesterolemia. All statins were equivalent in efficacy in lowering LDL-C; however, simvastatin was most cost effective. Statin use did not adversely affect aviator physical performance. **DISCUSSION:** Statins effectively reduce LDL-C and calculated 10-yr CHD risk in aviators, yet are overprescribed for individuals with <10% risk. Differences in composite score physical fitness tests were not detected; future work could investigate statin effects on individual fitness test components.

Learning Objectives:

1. Understand that statins are effective in reducing LDL-C and calculated 10-yr CHD risk.
2. Describe that statins are overprescribed in aviators that have less than 10% 10-yr CHD risk with isolated hypercholesterolemia.

3:00 p.m.
[368] HEREDITARY SPHEROCYTOSIS IN A U.S. AIR FORCE PILOT CANDIDATE

L.M. Bridge
Aeromedical Consult Service, U.S. Air Force School of Aerospace Medicine, Beavercreek, OH

INTRODUCTION: Hereditary spherocytosis is the most common inherited cause of chronic hemolytic anemia, particularly in Caucasians of European ancestry. The resultant chronic hemolysis and anemia, as well as the possible acute and long-term complications of this process,

raise significant aeromedical concerns. **METHODS:** A 24-yr-old male cadet in the U.S. Air Force Reserve Officer Training Corps presented with significant anemia in the setting of a mild viral illness during an initial flight physical. **RESULTS:** Serial complete blood counts demonstrated the gradual improvement of the cadet's anemia following resolution of his mild viral illness. However, persistent reticulocytosis led to subsequent evaluation, including additional history-taking and laboratory analysis. Ultimately, a diagnosis of hereditary spherocytosis was confirmed by family history, osmotic fragility testing, and observation of spherocytes on peripheral blood smear. **DISCUSSION:** The clinical presentation of hereditary spherocytosis and disease course are highly variable, with some affected persons demonstrating no to mild anemia while others develop severe symptoms. Common complications include splenomegaly and the formation of gallstones from the bilirubin released during hemolysis. Exacerbations of anemia can occur with physiologic stress, particularly viral illness, due to a combination of temporary bone marrow suppression and increased hemolysis. Aeromedical considerations include the effects of persistent hemolysis and anemia, as well as the worsening of hemolysis and anemia under the physiologic stress of flight. Additionally, the exact behavior of spherocytes in the aviation environment, particularly under increased G-loads, is unknown.

Learning Objectives:

1. Describe the basic pathophysiology of hereditary spherocytosis and the clinical consequences of this relatively common disease.
2. Conceptualize the aeromedical risks associated with hereditary spherocytosis.
3. Apply principles of aeromedical risk assessment to aircrew selection.

3:15 p.m.

[369] GASTROINTESTINAL DISEASE IN U.S. AIR FORCE PILOTS, 2001-2013

P.R. Storms
FEEG, U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: The frequency and distribution of gastrointestinal disease in the population of active duty U.S. Air Force (USAF) pilots are poorly understood, although gastrointestinal illness can both temporarily and permanently lead to disqualification from flying duties. Better understanding of gastrointestinal disease in this population could aid in assessing the effectiveness of current medical standards related to flight training and flight duty. **METHODS:** A dataset reflecting inpatient or outpatient healthcare visits from 2001 through 2013 was developed and reviewed. The frequency and distribution of gastrointestinal illness related to 16 defined categories of disease and the overall burden of gastrointestinal disease over the target dates of 2001-2013 were developed and reviewed. **RESULTS:** The frequency and distribution of gastrointestinal disease across the 16 defined categories were quite similar between pilots and non-aircrew active duty members, although pilots had a greater number of episodes of care related to dyspeptic conditions and colonic diverticulosis. The likelihood of having an episode of care for a gastrointestinal condition was not significantly different between the two groups. **DISCUSSION:** The frequency and distribution of gastrointestinal disease in USAF pilots and non-aircrew active duty members were quite similar, suggesting that application of current medical standards does not substantially impact the burden of gastrointestinal disease in the population of USAF pilots.

Learning Objectives:

1. Understand the frequency and distribution of gastrointestinal disease in USAF pilots over the study period.
2. Understand the potential reasons accounting for a similarity in the burden of gastrointestinal disease in USAF pilots and non-aircrew active duty members.
3. Understand the implications of the similarities in frequency and distribution of gastrointestinal disease in the consideration of medical standards and their application.

Wednesday, May 13 ***2:00 P.M.***
S. Hemisphere E3

[LXVIII.] PANEL: OPERATIONAL BASED VISION ASSESSMENT

Co-Chair: Steven Hadley
Wright-Patterson AFB, OH

Co-Chair: Marc Winterbottom
Wright-Patterson AFB, OH

Co-Chair: James Gaska
Wright-Patterson AFB, OH

PANEL OVERVIEW: The USAF School of Aerospace Medicine, Singapore Ministry of Defence and DSO National Laboratories, and Defence Research and Development Canada and Canadian Forces Environmental Medicine Establishment will present current and planned research examining the relationship between clinical and laboratory measures of vision and operationally relevant aircrew performance.

[370] OPERATIONAL BASED VISION ASSESSMENT OVERVIEW

S.C. Hadley[1,2]
[1] U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH; [2]Dept. of Surgery, USUHS, Bethesda, MD

INTRODUCTION: For over 100 years aerospace vision standards have been somewhat antidotal "lines in the sand" based on historical and observational science. Technologies did not exist to allow the Military Medical Services to validate or correlate clinical and laboratory visual performance measures with the visual performance requirements of operational tasks required in the aircraft or remotely piloted console. **METHODS:** The primary objective of the Operational Based Vision Assessment (OBVA) program is to correlate clinical vision standards to aircrew operational performance using a high fidelity synthetic environment to simulate operational visual tasks. This will enable more accurate assessments of the potential operational risk associated with vision standards and lead to decisions on standards that incorporate an acceptable risk. OBVA will ensure that airmen have visual performance capabilities that meet or exceed the performance requirements for the visual components of operational tasks. A secondary objective of OBVA is to investigate the high visual demands of current and future generation aircraft such as the F-35. **RESULTS:** The OBVA laboratory consists of a high fidelity synthetic environment (simulator) to perform experiments and explore the relationship of clinical measurements of vision with actual aviator performance, during simple and complex operational visual tasks. The first research from OBVA deals with comparing the visual performance between color normal and deficient patients in decreasing levels of contrast that would be found in the real world of flying. The next presentation will discuss the research of KC-46 boom operator performing their refueling tasks from the flight deck using 3D displays. OBVA collaborative partner from Singapore and Canada will discuss their planned research and results to date.

Learning Objectives:

1. Describe the capabilities of the Operational Based Vision Assessment lab.
2. Report on the first research projects of OBVA in color and stereopsis.
3. Discuss USAF aeromedical policy on color deficient and defective stereopsis aircrew and aircrew applicants.

[371] OPERATIONAL BASED VISUAL ASSESSMENT USING WITH FIFTH-GENERATION COLOR SYMBOLOGY

J.P. Gaska, S. Wright, M. Winterbottom, and S.C. Hadley
FECO, 711/HPW/ U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: The goal of the Operational Based Vision Assessment (OBVA) lab is to characterize the relationship between visual capabilities and performance in operational tasks. In this series of

studies, color vision capabilities were measured using the Cone Contrast Test (CCT) and were compared with operational performance measured using a simulated multi-function display that accurately displayed the shape, size and color of fifth-generation situational awareness symbology. **METHODS:** Experiment 1. Color vision normal (CVN) and color vision deficient (CVD) participants were required to determine if a red symbol was located between red and magenta lines. Experiment 2. Participants were required to determine if a green or red symbol was present using a range of symbol contrasts. **RESULTS:** Experiment 1. Bivariate correlation statistics between throughput (percent correct divided by reaction time) and the CCT scores were statistically significant. However, the proportion of CVD observers with throughput scores lower than 2 standard deviations below the CVN sample mean, (proportion below normal or pBN) was small (protan: pBN = 0.04, deutan: pBN = 0.09). Experiment 2. A percent correct discrimination versus contrast curve was generated for each individual. As contrast decreased, the separation between the CVN and CVD groups increased. For symbol contrast of 10.0 1.0 and 0.1, the pBNs for protans were 0.10, 0.14 and 0.81. For the same contrast values, the pBNs for deutans were 0.21, 0.38 and 0.94. **DISCUSSION:** In an operational environment, symbol contrast will change due to sun or other light sources reflecting off cockpit displays. When contrast is reduced, small performance differences between CVN and CVD individuals can become large.

Learning Objectives:

1. Familiarize the audience with research aimed at characterizing the relationship between the USAF color vision test used for the selection and retention of aircrew and operational performance measured using a simulated multi-function Display.

[372] OPERATIONAL BASED VISION ASSESSMENT: REMOTE VISION SYSTEM AERIAL REFUELING OPERATOR VISUAL PERFORMANCE

M. Winterbottom[1], C. Lloyd[3], J.P. Gaska[2], S. Wright[4], and S. Hadley[4]
[1]U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH; [2]FECO, 711/HPW/ U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH; [3]Visual Performance, LLC, Ellisville, MO; [4]Aerospace Ophthalmology, U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH

INTRODUCTION: The performance and comfort of aircrew using stereoscopic displays viewed at a near distance over long periods of time are now an important operational factor to consider with the introduction of the KC-46 aerial refueling tanker. Existing vision standards for Flying Class III aircrew with scanner duty, including aerial refueling operators, were designed for viewing real objects at long distances and may not be adequate for stereoscopic displays viewed at near distances. **METHODS:** The U.S. Air Force School of Aerospace Medicine's Operational Based Vision Assessment Laboratory coordinated with the Air Force KC-46 Directorate, Boeing, and Flight Safety International to develop an aerial refueling operator remote vision system simulation. We also developed a comprehensive set of stereo acuity and ocular alignment measures, which included current standard measures, as well as seven new/experimental vision tests, including a sophisticated new contrast sensitivity test. Twenty-four subjects participated in this experiment. Subjects were selected such that about one-third clearly met current standards, one-third would satisfy waiver criteria, and one-third would fail current standards and waiver criteria for stereo acuity and ocular alignment. **RESULTS:** Approximately one-quarter of the subjects reported little or no eye-strain or discomfort, about one-half reported mild to moderate eye-strain, while the remainder reported fairly severe eye-strain over the course of the 2-h refueling simulation. The vision test battery indicated that subjects with poorer stereo acuity tended to perform worse but that contrast sensitivity may be a better predictor. Categorizing subjects according to existing standards was not predictive of either performance or reported eye-strain. **DISCUSSION:** The relationship between visual performance metrics and operationally relevant refueling performance and self-reported eye-strain is reported in detail. Coarse measures of stereo acuity, and standard measures of ocular alignment, such as phorias, may not be adequate for screening aircrew using new technologies such as the KC-46 aerial refueling operator remote vision system.

Learning Objectives:

1. The relationship between USAF vision standards and tests and performance on a simulated remote vision system aerial refueling task will be discussed.

[373] DEVELOPMENT OF SINGAPORE'S OPERATIONAL BASED VISION ASSESSMENT (OBVA) LABORATORY: TOWARDS MILITARY OPERATIONAL VISION STANDARDS

S.T. Lin and L.K. Tey
Combat Protection and Performance, DSO National Laboratories, Singapore, Singapore

INTRODUCTION: In collaboration with 711 HPW/USAFSAM's Operational Based Vision Assessment Program, DSO National Laboratories, Singapore, aims to develop more accurate clinical screening criteria and understanding of vision requirements based on actual operational tasks. The key motivation is to enable operational visual abilities to be measured accurately, provide insights about key areas of visual perception in air-crew, and assist in the design and evaluation of future vision enhancement tools, particularly in the context of an Asian population. DSO's OBVA team developed a single-projector vision testing lane laboratory with the attempt to quantify dynamic vision performance in pilot operation's context. The most important aspects to the development of this laboratory are a projection display system capable of eye-limiting imagery, and an image generator and host computer system capable of driving such high resolution system and enabling precise control of operational scenarios. The simulation software is built based on the Unity gaming engine, equipped with a front-end scenario editor capable of allowing its user to pre-define air-craft visual stimulus and its movement, and allows experimenters precise control of operational scenarios using MATLAB. The simulation setup here is only limited to motion stimulus that are pre-defined in the form of templates, as there is no requirement for visual experiments at the current stage to have active real-time feedback control from the user. Further consideration for such template-based approach arises from the fact that visual images of pre-defined form are extremely stable and the cost of developing real-time control can be considerable, and may not be viable for the case of a vision testing lane. Nevertheless, the system is created to be upgradable to a fully functional simulator if future needs arise. The challenges of the laboratory development and its implications on experiment designs will be presented. As part of the OBVA collaboration plans for population cross-validation, this presentation will also discuss developments in the evaluation of Asian normative data from new stereo acuity, motion perception and automated vision tests pioneered by 711 HPW/USAFSAM.

Learning Objectives:

1. Customizing vision evaluation and assessment tools.

[374] VALIDATING METHODS OF VISION ASSESSMENT FOR RCAF AIRCREW

M.G. Glaholt[1], P.V. Hinton[2], J.K. Hovis[3], R. Morrell[2], and P. Burke[2]
[1]Defence Research and Development Canada, Toronto, ON, Canada; [2]Canadian Forces Environmental Medicine Establishment, Toronto, ON, Canada; [3]University of Waterloo, Waterloo, ON, Canada

INTRODUCTION: An ongoing research project seeks to evaluate methods of vision testing for Royal Canadian Air Force (RCAF) aircrew. In the present design we will examine tests of color vision and stereopsis, with the goal of identifying the most effective methodology for aircrew screening. The study is being conducted jointly at Defence Research and Development Canada (DRDC) and Canadian Forces Environmental Medicine Establishment (CFEME) and in collaboration with United States Air Force School of Aerospace Medicine (USAFSAM) and the University of Waterloo. A sample of Canadian Armed Forces (CAF) personnel will

participate in the study. Within each experimental session, a subject will complete a battery of vision tests that assess color vision (including pseudo-isochromatic plates, CAD, USAFSAM test of color contrast, Anomaloscope) and stereopsis (including RANDOT, Titmus stereo plates, OPTEC 5500 Stereo sub-test, USAFSAM stereopsis test battery). Test order will be randomized across subjects. Subjects will participate in two experimental sessions separated by up to a week. Outcome correlations between the first and second session will be used as measures of test-retest reliability. Specificity of color vision tests will be obtained through comparison with the Anomaloscope. We will present preliminary data and discuss the specificity, reliability, and practical utility of the tests.

Learning Objectives:

1. Acquire familiarity with novel tests of color vision and stereopsis.

Wednesday, May 13 ***2:00 P.M.***
S. Hemisphere E4

[LXIX.] PANEL: AEROMEDICAL ETHICS

Sponsored by the American Society of Aerospace Medicine Specialists

Chair: Allen Parmet
Kansas City, MO

PANEL OVERVIEW: We will review major theory and historical approach to aeromedical ethics. A series of panel vignettes will present topics for discussion by the senior aerospace medicine specialist panel members and audience. The examples and follow-on discussions will demonstrate aerospace medicine value conflicts and resolutions, and problem solving. Intense audience participation will occur.

[375] AEROMEDICAL ETHICS PANEL

A.J. Parmet[2], R.R. Ireland[3], C.S. Ramsey[1], D. Lestage[4], and F. Tilton[3]
[1]Occupational Medicine, Independent Contractor, Commerce City, CO; [2]Aviation Safety & Security, Viterbi School of Engineering, University of Southern California, Kansas City, MO; [3]Retired, Canyon Lake, CA; [4]Fleming Island Preventive Medicine, Fleming Island, FL

INTRODUCTION: Physicians in aerospace medicine recognize that being a flight surgeon and aviation medical examiner raises significant ethical dilemmas. Over 30 years ago, Drs. Urbano and Jones addressed such concerns in terms of value conflicts. Conflicts arise between due to outside influence on medical practice, loss of confidentiality, legal restraints and limitations, duty requirements and forced decisions. **METHODS:** A didactic review of ethical standards including Ethical Guidelines of the American Society of Aerospace Medicine, the 1975 Declaration of Helsinki a set of ethical principles regarding human experimentation developed for the medical community by the World Medical Association and endorsed by the American medical Association, a *document that should be considered the property of all humanity*, and the Genetic Information Nondisclosure Act of 2008. **RESULTS:** A of review major theories and historical approaches to problem solving will be followed by a series of panel vignettes will present topics for discussion by the senior aerospace medicine specialist panel members and audience. The Examples and follow-on discussions will demonstrate aerospace medicine value conflicts and potential resolutions. Intense audience participation will occur. **DISCUSSION:** Competence in ethics is demonstrated by aerospace medicine specialists who recognize value conflicts when they occur and articulate the relevant ethical perspective for dealing with them compassionately, professionally and medico-legally.

Learning Objectives:

1. Learn the process of ethical decision making.
2. Understand the ethical resources available and in particular, the ASAMS Ethical Guidelines.
3. Encourage thought and discussion of the ethical issues in Aerospace Medicine.

Wednesday, May 13 ***4:00 P.M.***
S. Hemisphere 1

[LXX.] SLIDE: COGNITIVE AND SENSORY PERFORMANCE

Co-Chair: Jaime Harvey
Washington, DC

Co-Chair: Troy Faaborg
Alexandria, VA

4:00 p.m.
[376] UNDERSTANDING THE REAL NATURE OF SPATIAL DISORIENTATION IN UK MILITARY AIRCRAFT

T. Grimshaw[1], R. Stott[1], and A. Belyavin[2]
[1]Aircrew Systems, QinetiQ, Farnborough, United Kingdom; [2]Human Performance, QinetiQ, Farnborough, United Kingdom

INTRODUCTION: Despite technological advances in military aircraft design, spatial disorientation (SD) still represents a real risk to flight safety. The prevalence of SD is influenced, in part, by changes in platforms, type of operations, and the environments in which these operations occur. In order for the UK MOD to develop strategies to mitigate the risk of disorientation accidents, it is important that up to date knowledge of disorientation incidents is collected. **METHODS:** An anonymous incident survey was developed, in which aircrew described occasions in flight when they had become confused or in error about their aircraft attitude or position. These aircrew descriptions were then analyzed by experts to determine the factors underpinning the incident. This survey has been conducted regularly since 2004, most recently in 2013, and has accumulated over 400 incidents, enabling detailed analyses of causal factors to be undertaken. This paper details the findings from the period 2010-2013. **RESULTS:** Aircrew reported 144 incidents: 87 from rotary aircraft, 42 from fast jet and training aircraft, and 15 from multi-engine aircraft. Data analysis using stepwise logistic regression showed several strong correlations ($p < 0.01$) between certain factors and unrecognized disorientation or incidents with a severe risk to flight safety. Many rotary incidents featured landing or take-off in dust and deck landing at night, with difficulties judging the distance from a minimally lit ship. Poor crew coordination was significantly associated with the more severe rotary incidents. For fast jet aircraft, several height errors were associated with severe implications for flight safety. Distraction often played a critical role in these incidents. For multi-engine aircraft, disorientation resulted from procedural errors, often due to high workload. Visual misperceptions were also reported, for example irregular cloud formations resulting in uncertainty about aircraft attitude. **DISCUSSION:** Results show that the most dangerous form of disorientation arises insidiously. Many incidents could readily have become accidents given slightly different circumstances or any further delay in recognition of the true situation. Results are being used to inform flight safety and training.

Learning Objectives:

1. To develop a deeper understanding of the factors involved in spatial disorientation, based on aircrew incident descriptions.

4:00 p.m.
[377] TACTILE DISPLAYS STRATEGIES FOR CONVEYING VEHICLE PROXIMITY TO SIGNIFICANT HAZARDS

A.H. Rupert[1], B.D. Lawson[1], J. Brill[2], L.I. Thompson[1,3], and A.M. Kelley[4]
[1]U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL; [2]Old Dominion University, Norfolk, VA; [3]Oak Ridge Institute for Science and Education, Oak Ridge, TN; [4]National Highway Traffic Safety Administration, Washington, DC

INTRODUCTION: Vehicle operators may see objects too late to avoid them, due to poor visual cues, misdirected gaze, etc. This presentation evaluates displays we and others have developed to avoid such hazards. **METHODS:** We considered seven tactile display strategies that have been prototyped to tell the user when a hazard is approaching or being approached: 1) a vibration cue that indicates the presence of the hazard; 2) vehicle, head, or torso-based vibrations that also cue gross hazard direction (left/right); 3) vehicle vibrations that become more frequent as hazards approach; 4) torso vibrations that cue many different hazard directions on the body and whose number of on-off pulses per second increases with increasing velocity of self-motion; 5) tactile analogues of audition whose vibration frequency (on the head or torso) rises as the hazard approaches; 6) analogues of touch whose site of spatial cueing across one's seat cues self-motion in a manner akin to sliding across the ground; 7) analogues of touch whose cues travel across one's body, e.g., from hands to torso (akin to walking through foliage); and 8) a spatial array whose site of cueing changes radially in a manner akin to visual flow. **RESULTS:** All seven display strategies have advantages and disadvantages. Strategies #1 and 2 are the simplest but too primitive for many applications. Strategies #2 and 5, when head-based, are highly salient but provide a changing frame of reference. Displays #3 and 4 are the most mature and well-studied; studies show that transverse rumble strips (#3) that increase rumble beat speed as a stoplight approaches and the Tactile Situation Awareness System (#4) should decrease accidents by 39% and 24%, respectively. (Nevertheless, a recent study implies that cue #5 is worth exploring for conveying approaching hazards in similar situations.) **DISCUSSION:** Most tactile displays for cueing approach are experimental and limited to simple vibrational cues with limited directional cueing, multi-point spatial cueing, or vibration frequency range. Additional qualities of cutaneous sensation (e.g., stroking) and richer stimuli are needed that can emulate the thousands of cutaneous receptors cueing one's movement in the natural world.

Learning Objectives:

1. To demonstrate the need for developing improvements in tactile display systems.

4:00 p.m.
[378] ANTICIPATORY PROCESSES INFLUENCE THE SENSATION OF THE CORIOLIS EFFECT: A PSYCHOPHYSIOLOGICAL APPROACH

C.M. Talker[1], W. Kallus[1], J. Schwandtner[2], K. Beykirch[2], and J. Joachimbauer[2]
[1]Department of Psychology, University of Graz, Graz, Austria; [2]AMST-Systemtechnik GmbH, Ranshofen, Austria

INTRODUCTION: Experience from training that allows correct anticipation of upcoming flight situations has been shown to improve a pilot's performance in spatial disorientation-provoking environments and hence, is a key factor in flight safety. The findings of a pilot study suggest that experience might even influence the impact of the Coriolis illusion - a vestibular-induced illusion that evokes symptoms of spatial disorientation and/or motion sickness, and can incapacitate a pilot. The purpose of this experiment was to replicate the findings of the pilot study by investigating the occurrence and intensity of the Coriolis illusion depending on experience. **METHODS:** 13 active pilots and 13 non-pilots were assigned to two groups according to their experience in flight motion. A Coriolis illusion was induced passively, i.e. solely by the cabin movements of a motion-based flight simulator. The experiment was conducted with a multi-level assessment approach. Subjective data, as well as psychophysiological data, were collected. ECG and EDA data were analyzed in psychophysiological analysis units of 10 seconds in order to shed light on the underlying processes involved. **RESULTS:** Experienced pilots showed significantly less electrodermal responses than non-pilots in the relevant psychophysiological time intervals (i.e. before, during and after the Coriolis induction) during the simulator session. Moreover, experienced pilots reported significantly less physical discomfort (e.g. nausea, vertigo) due to Coriolis induction than non-pilots after the simulator session. Thus, the findings of the pilot study could be replicated. **DISCUSSION:** It can be interpreted that experienced pilots are able to interpret upcoming Coriolis sensations better than non-pilots. The pilots' correct expectations of the to-be-sensed multi-sensory information, developed by continuous learning processes during their flight careers, led to a reduced incidence of mismatches and hence, inhibited the impact of Coriolis illusion.

Learning Objectives:

1. The particular relevance of anticipatory processes in spatial disorientation-prone situations is described.

4:00 p.m.
[379] GENETIC FACTORS IN MOTION SICKNESS

G.W. Knox
Surgery, UF Health-Jacksonville, Jacksonville, FL

INTRODUCTION: a previous study by our group suggested a hereditary factor or factors involved in motion sickness susceptibility. Therefore, we undertook another retrospective literature review to determine if there is a correlation between motion sickness genetic factors and genetic factors governing vestibular function. **METHODS:** Data sources: studies involving collection of primary data on susceptibility to motion sickness, correlated with any genetic factor; and, review articles concerning vestibular function and genetic factors. Study selection: A literature review was conducted to obtain articles that pertained to genetic factors governing vestibular function with the key words *genetic* and *vestibular*. **RESULTS:** The selected articles revealed that: 1. Genetic polymorphism of the alpha-2a adrenergic receptor is correlated with motion sickness susceptibility; and 2. there is a lack of significant genetic correlation between the gene for the alpha-2a adrenergic receptor and genetic factors governing vestibular function. . **DISCUSSION:** the development of motion sickness depends on adequate peripheral vestibular function. For example, patients who have absent vestibular function are essentially immune to seasickness (17). The alpha-2a adrenergic receptor phenotype *is* strongly correlated with motion sickness (2). This receptor mediates central and peripheral autonomic responses to stress, such as tachycardia, sweating, and nausea One interpretation of these findings is that a normal, intact peripheral vestibular system is needed to sense the sensory conflict that is expressed in autonomic functioning.

Learning Objectives:

1. Discuss the connection between genetics and motion sickness.
2. Discuss how some ethnic groups tend to have increased problems with motion sickness.

4:00 p.m.
[380] FLIGHT DECK ENGINEERING PART 1: IMPACT OF FLIGHT DECK CREW ALERTING AND INFORMATION SYSTEMS ON ENGLISH AS A SECOND LANGUAGE FLIGHT CREW PERFORMANCE IN AIRLINE FLIGHT OPERATIONS

D. Sevillian[1], D. Jarvis[2], M. Silveria[3], and D. Graeber[4]
[1]Flight Deck Human Factors-School of Engineering, Cranfield University/The Boeing Company, Mukilteo, WA; [2]Human Factors/ Flight Deck, Bedfordshire, United Kingdom; [3]Aeronautics and Human Factors, Lusofona University, Lisbon, Portugal; [4]Human Engineering, The Boeing Company, Seattle, WA

INTRODUCTION: Flight Deck Crew Alerting Systems (FDCAS)—alert systems/Quick Reference Handbook (QRH) checklists are designed with an understanding of how to effectively integrate human attributes with alert system complexities. However, there are large populations of English as a second language (ESL) flight crewmembers who operate western designed FDCAS, while conversing in an array of languages on the flight deck. Purpose of this study was to determine if ESL flight crewmembers' performance was impacted by use of western built FDCAS in a simulated flight environment. **METHODS:** Each of the 30 ESL flight crewmembers' piloted an A320 simulated flight deck. The researcher injected electrical (ATA 24) and hydraulic (ATA 29) system

failures via Electronic Centralized Aircraft Monitor (ECAM) during the cruise phase of flight. Independent variable was checklist language (English written/Portuguese written/translated QRHs). Control group was QRH written in English and experimental group was QRH Portuguese written/translated. Dependent variables were ESL flight crew response time and ESL flight crewmembers' NASA TLX workload scores. Interviews with ESL flight crewmembers' were conducted after experiment. **RESULTS:** Results support the researcher's experimental hypothesis. There is a significant difference between ESL flight crew performance using English written and Portuguese written/translated QRHs. Paired samples t-test found that English written QRH workload scores and response times were respectively significantly lower than the Portuguese condition [t=-3.803 sig. =. 049, sig 2 tailed= .001] [t=4.947; sig. = .695, sig 2 tailed= .000]. Pearson correlation test conveyed there was no significant correlation between ESL flight crewmembers workload scores with use of English written QRH and response time with use of English written QRH (.150 and .428)/(.158 and .404) respectively. There was no significant correlation between ESL flight crewmembers workload using Portuguese written/translated QRH and Portuguese QRH response time. **DISCUSSION:** Research is needed regarding impact of ESL flight crewmembers performance on FDCAS use, considering different language characteristics. Design requirements should address ESL flight crew members interface with FDCAS.

Learning Objectives:

1. The relationship between Portuguese written/translated QRH checklist on ESL flight crewmember performance is described.
2. The relationship between English QRH checklist on ESL flight crewmember performance is described.
3. Human performance factors identified from post experiment debrief with ESL flight crewmembers is described.

4:00 p.m.

[381] FLIGHT DECK ENGINEERING PART II: IMPACT OF FLIGHT DECK CREW ALERTING AND INFORMATION SYSTEMS ON ENGLISH AS A SECOND LANGUAGE FLIGHT CREW PERFORMANCE IN AIRLINE OPERATIONS

D. Sevillian[1], D. Jarvis[2], M. Silveria[3], and D. Graeber[4]
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INTRODUCTION: Flight Deck Crew Alerting Systems (FDCAS)—alert systems/Quick Reference Handbook (QRH) checklists are utilized by English as a second language (ESL) flight crewmembers on the flight deck. This study was to determine if ESL flight crewmembers' performance was impacted by use of western built FDCAS in a simulated flight environment. **METHODS:** Each of the 30 ESL flight crew members' piloted an A320 simulated flight deck, while the researcher injected electrical and hydraulic system failures via ECAM. Independent variable was checklist language (English written/Portuguese written/translated QRHs). Dependent variables were NASA TLX workload scores and errors of omission and commission. Control group was English written QRH and experimental group was Portuguese written/translated QRH. **RESULTS:** Results support the researcher's experimental hypothesis. There is a significant difference between ESL flight crew performance using English written and Portuguese written/translated QRHs. Independent samples t-test conveyed an effect on ESL flight crewmembers' airline years of experience < 20 and workload scores using Portuguese written/translated QRH. ESL flight crewmembers with years of experience <20 that utilized Portuguese translated QRH experienced higher workload (t= -3.270; sig 2 tailed=.004). ESL flight crewmembers' with 20 or > years of experience did not have difficulties utilizing Portuguese written/translated QRH. Independent samples t-test was performed regarding ESL flight crewmembers' English checklist workload score and ESL flight crewmembers' airplane language spoken on the flight deck (primary English/primary Portuguese). ESL flight crewmembers who primarily speak Portuguese language on the flight deck experienced higher workload utilizing English QRH. Researcher rejected the null hypothesis, since there was a significance factor of .046 (sig 2 tailed; t= 2.089) and the means are insufficient. Errors of omission and commission were analyzed using a t-test, with respect to ESL flight crewmembers' use of English written/Portuguese translated QRHs but no significance was found. **DISCUSSION:** Impact on ESL crew performance considering FDCAS use, design, and training in simulated flight environments should be further investigated.

Learning Objectives:

1. ESL flight crewmembers' workload and years of experience is described.
2. ESL flight crewmembers' demographics collected during experiment is described.
3. ESL flight crewmembers' interview questionnaires and responses collected after experiment are reviewed.

Wednesday, May 13 ***4:00 P.M.***
S. Hemisphere 2

[LXXI.] PANEL: THE 8TH ANNUAL RAM BOWL

Sponsored by the American Society of Aerospace Medicine Specialists

Co-Chair: Allen Parmet
Kansas City, MO

Co-Chair: Jan Stepanek
Scottsdale, AZ

[382] THE 8TH ANNUAL RAM BOWL

A.J. Parmet[1], J. Stepanek[2], R. Johnson[3], R.S. Blue[4], and J. McKeon[5]
[1]Aviation Safety & Security, Viterbi School of Engineering, University of Southern California, Kansas City, MO; [2]Mayo Clinic, Scottsdale, AZ; [3]FAA/CAMI, Oklahoma City, OK; [4]University of Texas Medical Branch, Houston, TX; [5]Mologne Cadet Health Clinic, West Point, NY

PANEL OVERVIEW: INTRODUCTION: The 8th Annual RAM Bowl features teams from the Air Force, Navy/Army, Wright State and University of Texas competing for the Louis H. Bauer Trophy. Aerospace Medicine Residents are required to demonstrate multiple competencies to satisfy the requirements of ACGME and ABPM and serve as specialists in the field. Multiple tools are available for developing appropriate didactic knowledge in aerospace medicine, public health, epidemiology, biostatistics and health care management. **METHODS:** Teams complete in a college bowl format that tests aerospace medicine competencies, recall speed, teamwork and individual knowledge. Topics include the specialty aerospace medicine competencies including the flight environment (atmosphere, radiation, vibration, acceleration, and microgravity), clinical aerospace medicine, aircraft and space vehicle systems/operations, accident investigation, historical events, aerospace physiology, human factors, ergonomics, medical standards, federal aviation regulations, passenger transport, restraint and escape, cockpit resource management and aeromedical transportation. **RESULTS:** Questions are divided into toss-up questions and bonus questions. **DISCUSSION:** Multiple rounds of competition will lead to the selection of this year's victor and awarding of the Louis H. Bauer Trophy, sponsored by the American Society of Aerospace Medicine Specialists.

Learning Objectives:

1. Preparation of Residents in Aerospace Medicine for the American Board of Preventive Medicine Examination.

Wednesday, May 13 ***4:00 P.M.***
S. Hemisphere 3

[LXXII.] PANEL: THE VISUAL IMPAIRMENT/ INTRACRANIAL PRESSURE (VIIP) SYNDROME—PROGRESS TO DATE (PART II)

Co-Chair: Christian Otto
Houston, TX

Co-Chair: Yael Barr
Houston, TX

PANEL OVERVIEW: In the two years that have elapsed since the last Visual Impairment/Intracranial Pressure (VIIP) panel at AsMA, advances have been made in defining and managing this recently identified risk to human health in space. This panel session will share new insights gained from research studies conducted on the International Space Station, in the analogue environment of head-down tilt bedrest, and via modeling of ocular and cerebrovascular changes associated with exposure to spaceflight or analogue conditions.

[383] THE PROSPECTIVE OBSERVATIONAL STUDY OF OCULAR HEALTH IN INTERNATIONAL SPACE STATION ASTRONAUTS: THE VISUAL IMPAIRMENT INTRACRANIAL PRESSURE RISK

C. Otto[1], Y.R. Barr[2], R. Ploutz-Snyder[1], R. Brady[3], C.R. Gibson[4], D. Alexander[5], A. Sargsyan[3], N. Patel[6], K. Garcia[3], R. Riascos[7], S. Platts[5], and B. Samuels[8]
[1]Universities Space Research Association, Houston, TX; [2]University of Texas Medical Branch, Galveston, TX; [3]Wyle Science Technology and Engineering Group, Houston, TX; [4]Coastal Eye Associates, Webster, TX; [5]NASA Johnson Space Center, Houston, TX; [6]The University of Houston, Houston, TX; [7]The University of Texas Health Science Center, Houston, TX; [8]University of Alabama at Birmingham, Birmingham, AL

INTRODUCTION: This study prospectively characterized the changes in astronaut eye structure and function across the 3 phases of a long-duration space flight. **METHODS:** Optical coherence tomography, ocular ultrasound, vision testing, fundoscopy, and intraocular pressure (IOP) were collected from 5 astronauts pre-, post- and monthly in-flight over a 6-month mission. Cycloplegic refraction and axial biometry were collected pre- and postflight. **RESULTS:** One astronaut developed disc edema. On average, the 5 subjects' optic nerve sheath (ONS) diameter increased in-flight (6.28±0.32mm, $p<0.0001$) compared to preflight (5.89±3.24mm) and returned towards preflight levels postflight (6.01± 0.32mm, $p=0.28$). Retinal artery peak systolic velocity was elevated in-flight (15.92±1.64cm/s, $p<0.0001$) and postflight (13.27±1.72cm/s, $p<0.011$) compared to preflight (10.66±1.78cm/s). Mean IOP was unchanged in-flight (13.95±0.55mmHg, $p=0.19$) from preflight (14.38±0.63mmHg) but was lower postflight (12.78±0.58mmHg, $p<0.0001$). Average circumpapillary retinal nerve fiber layer (RNFL) increased in-flight (104.66±2.71µm, $p<0.0001$) from preflight (101.42±2.75µm) and remained higher postflight (105.78± 2.73µm, $p<0.0001$). Circumpapillary choroidal thickness also increased in-flight (228.44± 21.67µm, $p<0.0001$) and was higher postflight (203.10±21.77µm, $p=0.094$) compared to preflight (193.90±21.88µm). Axial length remained unchanged from preflight, however uncorrected distance visual acuity improved in-flight in 4 myopic crewmembers compared to preflight, and remained improved postflight. Cycloplegic refraction preflight (-1.50±0.55D) to postflight (-1.22±0.56D) revealed a 0.27 Diopter shift ($p<0.003$). **DISCUSSION:** Elevated in-flight ONS diameter and increased retinal artery velocity reflect an elevated pressure within the ONS and likely contribute to the altered translaminar pressure gradient (TLPG) causing RNFL thickening. Choroidal thickness increased in-flight, and trended toward persisting postflight, contributing to a hyperopic shift and an improvement in uncorrected distance visual acuity in the 4 myopes. Significant alterations to astronaut eye structure and function occur with exposure to spaceflight, believed to be the result of chronic elevated ICP and changes in the TLPG.

Learning Objectives:

1. Understand the physiological changes underlying the development of the VIIP syndrome.

[384] OCULAR AND CEREBROVASCULAR CHANGES IN MICROGRAVITY

J. Buckey[2], J. Swan[2], A. Fellows[2], S. Phillips[1], N.T. Kattamis[3], D.A. Knaus[3], and M.E. Zegans[4]
[1]Engineering R&D, Creare LLC, Hanover, NH; [2]Geisel School of Medicine at Dartmouth, Lebanon, NH; [3]Creare LLC, Hanover, NH; [4]Ophthalmology, Dartmouth-Hitchcock Medical Center, Lebanon, NH

INTRODUCTION: In space, the combined effects of removing all hydrostatic gradients and eliminating tissue compressive forces (i.e. compression due to the weight of tissues), produces unique changes within the eye and throughout the cerebrovascular system. Ground-based studies cannot replicate microgravity's effects, but postural interventions can reverse the direction of the gravity vector (i.e. supine vs. prone), which allows gravitationally-produced effects to be understood and modeled. We are making both ocular and cerebrovascular measurements in the prone and supine positions, both with and without fluid shifts (produced by lower body negative pressure (LBNP) and lower body positive pressure (LBPP)). We are using these measures to construct a numerical model of the eye and cerebrovascular circulation that can be used to predict and generate hypotheses about microgravity-induced visual changes. **METHODS:** IOP (Perkins tonometry), globe geometry (optical biometer), and choroidal thickness (optical coherence tomography (OCT)) are measured every 15 minutes while resting for 60 minutes supine followed by 60 minutes prone. The biometer and OCT measures are made using a custom-built boom that allows the devices to be placed over the subject's eye in both supine and prone. For cerebrovascular data, data will be acquired using the 3T MRI scanner. The imaging protocols needed to assess cerebrovascular blood flow, cerebrospinal fluid flow, and cranial vascular anatomy and structure have been tested. A MRI-compatible LBNP/LBPP device has been designed, built, and tested at the imaging center. **RESULTS:** Preliminary data (n=1) show increased IOP (+25%) and axial length (+.09%), and decreased anterior depth (-1.9%) in the prone position compared to supine, which likely demonstrates hydrostatic effects on the eye. Data collection is ongoing. **DISCUSSION:** Hydrostatic and tissue weight effects are likely important in understanding the effects of microgravity. Modeling these effects could help with predicting visual changes in microgravity.

Learning Objectives:

1. To understand the effects of gravity on the eye and cerebrovascular system.

[385] MODELING THE OCULAR AND CEREBROVASCULAR CHANGES IN MICROGRAVITY

S.D. Phillips[1], N.T. Kattamis[1], A.B. Chepko[1], D.A. Knaus[1], J. Buckey[2], J.G. Swan[2], and M.E. Zegans[2]
[1]R&D Engineering, Creare LLC, Hanover, NH; [2]Geisel School of Medicine at Dartmouth, Lebanon, NH

INTRODUCTION: The prevailing hypothesis for the visual changes in microgravity is that they are associated with elevated intracranial pressure (ICP) due to microgravity-induced cephalad fluid shifts. This description may over-simplify what is a complex phenomenon, and recent parabolic flight data suggest that ICP may not actually increase in microgravity. Microgravity exposure eliminates both hydrostatic gradients and compressive forces due to tissue weight, but these factors are usually not incorporated into numerical models of physiological systems. **METHODS:** We are developing a numerical model of the eye to better understand the impact of microgravity on vision and the cerebrovascular system. The model includes both a structural model of the eye, and a system-level fluidic model that includes the circulatory system, the cerebral spinal fluid regulatory system, and the aqueous

humor regulatory system. We are developing and validating the model using posture study data in 1G, and using microgravity data from parabolic flight. **RESULTS:** Using a preliminary version of the structural model, we predicted intraocular pressure (IOP) for supine, prone, and microgravity conditions. The results were 8.4 mm-Hg supine, 11.5 mm-Hg prone, and 10.0 mm-Hg for microgravity. Our corresponding experimental data are 11 mm-Hg supine, 18 mm-Hg prone, and 16 mm-Hg for microgravity. **DISCUSSION:** In 1G, prone IOP increases relative to supine due to hydrostatic gradients. In microgravity, hydrostatic gradients are removed. However, the microgravity-induced cephalad fluid shift impacts IOP, and an intermediate result, between 1G supine and prone, results. Our model predicts the correct IOP trends, but the magnitude of the trend is smaller than the experimental values. The model is still under development, and this result likely is due components of the model that have yet to be incorporated. For example the fluid column associated with cerebrospinal fluid was not included in the current simulations.

Learning Objectives:

1. To understand the factors that may contribute to visual changes in microgravity and how they can be modeled.

[386] FLUID SHIFTS, VASODILATATION AND AMBULATORY BLOOD PRESSURE REDUCTION DURING LONG DURATION SPACEFLIGHT

P. Norsk
DSLS, USRA, Houston, TX

INTRODUCTION: Acute weightlessness in space induces a fluid shift leading to central volume expansion. Simultaneously, blood pressure is either unchanged or slightly decreased. Whether these effects persist for months in space is unclear. **METHODS:** 24-h ambulatory brachial arterial pressures were automatically recorded at 1 - 2 hour intervals with portable equipment in 8 male astronauts, once before launch, once between 85 and 192 days in space on the International Space Station and finally once at least two months after flight. During the same 24-h periods, cardiac output (rebreathing method) was measured 2 - 5 times (on the ground seated), and venous blood was sampled once (also seated on the ground) for determination of plasma catecholamine concentrations. **RESULTS:** The 24-h average systolic, diastolic and mean arterial pressures (mean ± se) were in space reduced by 8 ± 2 ($p = 0.003$, ANOVA), 9 ± 2 ($p < 0.001$) and 10 ± 3 ($p = 0.002$) mmHg, respectively. The nightly blood pressure dip of 8 ± 3 mmHg ($p = 0.015$) was maintained. Cardiac stroke volume and output increased by 35 ± 10 and 41 ± 9% ($p < 0.001$), heart rate and catecholamine concentrations were unchanged, and systemic vascular resistance reduced by 39 ± 4% ($p < 0.001$). **DISCUSSION:** The increase in cardiac stroke volume and output is more than previously observed during short duration flights and might be a precipitator for some vision problems encountered by the astronauts. The spaceflight vasodilatation mechanism needs to be further explored.

Learning Objectives:

1. To understand the magnitude of change in cardiac preload and output.
2. To understand how ambulatory blood pressure adapts to months of spaceflight.
3. To understand the possible mechanisms for systemic vasodilatation in space.

[387] THE FLUID SHIFTS STUDY

M. Stenger[1], A. Hargens[4], D. Ebert[1], S. Dulchavsky[2], S. Lee[1], S. Laurie[1], B. Macias[4], K. Garcia[1], A. Sargsyan[1], D. Martin[1], J. Liu[4], and S. Smith[3]
[1]Wyle, Houston, TX; [2]Henry Ford Hospital, Detroit, MI; [3]NASA Johnson Space Center, Houston, TX; [4]University of California, San Diego, CA

INTRODUCTION: Mechanisms responsible for the ocular structural and functional changes that characterize the visual impairment and intracranial pressure (ICP) syndrome (VIIP) are unclear, but hypothesized to be secondary to the cephalad fluid shift experienced in spaceflight. This study will relate the fluid distribution and compartmentalization associated with long-duration spaceflight with VIIP symptoms. We also seek to determine whether the magnitude of fluid shifts during spaceflight, as well as the VIIP-related effects of those shifts, can be predicted preflight with acute hemodynamic manipulations, including lower body negative pressure (LBNP). **METHODS:** Physiologic variables will be examined pre-, in- and post-flight in 10 International Space Station crewmembers, including fluid compartmentalization (D_2O and NaBr dilution); interstitial tissue thickness (ultrasound); vascular dimensions and dynamics (ultrasound and MRI, including cerebrospinal fluid pulsatility); ocular measures (optical coherence tomography, intraocular pressure, ultrasound); and ICP estimates (tympanic membrane displacement, otoacoustic emissions). Pre- and post-flight measures will be assessed while upright, supine and during 150 head-down tilt (HDT). In-flight measures will occur early and late during 6 or 12 month missions. LBNP will be evaluated as a countermeasure during HDT and during spaceflight. **RESULTS:** The first two crewmembers are in the preflight testing phase. Preliminary results characterize the acute fluid shifts that occur in the transition from upright to supine and HDT postures (increased stroke volume, jugular dimensions, and ICP) and are partially reversed with 25 mmHg LBNP. **DISCUSSION:** Initial results indicate that acute posture-induced cephalad fluid shifts on Earth share similarities with reported VIIP characteristics in-flight, and LBNP may counter these cephalad fluid shifts. Future work will determine the effect of chronic fluid shifts in-flight.

Learning Objectives:

1. Current spaceflight VIIP research is described, including novel hardware and countermeasures.

[388] ASSESSMENT OF THE MORPHOLOGICAL CHANGES OF THE BRAIN DURING PROLONGED BED REST AS A SPACEFLIGHT ANALOG

X. Zhu, T. Brown, E. Duffy, and D. Roberts
Radiology and Radiological Sciences, Medical University of South Carolina, Charleston, SC

INTRODUCTION: Bed rest has long been known to have significant physiological effects, many of which can be attributed to the altered distribution of fluids caused by the effects of gravity. Due to the fact that the brain is supported by liquid (cerebrospinal fluid), gravity change could have more noteworthy effects on the brain. Our study objective was to assess the effect of 60 days of bed rest on brain morphology as an analog to spaceflight. **METHODS:** Using a 1.5T-MRI, 3D volumetric scans were acquired from 8 subjects [33±7.4 yo, 3 females] before and after 60 days of bed rest. The subjects were positioned in 60 head down tilt. On day 60, subjects were moved from their beds onto the MRI table while remaining supine. Voxel based morphometry was performed using VBM8 toolbox. To compare the brain as a whole, we aligned the skulls in the pre- and post-bed rest scans and estimated parameters for rotation and translation. **RESULTS:** Post-bed rest brains showed significant tissue density increase in regions at the vertex, including the frontoparietal lobes. Other regions also showed significant increase (posterior cingulate, cuneus, thalami, inferior cerebellum). Density decrease was found in the orbitofrontal cortex, brainstem, corpus callosum, striatum, anterior cingulate, and parietal operculum. After bed rest, the brain as a whole showed significant displacement from the inferior-to-superior direction (0.36±0.15mm, $p<0.01$) and rotation was significant around the left-right axis (0.28±0.34˚, $p=0.051$). **DISCUSSION:** Our results indicate that the brain as a whole moved upward within the skull during bed rest. Downward shift of the brain occurs in patients with low intracranial pressure (ICP) suggesting an association between brain structure and ICP regulation. This raises the possibly that structural changes may contribute to alterations in ICP experienced by some astronauts after long-term spaceflight. Also seen were widespread regions of brain tissue redistribution. These locally occurring morphological changes may lead to functional changes. The frontoparietal lobes were most affected which could affect sensorimotor and high level cognitive functions. This pilot study suggests alterations in gravity can have significant physiological effects on the brain.

Learning Objectives:

1. Discuss the impact that long-term bed rest has on the structure of the human brain.

Wednesday, May 13 ***4:00 P.M.***
S. Hemisphere 4

[LXXIII.] PANEL: PERSPECTIVES IN IN-FLIGHT MEDICAL EVENTS IN COMMERCIAL AVIATION - PART 2 - IN-FLIGHT ASPECTS

Sponsored by the AsMA Air Transport Committee

Co-Chair: Claude Thibeault
Brossard, Quebec, Canada

Co-Chair: Fiona Rennie
Dubai, United Arab Emirates

PANEL OVERVIEW: In-flight medical events (IFMEs) pose frequent disruptions to commercial airlines operation. Medical diversions could cause significant costs and there is always the risk of litigation and bad publicity when the outcome of a case is not ideal. The adequate management of in-flight medical events can mitigate the risks and costs associated with IFMEs and first of all help a passenger in acute distress. This panel will discuss the current knowledge on IFMEs as well as the best practices on how to handle them and future trends.

[389] COMMERCIAL AIRCRAFT MEDICAL KITS/EQUIPMENT: AN UPDATE

C. Thibeault[1] and A. Evans[2]
[1]Consultants Aeromed Inc., Brossard, QC, Canada; [2]Aviation Medicine Section, International Civil Aviation Organization, Montreal, QC, Canada

INTRODUCTION: In 1998 the Air Transport Medicine (ATM) Committee of AsMA began reviewing the contents of the medical kit on board commercial aircraft. The resulting recommendations were revised in 2002 and 2007. In 2007, the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) jointly reviewed the on board medical supplies (including the first aid kit, the medical kit and the Universal Precaution Kit (UPK) - for managing a case of communicable disease) and all guidelines were harmonized. **METHODS:** Since the topic of on board medical supplies continues to attract attention and since the contents of the different kits had not been reviewed for seven years, the ATM Committee undertook another review. On this occasion it also submitted its proposal to subject matter experts in emergency medicine, i.e. the American College of Emergency Physicians (ACEP), which endorsed the recommendations. **DISCUSSION:** This presentation will describe the modifications to the different kits since 2007 and the reasons for such changes. It will also present a recent change to the UPK advocated by IATA, introduced as a result of the Ebola outbreak. The presentation will include a discussion of the on board use of the Automated External Defibrillator (AED).

Learning Objectives:

1. After this presentation the participants will be able to describe the typical medical kits/equipment on board a commercial aircraft.
2. After this presentation the participants will be better prepared to respond to an onboard medical event.

[390] SURVEY ASSESSMENT OF FLYING PHYSICIAN PUBLIC KNOWLEDGE REGARDING IN-FLIGHT MEDICAL EMERGENCIES

D. Chatfield[1], C.J. Cook[1], D. Bertino[1], P.M. Alves[2], C. Thibeault[3], D. Timpe[4], M. Squillante[4], and J. Vozenilek[5]
[1]Radiology, University of Illinois College of Medicine at Peoria (UICOMP), Peoria, IL; [2]MedAire Inc., Tempe, AZ; [3]Consultants Aeromed Inc., Brossard, QC, Canada; [4]Emergency Medicine, University of Illinois College of Medicine at Peoria (UICOMP), Peoria, IL; [5]Jump Simulation Center, Peoria, IL

INTRODUCTION: Physicians are frequently passengers on commercial flights and are routinely asked for assistance in the event of an in-flight medical emergency. These doctors make up a special passenger class we identify as the 'flying physician public' and often need to integrate with the cabin crew should an event occur. The purpose of this study was to assess the knowledge that the flying physician public has about in flight medical emergencies including available medications and equipment, legal ramifications, and procedures and protocols in place. **METHODS:** A survey of 20 questions was designed to assess physician knowledge of in-flight emergencies on passenger flights from U.S. airlines. Written and electronic forms of the survey were distributed to all physicians on staff at the 3 hospitals in a moderate sized metropolitan area, population 373,600 with approximately 1300 physicians. 418 responses were collected (32% response rate). Responses were analyzed by percentages and cross-tabulated with years of practice experience, number of flights per year, and number of in-flight emergencies responded to. A similar method was used to assess the same knowledge specifically among AsMA members. **RESULTS:** Demographics were 70% medical specialties, 20% surgical specialties, and 10% other specialties including radiology, anesthesiology, and pathology. 40% had been in practice 20 years or greater and 25% were residents in training. Of respondents at least 5 years past medical school, 73% fly 1-5 times per year, 20% more than 5 times. Knowledge questions demonstrated 20% were sure airlines were required to carry medical supplies. 50% had no understanding of which medical supplies were available; 1% expressed they were very familiar with medications and equipment provided. Only 18% of respondents were sure that the US has a Good Samaritan law applied to in flight medical emergencies. Similar results were found with the AsMA member-specific surveys. **DISCUSSION:** There is a general lack of knowledge among the flying physician public regarding in-flight medical emergencies. Were this knowledge gap closed through education efforts, physicians might be more effective at assisting and integrate more seamlessly with cabin crew in the event of an emergency.

Learning Objectives:

1. State knowledge deficits amongst the flying physician public with regard to in flight medical emergencies.

[391] GROUND-BASED MEDICAL SUPPORT, REACH AND IMPACT

P.M. Alves[1], N. Nerwich[2], D. Oscislawski[1], and M. Braida[2]
[1]MedAire Inc., Tempe, AZ; [2]International SOS, Sydeny, NSW, Australia

INTRODUCTION: The handling of in-flight medical events (IFMEs) has changed significantly since the advent of structured ground-based medical support (GBMS). The extent and impact of GBMS is not fully known. **METHODS:** A list of the major airlines as published in specialized literature was reviewed to identify those hiring GBMS. The volume of passengers transported by was retrieved to calculate the population covered by this sort of service. A historical review of cases handled by a major GBMS provider shows differences in utilization of the resource and results obtained. **RESULTS:** Four types of GBMS providers were identified: dedicated services, private non-dedicated, public non-dedicated and airline in-house. At least 59.3% of passenger traffic or 72% RPKs were covered by GBMS services in 2013. GBMS is used by 100% of major US carriers. Published data and historical data suggest progressive reduction of unnecessary medical diversions. **DISCUSSION:** Despite being an established practice, utilization of GBMS in the industry varies widely between different service providers and between different airlines utilizing the same provider. Better results should be expected from more consistent utilization, better integration with training, overall awareness by the travelling public and incorporation of new technologies.

Learning Objectives:

1. Understand the impact of ground-based medical support in the airline industry.

[392] TECHNOLOGY AS AN ENABLER IN THE MANAGEMENT OF IN-FLIGHT PASSENGER MEDICAL EMERGENCIES

I.M. Hosegood
Aviation Medicine and Occupational Health Services, Qantas Airways Ltd., Sydney, NSW, Australia

INTRODUCTION: Serious in-flight medical emergencies are relatively uncommon but challenging events on commercial aircraft. The consequences of misdiagnosis or mismanagement can be significant in terms of both human and operational costs. Airline medical departments are increasingly looking towards innovative ways to improve diagnosis and management decisions and emerging technologies may provide the next incremental improvement in outcomes. Cardiological and neurological emergencies present the largest risk for morbidity and operational impact and are where efforts need to be focused. **DISCUSSION:** This paper discusses the current and potential future use of technology as one facet of an overall holistic passenger health management system. Telemedicine and data telemetry are discussed as are point of care diagnostic analyses. Technological advances in diagnostic equipment paired with increased aircraft to ground communication capacity mean that improved diagnostic accuracy can be achieved through the application of appropriate technologies.

Learning Objectives:

1. To understand the evidence in relation to the epidemiology of in-flight medical emergencies and their consequences.
2. To understand the components of a resilient passenger safety management system.
3. To explore the role of technology in improving the management and outcomes of inflight medical emergencies.

Wednesday, May 13 ***4:00 P.M.***
S. Hemisphere 5

[LXXIV.] SLIDE: AERO-POTPOURRI: PAIN, PIERCING AND PLEASURE

Chair: James DeVoll
Washington, DC

4:00 p.m.
[393] DUAL ULTRASOUND CAN MEASURE KINEMATIC MOTION AND INTERVERTEBRAL DISC DEFORMATION OF CERVICAL SPINE

M. Zheng[1, 2], A. Masoudi[1], T. Licata[1, 3], D. Buckland[4], and B. Snyder[5, 1]
[1]Beth Israel Deaconess Medical Center, Boston, MA; [2]Boston University, Boston, MA; [3]Bouve College of Health Science, Northeastern University, Boston, MA; [4]Massachussets Institute of Technology, Cambridge, MA; [5]Boston Children Hospital, Boston, MA

INTRODUCTION: Back and neck pain allegedly related to intervertebral disc (IVD) disease are common complaints among Army aviators and NASA astronauts. Currently, there are no methods to evaluate the real-time motion of C-spine and strain of Functional Spinal Units (FSUs) in these operating personnel *in-vivo*. We show that a dual clinical ultrasound system (US) is capable to measure the kinematics of C-spine stereographically. **METHODS:** The precision of US was validated *ex-vivo* using phantom and human adult cadaveric spines. We compared the ability of US to measure motion of phantom and vertebrae subjected to known motion. The material properties of FSUs were compared to clinical Pfirrmann grades. For *in-vivo* trials, human subjects are seated on vertical neck motion simulation system. The US transducers measure c-spine displacement and compliance (Dh/DF) in subjects with HSM of varied applied loads. **RESULTS:** The mean absolute error of US tracking was ±0.041 mm. Dynamic FSU deformation measured by US was consistent with the IVD deformation measured directly. C6-7 FSU deformation derived from US accounted for 92% of the variation in FSU motion compared to direct measurements for frequencies up to 6Hz and 77% at 8Hz. Biomechanical test analysis showed the stiffness of a specimen was affected by its Pfirrmann Grade while the damping coefficient was not. Younger specimens with integral disc tend to be more compliant than older specimens. For preliminary *in-vivo* trials, biomechanical differences are seen in the motion of the c-spine between younger and older subject. The C4-5 IVD tended to be more compliant for the younger human subject in US. **DISCUSSION:** As this was conducted as a feasibility study, the number of samples analyzed was low and our preliminary findings must be viewed with some caution. But the correlation between stiffness and IVD hydration is consistent with the observation that the "health" and integrity of the IVD affects the mechanical performance of the FSU. Our US system provides a cost-effective clinical tool to evaluate the integrity and performance of the IVD by applying low amplitude traction and compressive loads to the head and neck *in-vivo*.

Learning Objectives:

1. Learn how clinical ultrasound can be used to image the cervical spine IVD in real-time.

4:15 p.m.
[394] CONSERVATIVE MANAGMENT OF MECHANICAL NECK PAIN IN A HELICOPTER PILOT- CASE STUDY

B. Alagha
Iranian Chiropractic Association, Tehran, Iran

INTRODUCTION: Acute and chronic spinal symptoms such as neck pain may limit flying performance significantly and disqualify the pilot from flying duty. Mechanical neck pain is highly common among military pilots due to exposure to vibration, $+G_z$-forces, helmet weight, poor neck posture during air combat maneuvers (ACM), previous neck injuries and poor previous treatment plans. It needs an appropriate therapeutic procedures as well as aeromedical assessment. Although the air force and navy waiver guides recommended non-steroidal anti-inflammatory (NASIDs) medications as well as spinal manipulation and mobilization therapy (SMMT) and exercise therapy (ET), there are currently a very few published studies that describe the benefits of SMMT and ET for managing mechanical neck pain for commercial and military pilots. The aim of presenting this case study is to demonstrate the benefits of manipulative and exercise therapy in treatment of chronic mechanical neck pain in a helicopter pilot. **METHODS:** A 36-year old male patient presented to clinic with intermittent non radicular chronic moderate neck pain and limited range of motion over a period of 2-year duration. The pain is mostly located on the left side of neck and got aggravated during head rotation to the left and left lateral bending. Some activities such as driving and head rotation during flying increase the pain severity as well. **RESULTS:** The patient was treated by cervical and upper thoracic spine manipulation procedures followed by home exercise therapy for 5 weeks. After this period the patient reported significant recovery and improvement in range of motion in neck. **DISCUSSION:** It seems that SMMT and home ET may be a safe and effective in treatment of uncomplicated mechanical neck pain in helicopter pilots.

Learning Objectives:

1. Spinal manipulation and home exercise therapy can provide some benefits in treatment of uncomplicated chronic mechanical neck pain in military pilots. It also helps to limit the using of medications such as pain killers which may cause some side effects after long term usage.

4:30 p.m.
[395] ASSOCIATION BETWEEN LOW BACK DISORDERS AND FUNCTIONAL TEST MEASURES AMONG MILITARY PILOTS: A FIVE YEAR FOLLOW-UP

T. Honkanen[1, 2], M. Mäntysaari[1], H. Kyröläinen[2], J. Avela[2], and T.K. Leino[3]
[1]Aero Medical Centre, Centre for Military Medicine, Helsinki, Finland; [2]Department of Biology of Physical Activity, University of Jyväskylä, Jyväskylä, Finland; [3]The Finnish Air Force Headquarters, Tikkakoski, Finland

INTRODUCTION: Low back pain (LBP) is common complaint among military pilots. Besides the fact that pilots exposed to high G-force are known to suffer LBP, there are not many studies published of predictors, risk factors or prevention of LBP among military pilots. The aim of this study was to estimate the number of Finnish military

pilots suffering from LBP and investigate the change of the prevalence of LBP among the cohort in five years as well as investigate the association between LBP and results of functional tests done five years before. **METHODS:** 104 Finnish Air Force male military pilots were selected to this study. The cohort consisted of 72 high performance aircraft (HPA) pilots and 32 former HPA pilots currently flying non HPA. The survey was conducted with a self-administered questionnaire and functional tests were performed as part of their annual aero medical examination. Association between LBP and results of seven functional tests (three spinal mobility tests, two lower limb elasticity tests and two static muscular endurance tests) was analyzed with logistic regression and chi-square. **RESULTS:** The prevalence of overall LBP was 71 % at baseline and 59 % at follow-up while flight related LBP prevalence was 31 % at baseline and 16 % at follow-up. Demographic information did not associate with LBP in the initial questionnaire or during the follow-up. The only statistically significant findings were that the HPA pilots experienced more flight related LBP than non HPA pilots (p= 0.013) and that static low back endurance test result and sport/activity related low back pain were associated (p=0.029) at five year follow-up. **DISCUSSION:** Our findings show that LBP among military pilots is common problem but it is also associated with other tasks than flying itself. The functional test results were not associated with flight related LBP. When trying to find the pilots with increased risk of flight related LBP more sensitive tests should be arranged.

Learning Objectives:

1. The association between different functional test results and LBP among military pilots will be described to the audience.
2. The audience will learn the recent prevalence of overall and flight related LBP as well as LBP prevalence in other tasks in FINAF.
3. The reason for decrease of LBP prevalence in 5 years of follow-up will be discussed.

4:45 p.m.
[396] ALCOHOL & DRUG TESTING AND NOT PUNITIVE PROGRAM FOR CREWMEMBERS IN BRAZILIAN AIRLINE

E. Aguiar[1] and V.E. Melhado[1, 2]
[1]Medical Department, Azul Airline, Sao Paulo, Brazil; [2]Internal Medicine, FCMSCSP, Sao Paulo, Brazil

INTRODUCTION: Suggested treatment protocols for the alcoholic and/or chemically dependent airline pilots are well established in many countries of the world. Since 2011 National Civil Aviation Agency in Brazil became mandatory by publication RBAC 120-02 for all airline transportation develop and apply own Alcohol & Drug Testing Programs. The suggested drug test of National Civil Aviation Agency is the urine test. Azul Brazilian Air Line started operational work in Brazil in December 2008.Flight Crew and maintenance technicians were drug tested since company day1.On 2012 company have a fusion with another regional company that had not Alcohol & Drug Testing Programs implanted. **METHODS:** During the Assessment day all candidates since 2008 are subjected to complete physical examination including testing for drugs. The drug test used is Keratin-hair test and the drugs are; Cocaine ,Marijuana ,Amphetamines ,Methamphetamines, Ecstasy ,Opium ,Morphine ,Heroine ,Codeine ,Oxycodone (synthetically form of morphine),PCP. All candidates had a pre-employment positive test are invited for an interview with the doctor and was not approved. **RESULTS:** We observed that the candidates in the pre admission exam positive drug test for a 0, 95% of pilots and 2,78 % for fly attendants first year, 1.15% second year for all crew people and 0,2% in the last four years .The more frequently drugs are marijuana, cocaine and ecstasy. Since June 2014 we started random test and showed 2% exam positive drug test. The more frequently drugs are codeine, marijuana. **DISCUSSION:** The medical history and the wide window testing can identify the pattern of use. A person who is not dependent, but behavior has harmful use of the substance, may be unused for one and. The codeine positive drug test identify pilots receive prescription drug. Besides recommendation are urine our dates give us better safety results.

Learning Objectives:

1. How important is Alcohol & Drug Testing and not Punitive Program for Flight Crewmembers.
2. The choice of test used for drug test during after admission change the results on random period.

5:00 p.m.
[397] TOBACCO USE IN U.S. AIR FORCE AVIATORS

J. Sill[1,2]
[1]Aeromedical Consultation Service, USAF School of Aerospace Medicine, Virginia Beach, VA; [2]Pulmonary and Critical Care, Eastern Virginia Medical School, Norfolk, VA

INTRODUCTION: Cigarette smoking is the leading cause of preventable death in the United States, causing an estimated 480,000 deaths every year. It has also been associated with numerous debilitating and aeromedically disqualifying medical conditions, including chronic obstructive pulmonary disease, spontaneous pneumothorax, coronary artery disease, peripheral vascular disease, asthma, and lung cancer. Despite aggressive anti-smoking campaigns and legislation, tobacco use remains a major public health concern, both in civilians and in military personnel. Numerous studies on tobacco use in U.S. military personnel have been performed, though data on smoking rates in U.S. military aviators is limited. **METHODS:** The U.S. Air Force School of Aerospace Medicine's Aeromedical Consult Service performs comprehensive medical evaluations on U.S. military aviators. Data on tobacco use was collected as part of these examinations. We retrospectively reviewed tobacco usage data on 8,331 individuals during 15,837 evaluations from 1967 to 2010. **RESULTS:** Overall tobacco use over the course of our study was substantial, though lower than that of the general population. Use in females was slightly lower than that of males. Tobacco use was similar across different racial groups. Perhaps the most striking data from our study was the dramatic decrease in tobacco use over time in U.S. Aviators. **DISCUSSION:** Smoking continues to be a major health concern for the U.S. military. Our study shows that while use in U.S. Air Force aviators has at times been substantial, there has been a significant decrease in smoking rates in recent years. Our data support similar findings that have been noted in small surveys of U.S. aviators and in studies of commercial pilots. Continued efforts to reduce smoking among aviators and other military members should be encouraged.

Learning Objectives:

1. Describe trends in tobacco use in U.S. Air Force Aviators.

Wednesday, May 13 ***4:00 P.M.***
S. Hemisphere E3

[LXXV.] PANEL: AN EYE TO THE FUTURE: MODERN SURGICAL MANAGEMENT OF REFRACTIVE ERRORS IN AIRCREW

Sponsored by the AsMA Air Transport Medicine Committee

Chair: Martin Hudson
Crewe, Cheshire, United Kingdom

PANEL OVERVIEW: In recent years major advances have been made both surgically and with the use of sophisticated contact and intraocular lenses to achieve normal vision. Modern Laser methods are available which rapidly correct corneal aberrations, have a very rapid recovery time and a low incidence of post operative complications. New varifocal contact lenses are also being used which correct for myopia, astigmatism and presbyopia. In some patients different types of contact lenses can be used in the same individual with one eye correcting distance vision and the other near vision. Similarly insertion of sophisticated intraocular lenses can correct for multiple visual aberrations. Current regulations also do not permit commercial pilots to use sophisticated multipurpose contact lenses or intraocular lenses. However,

in the current world of commercial aviation most pilots have to rely on use of spectacles and unifocal contact lenses to achieve normal or near normal vision because the majority of aviation authorities insist on a three month flying ban following Laser eye surgery. On the other hand some authorities, including the military, have a more liberal approach allowing a rapid return to flying as soon as recovery and stability of vision is achieved following Laser eye surgery. This wide variation in regulation is puzzling and this Panel will review the rules in the regulations among different aviation authorities and will consider why there is a difference. The panel will also present an update on the use of contact and intraocular lenses as well as modern Laser techniques and will consider if the complication rate is sufficiently low to allow commercial airline pilots to benefit without compromising flight safety.

[398] OPHTHALMOLOGY STANDARDS FOR COMMERCIAL PILOTS

M.F. Hudson
Medical Adviser, Thomas Cook Airlines, Crewe, United Kingdom

INTRODUCTION: In recent years major advances have been made both surgically and with the use of sophisticated contact and intraocular lenses to achieve normal vision. Modern Laser methods are available which rapidly correct corneal aberrations, have a very rapid recovery time and a low incidence of post-operative complications. New varifocal contact lenses are also being used which correct for myopia, astigmatism and presbyopia. In some patients different types of contact lenses can be used in the same individual with one eye correcting distance vision and the other near vision. Similarly insertion of sophisticated intraocular lenses can correct for multiple visual aberrations. Current regulations do not permit commercial pilots to use sophisticated multipurpose contact lenses or intraocular lenses. In the current world of commercial aviation most pilots have to rely on use of spectacles and unifocal contact lenses to achieve normal or near normal vision because the majority of aviation authorities insist on a three month flying ban following Laser eye surgery. On the other hand some authorities, including the military, have a more liberal approach allowing a rapid return to flying as soon as recovery and stability of vision is achieved following Laser eye surgery. This wide variation in regulation is puzzling and this Panel will review the rules in the regulations among different aviation authorities and will consider why there is a difference. The panel will also present an update on the use of contact and intraocular lenses as well as modern Laser techniques and will consider if the complication rate is sufficiently low to allow commercial airline pilots to benefit without compromising flight safety.

Learning Objectives:

1. To provide an update on modern techniques to correct visual abnormalities and to make recommendations for aviation authorities to review the current ophthalmology regulations.
2. To understand what types of visual correction are allowed or not allowed.
3. To learn what are the ophthalmology standards for commercial pilots and whether they are appropriate.

[399] CORNEAL REFRACTIVE SURGERY AND THE MILITARY - A SCRUITINY OF CURRENT STANDARDS AND THEIR RATIONALE

I.A. Mollan
RAF Centre of Aviation Medicine, Royal Air Force, RAF Henlow, United Kingdom

INTRODUCTION: Good vision in the aviator is paramount in order to maintain flight safety and mission effectiveness. Whilst Corneal Refractive Surgery (CRS) comprises many separate techniques, overall they are now widely practiced methods of correcting moderate degrees of myopia, astigmatism and hyperopia. Aviation duties in military environments differ from those of civilian settings. Military pilots are more likely than their civilian counterparts to be exposed to hazardous stimuli. Mission requirements in military aviation are unlike that in civilian aviation. The varying techniques of CRS and their potential complications may cause structural weakening or degrade vision and therefore have detrimental effects on flight safety or mission effectiveness. **METHODS:** Member nations of the Air Space Interoperability Council (ASIC) and the European Air Group (EAG) were contacted. Aviation medicine policies and the standards for CRS were obtained; where possible the rationale for policy positions was examined. **RESULTS:** Although there were policy differences in the type of surgery allowed between individual Nations, the incisional corneal surgery techniques of Astigmatic Keratotomy (AK) and Radial Keratotomy (RK) were disqualifying. In general, Photorefractive Keratectomy (PRK), Laser In-Situ Keratomileusis (LASIK) and Laser Epithelial Keratomileusis (LASEK) were acceptable in specified circumstances. The refractive error requirements both pre- and post-surgery was examined and varied between Nations. The nature of post-operative assessment and follow up requirements was scrutinized and differed between Nations. **DISCUSSION:** Incisional techniques of AK and RK cause significant weakening; diurnal changes in refraction and changes with altitude are observed with RK; therefore these techniques are not compatible with military aviation. Pre-surgical refraction range is limited due to known risks of developing other problems over time, however precise requirements varied between Nations due to risk tolerance. Primarily, pre- and post-surgical testing is undertaken to look for effects of post-surgical corneal scarring and optical aberrations. Despite differences in testing requirements, further research and investment in testing equipment is required.

Learning Objectives:

1. To understand the military medical standards for corneal refractive surgery.
2. To understand the rationale for the military medical standards in corneal refractive surgery.

[400] KERATOCONUS AND CORNEAL SURGERY IN COMMERCIAL PILOTS

N. Ahmed
Emirates Airline, Dubai, United Arab Emirates

INTRODUCTION: Keratoconus is a pathological process of the eye which can significantly affect vision leading to potential permanent loss of medical certification. The advent of newer corneal surgical techniques like corneal cross linking and corneal transplant has improved the outcome for pilots with Keratoconus. **METHODS:** An audit of three class one pilot cases was undertaken, all of whom were required to undertake surgery for Keratoconus. Pre and post-operative visual correction, surgical techniques, potential side effects, time to stability, re-licensing issues and post-operative complications were reviewed **RESULTS:** Both pilots who only required corneal cross-linking did extremely well and were relicensed back to work within 1 year. Subsequent follow ups have not highlighted any issues and their vision remains stable and within licensing requirements. The pilot who additionally required a corneal transplant suffered some complications related to his sutures and over correction. However, post LASIK eye surgery, his vision stabilized and he regained his medical certification. **DISCUSSION:** Newer techniques available to corneal surgeons including corneal cross-linking, laser eye surgery and corneal transplants may allow commercial pilots who develop significant Keratoconus to regain their certification and careers.

Learning Objectives:

1. Keratoconus is a genetic condition which can lead to the permanent loss of a pilot's medical certification.
2. Newer techniques of corneal cross-linking can stabilize and improve vision significantly with minimal side effects.
3. Commercial pilots undertaking corneal transplants or cross-linking can be successfully returned to flying.

[401] EASA REQUIREMENTS AND UK CAA POLICY ON REFRACTIVE SURGERY AND MULTIFOCAL CORRECTION

A. Chorley
Medical Department, UK Civil Aviation Authority, West Sussex, United Kingdom

INTRODUCTION: EASA medical requirements are implemented by all member states. The implementing rules form a legal regulatory

framework which member states must follow. Other areas within the guidance material form suggested best practice and can be subject to review and change by individual National Authorities. For the UK CAA, this would be supported by evidence based medicine. There are a number of ways achieving optical correction for the ametropic presbyope including spectacles, single vision, monovision or multifocal contact lenses, corneal refractive surgery and various types of intraocular implants which are discussed in the context of the requirements. There are some discrepancies in the standards with regard to multifocal correction with contact lenses or intraocular lenses although optically, the two forms of correction are likely to have similar side effect profiles. The UK CAA has some experience of certification of pilots with multifocal lens implants. The outcome of these cases and subsequent proposed CAA policy is discussed. It would appear outcomes are variable and less predictable than for single vision implants. There is a good case to certify the pilot with multifocal implants who has a good surgical result and whose visual function falls within normal parameters however this is less certain than for single vision implants or corneal surgery. It is suggested that the regulator should not encourage the use of multifocal implants however should assess each case on its merits. Pilots must understand the risks to re-certification before undertaking this type of procedure. Data on the certificatory outcomes of professional pilot applicants presenting at the UK CAA AeroMedical Centre with previous corneal refractive surgery are presented. Current guidelines for revalidation periods following corneal surgery and intraocular lens implants are discussed.

Learning Objectives:

1. To provide the audience with an overview of the EASA requirements for refractive surgery and multifocal correction and the experience of the UK CAA in assessing applicants with multifocal lens implants or refractive surgery.

[402] MODERN LASER EYE SURGERY FOR COMMERCIAL PILOTS. A PILOT DOCTOR EXPERIENCE

E.A. Ivory
Aviation Medicine, Flight Operations, Marlborough Aviation Medical & British Airways, Marlborough, United Kingdom

INTRODUCTION: Laser eye surgery for the correction of refractive errors is an established technique. There has been much caution in the aviation environment concerning side effects and recovery period to ensure safe flight operations. Over the last ten years there have been rapid and significant advances in laser quality, operative techniques, preoperative assessment and planning. There is now good evidence to suggest that prolonged grounding periods for pilots following surgery are no longer necessary. **METHODS:** The author, who is a medically qualified commercial pilot, presents a personal account of undergoing modern laser eye surgery to correct both myopia and presbyopia. A review of personal pre-operative and follow up data is presented. Extensive follow up data from the treating clinic is presented along with a brief review of the literature. The visual related, flight safety critical tasks are discussed in the context of refractive error and correction options. **RESULTS:** Personal real time results are presented including refraction, visual acuity, and contrast sensitivity at 1 day, 1 month, 5 months and 15 months. The author returned to multicrew medium short haul jet operations at three months post op but would have been assessed as fit by the treating surgeon at 2 - 3 weeks. **DISCUSSION:** Modern laser eye surgery is a positive contribution to flight safety. Careful case selection and preoperative assessment and the use of modern techniques are the key to a successful outcome. Post-operative grounding periods need to be considered on the basis of current evidence and should be made on a case by case basis following expert assessment rather than a regulatory fixed minimum grounding period. Flexibility and individual assessment, as is the norm in the USA, will allow more pilots to benefit from this treatment method for refractive error without loss of income or flight currency. The remote, but real possibility of pilots "going underground" to seek treatment without disclosure and therefore appropriate follow up would be avoided.

Learning Objectives:

1. Evidence is the best defense. In a rapidly progressing area of medical intervention, regular review of good quality data facilitates inclusive aeromedical decision making without compromising flight safety. Continual examination of safety critical flight tasks in conjunction with medical interventions, further aids evidence based and accountable aeromedical decision making.
2. To promote pilot and airline education concerning laser eye surgery as an option for the correction of refractive error including presbyopia. There is a common misconception amongst commercial pilots, certainly in the UK, that laser surgery is not permitted by either the regulator or the airlines.

Wednesday, May 13 ***4:00 P.M.***
S. Hemisphere E4

[LXXVI.] PANEL: AEROSPACE MEDICINE IN AIR SPORT

Chair: Kazuhito Shimada
Lausanne, Switzerland

PANEL OVERVIEW: When a pilot seeks world records or participate in a world championship, he/she falls under the jurisdiction of the Fédération Aéronautique Internationale (FAI) - The World Air Sports Federation, which was founded in 1905. It has the Commission Internationale Medico-Physiologique (CIMP), for the study of the medical and physiological factors that influence human performance and behavior in the air sports environment. FAI-CIMP is one of 40 AsMA Affiliated Organizations. What are 'Air Sports ?' The definition is in 'FAI Sporting Code,' which includes: Balloons & Airships, Aeroplanes, Gliding, Aeromodelling, Parachuting, Aerobatics, Hang-Gliding & Paragliding, Astronautic Records, Rotorcraft, Microlights, Human Powered Aircraft, Unmanned Aerial Vehicles (UAV), and Solar-Powered Aeroplanes. Air Sports' pilots are called 'athletes', as achieving records (could be personal, FAI badge, or absolute new world number) or participating in competitions are involved. When an 'athlete' shows up at a clinic, its physician should treat the person not only with standard medical methodology and/or aviation medical exam items, but also with anti-doping procedure knowledge. The checklist had been special to Olympic athletes in the past, but now most of us are bound by the 'International Convention against Doping in Sport.' The 'World Anti-Doping Code' has a banned items list. The process is counter-intuitive; a diuretic for hypertension should always be followed by a Therapeutic Use Exemption document signed by the treating physician and the athlete. Aeromodel operators are not exempted. CIMP has NOT been much positive about applying the Anti-Doping Code to Air Sports; still CIMP has been giving advice to FAI anti-doping activities, and CIMP TUE Panel helps in TUE process. FAI was only recently reorganized to involve flight safety experts, before which CIMP was the only group to discuss flight and competition safety of all of Air Sports. Obtaining accident data is the starting point of accident prevention, but it is not easy to do so with some activities, e.g., Unmanned Aerial Systems (UAV, UAS, aeromodels, etc.).

[403] THE MEDICO-PHYSIOLOGICAL COMMISSION (CIMP) OF THE WORLD AIR SPORTS FEDERATION (FAI)

M.J. Osinga-Meek
[1]Federation Aeronautique Internationale, Commission Internationale Medico--Physiologique, Lausanne, Switzerland; [2]Royal Netherlands Aeronautical Association, Aeromedical Board, Woerden, Netherlands

INTRODUCTION: Background and history of Aerospace Medicine in Air Sports. Program of FAI-CIMP Practicing air sports is widely spread over the world. The definition of air sports is laid down in the FAI Sporting Code. The Fédération Aéronautique Internationale (FAI) was founded in 1905. It is a non-governmental and non-profit making international organization with the basic aim of furthering aeronautical and astronautical activities worldwide, ratifying world and continental records and coordinating the organization of international competitions. FAI is now an organization of more than 100 member countries, forming a strong network linking all those who

participate in air sports worldwide. FAI activities include the establishment of rules for the control and certification of world aeronautical and astronautical records. FAI establishes regulations for air sporting events which are organized by member countries throughout the world. FAI promotes skill, proficiency and safety in aeronautics. FAI confers awards to those who have contributed to the achievement of these aims. Air sports pilots participating in competitions are subjected to the rules of WADA (World Anti Doping Agency). When a pilot uses medication that is on the banned list of WADA, there is a procedure to request Therapeutic Use Exemption (e.g. for insulin). This will be validated by the TUE-panel of CIMP. The medico-physiological commission (CIMP) is a technical commission of the FAI. The aim of the CIMP is the study of the factors that influence human performance and behavior in the air sports environment. The CIMP membership is open to medical and medical-related professionals of the member states of the FAI. In the annual meeting issues of aeromedical interest are discussed. The task of CIMP is obtaining scientific data on flight safety, discussing present and future aeromedical rule making, giving aeromedical advice to national aeroclubs and air sports communities, giving advice to FAI in anti-doping activities. Information of the medical standards used in several countries to assess the fitness for flying of air sport pilots is available. The CIMP is one of the AsMA Affiliated Organizations.

Learning Objectives:

1. The audience will learn the background and history of aeromedical issues in air sports, as studied by the Medical-Physiological Commission (CIMP) of the World Air Sports Federation. The aim of the CIMP is the study of factors that influence human performance and behavior.

[404] O2 SATURATION SAFETY AT MOUNTAIN WAVE PROJECT (MWP) GLIDER OPERATION FLIGHTS MT EVEREST FL 280, 01 FEBR2014

J.K. Knueppel[1, 2] and C. Ledderhos[3]
[1]Commission Medico Physiologique, Federation Aeronautique Internationale, Schwalmstadt, Germany; [2]MedAdvisor, Mountain-Wave-Project, Berlin, Germany; [3]Applied Science, Institute of Aviation Medicine, Fuerstenfeldbruck, Germany

INTRODUCTION: The first time in history a glider ascent of up to FL 280 was performed on the south side of Mt Everest. Goal was to study the specific mountain meteorological situation for updrafts, with hang-winds, thermals and wave conditions at these very high altitude flying conditions. For safety reasons Oxygen saturation was measured in flight, as only simple Oxygen hardware could be used. **METHODS:** In cooperation with CAA Nepal a scientific expedition took place winter 2013/14. Electronic Oxygen Delivery System (EDS) and Diluter Demand systems at altitudes above 20.000 feet were combined to an redundant operational setup to supply the two man pilot cockpit with sufficient oxygen. Two 5-L oxygen bottles, one each for one pilot, were used for two pilots. The STEMME S 10 Motorglider had to be flown primarily in powered mode due to winds up to 200 km/h, but was also used in glider mode to measure climb rate and altitude gain. **RESULTS:** Motorglider flights up to FL 280 were difficult to perform due to regular very high wind speeds and the orography of mountain ridges close to jet streams. Only in rare occasions with less wind-turbulence pure glider flying could be successfully performed on 1 Feb. 2014. The Oxygen supply, EDS and Diluter Demand system, provided a safe oxygen supply for two pilots at these altitudes. Two independent oxygen bottles were available to care for redundancy, as in case of system-malfunction the second pilot could sink and fly the AC to safe altitudes. Sophisticated pulsoximetry sensors were used at different body locations (forehead, breast, leg) to check the actual pilots oxygen saturation. It could be shown that O2 saturation levels were most reliably measured at the forehead with transluminal sensors. Oxygen saturation was up to FL 280 always well above 90%.

Learning Objectives:

1. Best reliable O2 saturation levels were measured at the forehead with transluminal sensors.
2. For a two man glider Cockpit two independent 5-L oxygen bottles were used.
3. EDS was used for altitudes below 20.000 feet, above a Diluter Demand System could be added.

[405] ANTI-DOPING IN AIR SPORTS

G.W. McCarthy[1,2]
[1]AvMedSafe, Portland, OR; [2]CIMP, Federation Aeronautique Intl, Lausanne, Switzerland

INTRODUCTION: The 11 air sports in which athletes compete internationally are governed by the FAI. Although no air sport is currently an Olympic sport, FAI conforms to the Olympic Code, as administered by the World Anti-Doping Agency (WADA). In this panel session, I shall outline the history of anti-doping, present the Prohibited List of drugs in and out-of-competition, and illustrate how Therapeutic Use Exemptions (TUE) from this list are requested and adjudicated by the TUE Committee (TUEC). Efforts to prohibit use of performance-enhancing drugs in sports are not new, but were codified by the Olympic Committee in the early 1990s. Acceptance by sport and by government varied, but the UNESCO *International Convention Against Doping in Sport* has been ratified by 174 states. WADA is funded partly by the Olympic Committee and by various governments. In turn, sports' governing bodies impose adherence to the code for their licensed athletes. It is the athlete's duty to avoid prohibited drugs, to provide blood and/or urine samples on demand, and if in a Registered Testing Pool (RTP) to notify their location continuously to WADA. If the athlete and his/her physician determine that use of a prohibited drug is necessary, a TUE may be requested. Six members of the Commission Internationale Médico-Physiologique (CIMP) of FAI form the TUEC. Four criteria are considered: the medical necessity for the drug, the possibility of enhanced performance, the potential for an equivalent, non-prohibited drug, and the use being derived from another prohibited substance or method. The incidence of anti-doping in air sports and examples of unusual or controversial TUE will be shown. Aspects of anti-doping that can affect flying safety will be emphasized.

Learning Objectives:

1. Understand the potential abuse of drugs in aerial athletes.
2. Understand the World Anti-Doping Agency Prohibited List.
3. Understand the considerations for issuance of a Therapeutic Use Exemption to use a prohibited drug or method by a registered aerial competitor.

[406] THE IMPACT OF AIRMAN CERTIFICATION STANDARDS ON AIR SPORT PARTICIPATION

R.T. Garrison
Aerospace Medicine, Wright State University, Dayton, OH

INTRODUCTION: Air Sports competitions are held in numerous countries and involve all types of aircraft and aerial conveyance such as parachuting, model airplanes, etc. The participating airmen must meet national requirements to operate conventional aircraft in their homelands. Most nations with general aviation activity have regulations for both pilot privileges and medical certification and are often similar to other countries' standards and treated with reciprocity. Even with these similarities the ability to easily cross borders and be able to pilot an aircraft in foreign airspace during competitions may be problematic. Several nations have created airman certificates and pathways to medical certification that are intended to foster more participation in aviation. The United States (FAA) and European Union (EASA) have medical standards that are simplified to meet this goal. The FAA" Light Sport Pilot" certificate and the EASA Leisure Pilot License " are the example of this effort to encourage participation in aviation. There are other examples of medical certification in other countries that are either more or less restrictive. Unfortunately there are no universal standards and these licenses may not be accepted as adequate in some countries. This fact may make international competition more problematic for airmen. Other types of air sport may have no medical requirements but this is irregular in their application, such as parachuting. This situation's impact on air sport has not been reviewed. It is the intent of this presentation to compare and contrast different certification standards and highlight differences and possible impediments to airmen competing in international venues.

Learning Objectives:

1. To make the participant aware of international differences in medical requirements and airman certification. It will help them advise airmen anticipate the need for further documentation or certification before competing in a country that may impose restrictions on their being allowed to compete with their current medical and pilot certificates.

[407] AEROMEDICAL SUPPORT FOR AN INTERNATIONAL MULTI-AIR-SPORT EVENT

S. Kajornboon[2], J.K. Knueppel[3], G.W. McCarthy[1], R.T. Garrison[5], and K. Shimada[4]
[1]AvMedSafe, Portland, OR; [2]Civil Aeromedical Center, Bangkok, Thailand; [3]Commission Medico Physiologique, Federation Aeronautique Internationale, Schwalmstadt, Germany; [4]Flight Research Center, JAXA, Mitaka, Japan; [5]Aerospace Medicine, Wright State University, Troy, OH

INTRODUCTION: With increase in frequency and number of participants of international Air Sport events, aeromedical support for competitors and visitors became complex. The author supported the 4th Asian Beach Games held at Phuket Island, Thailand in 2014. The event involved not only Paragliding and Power Paragliding, but also 26 other sports which included Sambo, Jet ski, Triathlon, etc. There were many aspects to be shared by AsMA members. **METHODS:** The aeromedical support for the Asian Beach Games started with planning with stakeholders. Overall sports event management was by the Olympic Council of Asia and National Olympic Committee of Thailand. The Ministry of Health takes the responsibility for all aspect of the medical support. Regional support came from Ministry of Tourism and Sports. Air Sport safety skills came from FAI. The author's principal role was in inter-hospital interface and aeromedical evacuation. **RESULTS:** The author's regular health service extended to Phuket Island only as aeromedical evacuation network to support complex or complicated medical need from Bangkok area. Example case reports will be presented. **DISCUSSION:** In addition to Olympic Sports, other sports gaining popularity, including parachuting from Air Sports, are holding larger and more complex events. As not all of sports associations are skillful in holding a multi-disciplinary event, aerospace medicine specialists should be more proactive in assisting event organizers.

Learning Objectives:

1. To understand the complexity of aeromedical support for an international multi air sport event.

Thursday, May 14 ***8:15 A.M.***
Northern Hemisphere Ballroom

50TH ANNUAL HARRY G. ARMSTRONG LECTURE

The Kennedy Space Center and NASA's Vision for the Future

Robert Cabana
Center Director, NASA-John F. Kennedy Space Center, FL

Thursday, May 14 ***10:00 A.M.***
S. Hemisphere 1

[LXXVII.] SLIDE: MUSCULOSKELETAL ISSUES AND HUMAN PERFORMANCE

Chair: Paul Young
San Antonio, TX

10:00 a.m.

[408] EXPOSURE-RELATED DIFFERENCES ON NECK AND TRUNK MUSCULOSKELETAL CHARACTERISTICS IN US ARMY HELICOPTER PILOTS

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INTRODUCTION: A high prevalence of nonspecific neck pain (NP) and low back pain (LBP) is reported among military helicopter pilots, especially in senior and master pilots. Due to exposures to physical stress during flight (altitude, noise, vibration, poor sitting posture (due to confined cockpit space), fatigue, night-vision goggle, and additional protective gears), pilots may gradually deteriorate their neck and trunk musculoskeletal characteristics that predispose them to NP/LBP. Therefore, the purpose of this study was to compare neck and trunk strength, flexibility, and posture among pilots with various flight-hours. **METHODS:** A total of 115 male helicopter pilots participated in laboratory testing and were divided into five groups based on total flight-hours (0-999hrs (n=61), 1000-1999hrs (n=22), 2000-2999hrs (n=17), 3000-3999hrs (n=8), and 4000+hrs (n=7)). Laboratory testing included isometric cervical muscular strength and isokinetic trunk muscular strength, cervical/lumbar spine active range-of-motion (ROM) and hip rotation passive ROM, forward head/shoulder posture, and pectoralis minor length. Strength values were normalized to body weight. Based on the tests for normality and equality of variance, appropriate one-way analysis of variance and post-hoc analyses were used to examine the group differences ($p<0.05$). **RESULTS:** When compared to the pilots with less than 1000 flight-hours, there were significant reductions in neck extension and lateral flexion strength and lumbar spine extension and lateral flexion ROM among the pilots with 3000+ flight-hours. Similarly, significant reductions in cervical spine extension and lateral flexion ROM and increase in pectoralis minor length were found in the pilots with 2000+ flight-hours ($p<0.05$). **DISCUSSION:** The current findings confirmed exposure-related musculoskeletal changes. Interestingly, cervical spine ROM and posture may be more sensitive to the exposure than neck strength and lumbar spine ROM. Clinically, it is important for clinicians and pilots to monitor their musculoskeletal characteristics and implement strategic intervention programs to minimize those exposure-related declines at different stages of their career.

Learning Objectives:

1. Modifiable musculoskeletal characteristics that are associated with individuals with NP/LBP are described.
2. Exposure-related differences (based on total flight-hours) in musculoskeletal characteristics are described.

10:15 a.m.

[409] DEVELOPMENT OF A METHOD TO IMPROVE THE ANALYSIS OF POSTURAL CONTROL IN HEALTHY SUBJECTS AFTER PROVOCATIVE SETTINGS

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INTRODUCTION: For objective testing of a patient's balance, posturography can be used. In aviation medicine, there is the need for a portable device which is quick, non-invasive and sensitive enough to measure subjects that are younger and, most importantly, healthier than the average patient. The device should supply measurements for healthy subjects while their balance system is exposed to various provocations occurring in flight simulators and disorientation devices as well as during real flights and after G loads produced by the human-use centrifuge. Eventually, the analysis should allow for a statement about the impact of challenges to the equilibrium system for pre-selected subjects in the most sensitive way. **METHODS:** For the tests, a commercially available system (TETRAX IBS) was used. In order to disclose even small disturbances of balance control, we modified the testing procedure following a suggestion of Prof. Kohen-Raz. Ante-posterior and lateral inclinations of the platform made it possible to compare the conventional method with the modified procedure in a group of healthy subjects. Out of the various parameters generally measured by the system, the following parameters were considered in the study: the Stability Index (ST), frequency bands of the Fourier Transformation and the synchronization between left and right toes. **RESULTS:** 178 healthy persons (male/female; age 18 to 55) participated. A statistically significant difference