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Oral Presentation Abstracts

001 Allard Lecture

PREDICTION AND PREVENTION OF CARDIOVASCULAR EVENTS IN AIR FORCE OFFICERS

PREVISION ET PREVENTION DES EVENEMENTS CARDIOVASCULAIRES CHEZ LES OFFICIERS DE LA FORCE AERIENNE

Air Marshal G Veerakul

Introduction: The most frequent reason for aircraft diversion is cardiac emergency and the most serious reason is in-flight sudden cardiac death (SCD) (1,2). The occurrence of SCD in the cockpit is very low but it instantaneously causes pilot incapacitation and possibly a tragic aircraft accident (3). Generally, SCD contributes to 50% of all cardiovascular deaths worldwide and the survival rate remains unacceptably low ($\leq 10\%$) (4,5). For over a decade, the SCD scenario has changed, the prevalence of ventricular fibrillation declining while the occurrence of asystole and pulseless electrical activities has increased (6-8).

Background: The causes of SCD are varied in different age groups and geography. In young western victims (age < 35 years), the frequent etiologies are hypertrophic cardiomyopathy and anomalous coronary artery (9). However, myocarditis and sudden unexplained death are more common among young Asians (10,11). Beyond the age of 35 years, occult coronary artery disease (CAD) remains the major issue (4,9,10).

Cardiovascular risk scores (i.e. Framingham, New Zealand, The SCORE, etc.) are routinely applied by aviation authorities and others to predict future cardiovascular event, including SCD, but their prediction rate is disappointing (12,13). Various invasive and non-invasive tools including rest, ambulatory and stress ECG, late potentials, heart rate variability, etc., have been studied but none is able to predict SCD (5,14). The only reliable test is left ventricular systolic function (LVEF) (14), however, a recent community-based study indicates that the number of young SCD victims with preserved LV systolic function is increasing (15). Thus, SCD prevention, in attempt to identify the high risk candidates and lowering the risk to active aviators, remains a challenging chapter in Aviation Medicine.

Summary: Understanding the arrhythmogenic substrates of heterogeneous victims is one of the keys to developing a SCD prevention program. In this review, sample cases of sudden unexplained death syndrome (16), myocardial infarction in the young (17), near fatal myocarditis and sudden coronary death without major risk factors will be presented. Non-invasive cardiac imaging techniques such as cardiac MR or coronary CT scan have been used to identify target pathology for specific treatment (18) or risk stratification (19). Genetic risk score for predicting CAD has been developed and tested in larger population (20). For the individual person, a healthy life style remains highly recommended since it could reduce coronary events by 48 %, even in participants who are genetically susceptible to CAD (20).

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002

SHARING THE SKIES SAFELY: FUTURE CHALLENGES TO AVIATION SAFETY (ERNSTING PANEL OVERVIEW)

*PARTAGER LES CIEL EN TOUTE SÉCURITÉ: DÉFIS FUTURS POUR LA SÉCURITÉ AÉRIENNE
(APERÇU DE LA PRÉSENTATION)*

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Introduction: The skies are the aviator's work environment, within which are many hazards threatening the aviator's safety and the safety of his/her passengers. There are many factors within the aviator-endogenous factors-that affect his/her performance and safety while in flight, but many other factors are exogenous and system-related. The International Academy of Aviation and Space Medicine is comprised of senior aviation medicine practitioners who play a role in constructing and regulating this global aviation environment. The objective of this panel is to highlight emerging factors affecting safe operations in the aviator's work environment, related to "sharing the skies safely."

Background: There are many challenges in sharing the aviation environment safely. First, the natural occupants of the airspace (e.g., birds, bats); Second, man-made flying objects (i.e., aircraft and flying vehicles of various sizes). Great resources have been expended to minimize the continuing hazard of bird strikes, which continue to pose a threat to aviation safety.

As commercial air travel has grown worldwide, so has the attention to commercial airspace safety, with ever-increasing technologies to maintain margins of safety among passenger-carrying aircraft. On-board collision avoidance systems, as well as air traffic control innovations, have been designed to keep pace with increased traffic demands.

The recent growth in unmanned aerial vehicles (UAVs) is forecast to increase exponentially with increased demand from industry as well as general aviation / air taxi interests. The projected congestion of low-level airspace, particularly in urban areas, is a challenge for the transportation industry and aviation safety regulators into the future.

Finally, the growth of commercial space travel has created great future need for space launch (vertical) vehicles to share airspace with conventional (horizontal) aircraft.

Summary: This panel will present the major areas of concern for future safe airspace sharing: commercial airspace management, UAVs, and commercial spaceflight. Policies and regulations will continue to evolve to ensure passage while preserving safety for all forms of flight.

003

KEEPING COMMERCIAL AIR TRAVEL AND AIRSPACE SAFE: EUROPEAN PROBLEMS ARE GLOBAL ISSUES

GARDER LE TRANSPORT AÉRIEN COMMERCIAL ET LA SÉCURITÉ DES ESPACES AÉRIENS: LES PROBLÈMES EUROPÉENS SONT DES PROBLÈMES GLOBAUX

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Introduction: Demands on commercial airspace are increasing dramatically—this is especially true in the European region. This presentation will outline the present and future challenges to aviation safety and how these problems are being approached.

Background: The European Air Traffic Network Manager plays an important role in mitigating the potential safety hazards of the growing demands on European airspace. Statistical data illustrates the challenges – increasing flights, regional differences, weather, industrial actions, capacity of airports, etc.

Summary: The challenges of the European air travel and airspace environment illustrate the global issues confronting the aviation industry and regulatory authorities. It is critical to understand the challenges and the way forward, to ensure safety and avoid disruption of the system in the future.

004

UNMANNED AERIAL SYSTEMS AND AIRSPACE SAFETY: SHARING A CROWDED AIRSPACE INTO THE FUTURE

SYSTÈMES AÉRIENS NON HABITÉS ET ESPACE AÉRIEN SÉCURISÉ: PARTAGE D'ESPACE AÉRIEN

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Introduction: While drone aircraft have been in use for decades, these were tightly controlled for special uses and posed no threat to aviation safety or the flying public. In the past decade, technology has put drones—unmanned aerial systems (UAS)—in the hands of a vastly increased number of users, employing UAS for an ever-increasing range of purposes. The general public can easily afford 'personal' UASs capable of flight out-of-visual range; industry is racing to develop larger UAS for cargo delivery or even air taxi applications; and the military continues to develop new uses for larger and more capable UAS platforms, in solo, team, or swarm applications. The safety implications of these UAS are urgent and challenging.

Background: The hazards posed by UAS to aviation safety are principally related to physical contact. Hazards to operators range from minor lacerations from toy UASs to fatal injuries from collisions with larger unmanned aircraft; UAVs can also pose a noise hazard to operators. Studies have documented significant injury risk from collisions with humans, either as operators or bystanders. The risk to larger aircraft in the event of a collision is most problematic, as the urban airspace of the future becomes more and more crowded. Rotary-wing aircraft in particular are at risk due to their low-altitude flying environment and more vulnerable windscreens, exposed rotors, etc. As larger UAS become more common, the control of airspace and cyber-vulnerabilities will become critical.

Summary: UAS are increasing in number and practical applications. It is essential that UAS are designed and operated to protect the safety of users, the uninvolved public, and other users of the global airspace system now and in the future.

005

DECONFLICTING TRAVEL OF AIRCRAFT AND SPACECRAFT THROUGH THE US NATIONAL AIRSPACE SYSTEM

DECONFLICTION DES DEPLACEMENTS D'AERONEFS ET D'ENGINS SPATIAUX DANS LE SYSTEME DE L'ESPACE AERIEN NATIONAL

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Introduction: Launching or reentering spacecraft have involved closing large swaths of the US National Airspace System (NAS) for extended periods of time to aviation traffic throughout the history of space flight. With the increasing frequency of space flights there has been high interest in finding ways to minimize the amount and duration of airspace restriction that is needed to allow for safe passage of aircraft and spacecraft. With funding support from the FAA's Center of Excellence for Commercial Space transportation, research has been conducted over the past eight years to examine this issue. Novel approaches have been proposed to reduce the negative impact to aviation and spaceflight through the same areas of the NAS.

Background: Approaches to address this concern have been undertaken by researchers at Stanford University and by a team at the MITRE Corporation. In both cases, research studies using existing data from routine aircraft pathways and spacecraft trajectories followed by simulations of options to reduce or eliminate aircraft hazard areas (AHA) have been undertaken. These approaches studied the ability to create dynamically changing compact envelopes of the NAS and the ability of the Air Traffic Control (ATC) system to respond quickly to the need to evacuate AHAs. Multiple simulations were run using data from four different spaceport locations across the country.

The simulations using compact envelopes that change dynamically during the time of a space flight launch or reentry showed the near elimination of airspace disruption from commercial space traffic. Further, simulations using the realistic speed with which ATC could reroute aircraft only when necessary for a launching or reentering spacecraft showed this approach is entirely achievable.

Summary: Research conducted under the FAA Center of Excellence for Commercial Space Transportation has demonstrated approaches that almost entirely eliminate the need for prolonged closure of extensive segments of the US NAS.

006

THE CENTENNIAL ANNIVERSARY OF THE USAF SCHOOL OF AEROSPACE MEDICINE AND THE HISTORY OF 100 YEARS OF US ARMY/USAF AVIATION COLOR VISION TESTING

L'ANNIVERSAIRE DU CENTENAIRE DE L'ÉCOLE DE MÉDECINE AÉROSPATIALE DE L'USAF ET L'HISTOIRE DES 100 ANS DE L'ESSAI DE VISION DES COULEURS DE L'AVIATION DE L'ARMÉE AMÉRICAINE ET DE L'USAF

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Introduction: One hundred years ago, the U.S. Army Air Service (USAAS) formally chartered the Medical Research Laboratory that became today's United States Air Force School of Aerospace Medicine. 100 years ago, the USAAS attempted to quantify vision standards. Dr. William H. Wilmer, Commander of Air Service Medical Research Laboratories at Issoudon, France wrote, "We consider that (color vision) is most important for the aviator to be able to recognize colors rapidly in (all light conditions) including reduced light and fog." Every US service has historically identified the requirement for "color normal" or "color safe," depending on the time frame, but the methods to test human color vision have changed dramatically over the past 100 years due to technology, wars, politics, the internet and the requirement for increased reliability of color testing.

Background: Testing for color vision in the USAAS in 1918 was by Holmgren wool test, perforated cardboard with red/green confusion colors, lanterns, colored lights and simple color plates. Over the next 100 years color vision testing by the US Military varied from the simple yarn tests, pseudochromatic "lines of confusion" plates (PIP-until they were declared "foreign" after the start of WWII), US Army threshold test, FALANT lights, back to PIP tests then to modern digital threshold testing.

Summary: The history of each of the color test used historically by the USAAS, US Army Air Corps and the US Air Force will be reviewed with their good and bad points, and why the tests were replaced or remained. Finally, the USAF Operational Vision Assessment Laboratory current color vision test, the CCT-HD, which is one of the most reliable color vision test on the market today, will be reviewed in testing 2000 USAF pilot candidate applicants at USAFSAM over the past two years and the USAF decision changing the color standard from color normal to color safe will be discussed.

007

CONE CONTRAST TEST FOR COLOUR VISION DEFICIENCY SCREENING AMONG TRAINED MILITARY AIRCREW AND FLYING-RELATED VOCATIONS

TEST DE CONTRASTE DE CONE POUR LE DÉPISTAGE DE DÉFICIENCE DE LA VISION EN COULEURS ENTRE LES AVIONS MILITAIRES FORMÉES ET LES VOCATIONS ASSOCIÉES AU VOL

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Introduction: The Cone Contrast Test (CCT) was implemented in 2016 to more accurately exclude colour vision deficiency in aircrew and flying-related vocations in the Republic of Singapore Air Force (RSAF). With the introduction of CCT, a new algorithm was created to guide the management of trained personnel affected by this change. We examined the RSAF Aeromedical Centre's database of trained personnel who had abnormal CCT scores to determine the effectiveness of the new algorithms in assessing for colour vision deficiency.

Methods: We retrospectively reviewed records of 143 trained personnel who underwent periodic medical examinations at the RSAF Aeromedical Centre from November 2016 to June 2018 and had abnormal CCT scores. Three subsets of CCT scores were defined: normal (CCT score ≥ 75 AND abnormal (CCT score ≤ 35 AND points difference between eyes); grossly abnormal (CCT score ≤ 15 points difference between eyes). Personnel with mildly abnormal CCT scores and passed the Farnsworth Lantern Test (FALANT) were graded CCT2 and returned to unrestricted aviation-related duties. Those who failed FALANT or had grossly abnormal CCT scores were deemed unfit and were seen by an Aviation Medical Specialist for further clinical and functional assessments.

Results: Of the 143 trained personnel who were found with abnormal CCT scores, 139 passed the FALANT and were deemed fit for aviation-related duties. Among the four personnel who failed FALANT, three personnel were able to return to unrestricted aviation-related duties following clinical and functional assessments, while one was deemed unfit.

Conclusions: CCT has been effective in identifying trained personnel who were previously deemed to have normal colour vision, to have varying degrees of colour deficiencies. The RSAF's Aeromedical Centre's algorithm for the management of trained personnel who previously passed colour vision testing but failed the recently introduced CCT has proved useful in managing the medical outcome through the utilisation of FALANT and functional assessments.

009

COMPARATIVE OBSERVATION OF CLINICAL EFFECT OF ZENGSHINENG TRAINING SOFTWARE AND PEN NIB TRAINING FOR THE ABILITY TO CORRECT THE SMALL DEGREE OF CONCOMITANT EXOTROPIA OF PILOTS

OBSERVATION COMPARATIVE DE L'EFFET CLINIQUE DE LA FORMATION DES LOGICIELS DE FORMATION DE ZHENGSHENG ET DE PEN NIB SUR LA CAPACITE A CORRIGER LE PETIT DEGRÉ D'EXOTROPIE CONCOMITANTE DES PILOTES

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Introduction: To compare and study the clinical effects of Zengshineng training software and pen nib training for the ability to correct the small degree of concomitant exotropia of pilots.

Methods: 40 cases of pilots who has been diagnosed with concomitant exotropia checked the range of fusion in the same Synoptophore. The 40 patients with concomitant exotropia were randomly divided into Zengshineng training group (n = 20) and pen nib training group (n = 20), and underwent the fusion training. In the Zengshineng training group were taken the intelligent training system for the subject of the convergence function training, 3 times a day, every 10 minutes; the pen nib training group were taking the pen nib training for 3 times, every 30 times. Then, the range of fusion for 1 month, 3 months and 6 months were checked by the same Synoptophore, and the groups were compared.

Results: In the Zengshineng training group, the range of convergence for 1 month, 3 months and 6 months was significantly improved compared to before the correction. In the pen nib training group, the convergence range at 1 month was not significantly improved ($P>0.05$), and the 3 months and 6 months were significantly improved (1 month, 3 months and 6 months) in the Zengshineng training group were significantly higher than those of the pen nib training group.

Conclusion: Zengshineng training software and pen nib training for the ability to correct the small degree of concomitant exotropia are exact, and the Zengshineng software is faster and more efficient than the pen nib training.

010

HEARING AIDS AND AEROMEDICAL FITNESS FOR PILOTS

APPAREILLAGE AUDITIF ET APTITUDE AERONAUTIQUE DU PILOTE DE LIGNE

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En Europe, depuis 2013, le règlement européen UE 1178/2011 détermine les exigences techniques et les procédures applicables au personnel de l'aviation civile. Pour le pilote de ligne, le trigramme HAL est apparu dans les normes de restriction permettant à celui-ci de porter un ou deux appareillages en cas de déficit auditif, une fois qu'une pathologie aiguë ou chronique de l'oreille pouvant mettre en jeu la sécurité aérienne est éliminée. Le port de prothèse auditive, auquel s'ajoute la mention de port obligatoire de casque audio en vol, est déterminé par l'autorité. Il se déroule dans des conditions médicales bien précises. Nous étudierons ces conditions générales d'application et donnerons un exemple significatif de cette possibilité d'aptitude en cas de déficit auditif chez un pilote.

Introduction: In Europe, since 2013, the European regulation EU 1178/2011 determines the requirements, techniques and procedures applicable to civil aviation personnel.

Background: For the line pilot, the HAL trigram has appeared in the restriction standards allowing to wear one or two hearing aids in case of hearing loss, once an acute or chronic pathology of the ear that may jeopardize aviation safety is eliminated. The wearing of a hearing aid, to which must be added the mention of compulsory wearing of headphones in flight, is determined by the authority. It takes place in very specific medical conditions.

Summary: We will study these general conditions of application and give a significant example of this possibility of aptitude in case of auditory deficit in a pilot.

011

DEVELOPMENT AND EVALUATION OF A NEW MANDARIN SPEECH AUDIOMETRY MATERIALS BASED ON RADIOTELEPHONY COMMUNICATIONS FOR CHINESE CIVILIAN PILOTS

*French: DEVELOPPEMENT ET EVALUATION DE NOUVEAUX MATERIAUX D'AUDIOMETRIE DE
MANDARINE A PARTIR DE COMMUNICATIONS RADIOTELEPHONIE POUR DES PILOTES CIVILS
CHINOIS*

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Introduction: The purpose of this project was to develop and evaluate a new Mandarin speech audiometry test and materials, based on Chinese radiotelephony communications, that can be used to measure the speech perception abilities of Chinese civilian pilots.

Methods: Sentence lists were designed based on both the basic rules for developing speech materials and the particular characteristics of Chinese radiotelephony, and recorded digitally. In order to establish validity and reliability, both the equivalence verification and the performance intensity (P-I) functions of all lists were conducted in a group of 40 subjects (age-range 21 to 26 years) with normal hearing.

Results: Speech audiometry materials consisting of 20 sentence lists (20 sentences in each list) had been developed for Chinese civilian pilots. The difficulties of the lists were all equivalent ($p > 0.05$). The P-I function was also obtained, and its mean threshold (50%) was 8.22 ± 0.35 dB HL, the slope at threshold was $11.34 \pm 1.84\%/dB$, and the slope of linear area (from 20% to 80%) was $4.50 \pm 1.29\%/dB$. Furthermore, six of the sentence lists were found to show a character of non-monotonicity with irregular shapes in P-I functions.

Conclusions: The remaining 14 sentence lists of the materials were found to have sufficient reliability and validity to be used for future research.

012

STUDY ON THE CORRELATION BETWEEN NASAL SEPTAL DEVIATION AND CHRONIC RHINOSINUSITIS IN PILOTS

French: ÉTUDE SUR LA CORRÉLATION ENTRE DÉVIATION SEPTALE NASALE ET RHINOSINUSITE CHRONIQUE CHEZ LES PILOTES

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Introduction: There are few studies on the correlation between nasal septal deviation and chronic rhinosinusitis in pilots. The relationship between nasal septal deviation and chronic rhinosinusitis is necessarily investigated in pilots' health management. More attention should be paid and prevention research must be strengthened.

Method: Randomly selected 188 pilots who were diagnosed with chronic rhinosinusitis and examined with sinus coronal CT scan in Civil Aviation Aircrew Medical Assessment from 2015 to 2017. According to the set of conditions, 169 pilots were included. By analyzing the cases of chronic rhinosinusitis between the groups, with and without nasal septal deviation, the types of deviation, the cases of nasal septal deviation with chronic rhinosinusitis in wide side, narrow side or both sides and the involved sinuses, composed the statistical analysis.

Results: The incidences of chronic rhinosinusitis with and without nasal septal deviation were 62.72% and 37.28% respectively. The high deviation and non-high deviation were 64.15% and 35.85% respectively. The high deviation with chronic rhinosinusitis in wide side, narrow side and bilateral incidence were 17.65%, 29.41% and 52.94% respectively; while the non-high deviation with chronic rhinosinusitis in wide side, narrow side and bilateral incidence were 18.42%, 26.32% and 55.26%. There was no significant difference between the two groups ($P > 0.05$). The involved sinuses with nasal septal deviation in wide side or narrow side were different. The difference between the two groups was statistically significant ($P < 0.05$).

Conclusion: Nasal septal deviation is related to the formation of chronic rhinosinusitis, and different types of nasal septal deviation have different influences on the formation of chronic rhinosinusitis.

013

BIOMARKER-ENHANCED VIRTUAL REALITY-BASED PLATFORM FOR ASSESSING MOTION SICKNESS

SUSCEPTIBILITY PLATEFORME À BASE DE RÉALITÉ VIRTUELLE RENFORCÉE PAR BIOMARQUERS POUR ÉVALUER LA SENSIBILITÉ À LA MALADIE DE MOUVEMENT

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Introduction: Motion sickness (MS) is a relatively common occupational hazard in aviation and space exploration. One reason for this is a lack a simple and cost-effective method of assessing MS susceptibility that could be used during recruitment; MS desensitisation programs are expensive and time-consuming. Exposure to provocative VR content readily elicits MS ("cybersickness"), and it may be that VR technology could be used for both identification of MS-susceptible individuals and for MS desensitisation. To advance this idea, two issues should be first clarified: i) whether sensitivity to VR provocations reflects sensitivity to vestibular provocations; and ii) whether cybersickness is clinically identical to a "classic", motion-induced motion sickness. Consequently, our aim was to fill this gaps of knowledge.

Methods: A cohort of 30 young healthy volunteers was exposed to both vestibular (Coriolis cross-coupling) and VR (virtual ride on a roller coaster) provocations in a counter-balance order on different days. Nausea scores were recorded during the exposure, and Motion Sickness Assessment Questionnaire (MSAQ) was used to profile subjective symptoms. Tonic and phasic forehead skin conductance level (SCL) was measured before and during exposure.

Results: Nausea onset times and maximum nausea ratings correlated during both provocations ($r=0.40$, $p=0.03$ and $r=0.56$, $p=0.0012$, respectively). Symptom profiling with the MSAQ revealed substantial and significant correlations between total symptom scores ($r=0.69$, $p<0.0001$) and between 15/18 individual symptoms assessed in both conditions. Both provocations caused increase in tonic and phasic SCL activity associated with nausea, with a reasonably close correlation between the conditions ($r=0.48$, $p=0.04$).

Conclusions: Similarities in sensitivity to both provocations, and in clinical profile and physiological changes occurring during VR-induced and "classical" motion sickness suggest that using VR technology might be a promising approach for identification of MS-susceptible individuals and for MS desensitization.

014

THE REMARKABLE RESCUE FROM A NORTHERN THAILAND CAVE

LE SAUVETAGE REMARQUABLE D'UNE GROTTTE DU NORD DE LA THAÏLANDE

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Introduction: The rescue effort expanded into a massive operation, with worldwide public interest, to save the 12 young footballers and their coach trapped in the flooded Tham Luang Nang Non cave in Chiang Rai Province, Thailand. It has been described as one of the world's most dangerous and challenging rescue missions. Even the experienced cave divers involved in the operation admitted that the nature of the rescue plan was unprecedented and that they were taking extreme risks that could put the boys' lives in jeopardy. Despite the risks, the looming monsoon rains and the dwindling oxygen level in the cave required immediate decision-making.

Background: As the Chief Medical Commander of the field hospital and operation that consisted of medical personnel from the Royal Thai Army, Royal Thai Navy, and Ministry of Public Health, we conducted the field hospital, personnel, equipment and logistics, medical operations and the evacuation plan. My team and I have acquired the knowledge and skills to conduct medical operations under limited data and improper environment and together, the guidelines in conducting similar future field operations.

Due to the long, muddy, cold and dark complex water passage, it took the rescue divers 3 to 4 hours to bring each boy out of the cave. All of the boys including the coach were sedated by medication requested by the cave diving expert and approved by the Royal Medical College of Thailand. The medication chosen was firstly intended for the sedation to prevent panic and reduction of secretion while being brought out of the cave, but it also proved useful in a different way. The medication caused tachycardia which counteracted the effect of bradycardia, caused by hypothermia from staying under cold water. It also caused the children to have no memory of what happened, preventing them from psychological trauma from any attempts to rekindle the traumatic experience.

Summary: At the hospital, we reminded the boys that with all that has happened, this would be one of their most valuable experience and additionally, the operation has also offered a valuable lesson for Thailand and for the world on how to deal with the situation. Finally, we would like to thank you each and every one of you who participated in the rescue procedures. My team and I will always be grateful for your contribution.

015

THE ROLE OF A ROYAL THAI NAVY DOCTOR IN THE THAI CAVE RESCUE

LE RÔLE D'UN MÉDECIN DE LA MARINE ROYALE THAÏLANDAISE DANS LE SAUVETAGE GROTTES THAÏLANDAISE

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Introduction: On 23 June 2018, twelve members of a football team and their coach were reported missing after becoming trapped when Tham Luang cave system in Chiang Rai was flooded. A lot of expertise from around the country and the world had poured in for the support on the search and rescue operation, including international cave-diving specialists, navy SEALs, medical experts, scientists, geologists and many more government units who shared their expertise to find ways and means to reach them. Medical professionals are considered one of the key supporting teams. Military doctors, especially navy and army doctors, worked side-by-side for many aspects of the operation from the beginning of the SAR (search and rescue) phase to the last phases of the successful evacuation operation.

Background: Navy doctors were involved in 4 main key operations: search operation, dive planning, in-cave support for victim evacuation, and clinical monitoring and management. From the search operation, the navy medical team supported the medical and diving team in planning the safest and most effective way to conduct the search. Some of the diving medical officers also dived with the team to reach the deepest possible distance to offer best support. During the dive planning phase, diving medical officers brainstormed the potential risks, mitigating measures, and the practical actions for the diving teams. The navy medical team also played as a key medical support during the in-cave evacuation phase to access, stabilize and support the victims for the long journey out from kilometers deep inside the cave, with hypothermic, dehydrated, and lethargic conditions. Finally, the monitoring and management for the victims to be safely stabilized onsite and evacuated to the tertiary care, treated, and then released from the hospital safely back to their beloved families.

Summary: The full rescue mission of the 12 boys and their coach, including four navy SEALs who went deep inside the cave to support those who were trapped, was announced as having been miraculously successful on 11 July 2018. The rescue operation was considered a world's agenda. Despite the loss of an ex-navy SEAL, Saman Kunan, the operation was considered a robust success. With the same determination to save the victims and the support from all specialists and everyone around the globe, the world helped it from an almost impossible operation to become a possible one. As Nelson Mandela said, "It always seems impossible until it is done."

016

PREHOSPITAL HYPOTHERMIA MANAGEMENT FOR THE THAI CAVE RESCUE: LESSONS LEARNED FOR EMERGENCY PREPARATION PLANNING

*GESTION DE L'HYPOTHERMIE PRÉHOSPITALIÈRE POUR LE SAUVETAGE DES GROTTES
THAÏLANDAISES: LEÇONS APPRISSES POUR LA PLANIFICATION DES PRÉPARATIFS D'URGENCE*

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Introduction: Hypothermia is defined as a body core temperature of less than 35°C without a primary defect in the thermoregulatory system. It is a serious threat to prehospital patients, especially injured patients who can induce a vicious cycle of the synergistic effects of hypothermia, acidosis and coagulopathy, referred to as the trauma triad of death.

Background: To prevent and manage deterioration of a cold patient, prehospital hypothermia management should start before the medical evacuation. The Thai Cave Rescue demonstrated the significance of medical operations with limited data and difficult environmental conditions.

Summary: The aim of this discussion is to share the best practices and lessons-learned for emergency preparation planning of a hypothermia protocol for combat medicine, based on actual practice in the "Operation the World Never Forget" and to provide an up-to-date systematic overview of the current available treatment modalities and the effectiveness of prehospital hypothermia management.

017

PULMONARY CONCERNS DURING AIR EVACUATION IN THE THAI CAVE RESCUE OPERATION

PROBLÈMES PULMONAIRES PENDANT L'ÉVACUATION DE L'AIR DANS L'OPÉRATION DE SAUVETAGE EN GROTTTE THAÏLANDAISE

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Introduction: In the world renowned Thai cave rescue during 23 June-10 July 2018, in Chiang Rai province, Thailand, victims were rescued from a flooded cave by diving them out. This would have affected their pulmonary physiology.

Background: After having been treated and stabilized in the field hospital, the young footballers and their coach had to be transferred to a tertiary care medical facility (Chiangrai Prachanukroh Hospital). Twelve of them were transferred by air, and one by ground due to unfavorable weather condition. Air evacuation was able to shorten transportation time from 1 hour to 25 minutes.

Two types of aircraft participated in this mission: the MI-17 (provided by the Royal Thai Army), and the Bell 429 (provided by the Royal Thai Police Force). Both were equipped with intensive monitoring and advanced cardiac life support systems. Each MI-17 flight contained two patients, accompanied by medical escort consisting of 2 doctors, 2 registered nurses, and 2 practical nurses and another staff.

During enroute care, recurrent hypothermia was encountered in some cases; hypoglycaemia was also detected and treated during the flight. Fortunately, there were no serious adverse pulmonary events nor hemodynamic instability throughout the flights.

Upon arrival at the referral hospital, most cases were partially awakened. At this stage, the major concern was still hypothermia, despite having been rewarmed with normal procedures, to keep the target body temperature of 35 degree Celsius, which is optimally required to be maintained.

Summary: Transportation of the young footballers and their coach to the tertiary medical care facility was successfully accomplished with careful medical monitoring and supervision.

018

THE OUTCOME OF EMERGENCY PATIENT TRANSPORTED BY PUBLIC AIR AMBULANCE SERVICE IN THAILAND

LE RÉSULTAT DU PATIENT D'URGENCE TRANSPORTÉ PAR LE SERVICE PUBLIC D'AMBULANCE AÉRIENNE EN THAÏLANDE:

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Introduction: Insufficiency and less accessibility to public emergency medical services (EMS) persist among emergency patients in remote area of Thailand. Thai Sky Doctor Service was initiated by the National Institute for Emergency Medicine (NIEM) to improve the accessibility of those emergency patients whose condition needs aeromedical services. However, there is a lack of study on the provision of this service. This research intent to study the characteristics and outcome of Public air ambulance service in Thailand.

Methods: A descriptive cross-sectional study was used to study the outcome of emergency patient transported by public air ambulance service in Thailand. Purposive selective for quantitative data used secondary data of all patient records from NIEM (N= 205). Additional interview data used primary data from staff associated with Thai Sky Doctor System; National 1669 Dispatch center (N=3); Regional 1669 Dispatch center (N=1); Flight medical director (N=3); and Flight medical team (N=6). Percentage, mean, median, SD were used for descriptive data, while Fisher's Exact test was used to explore factors associated with one-day and three-day outcome.

Results: Results showed that 205 missions were requested for public air ambulance service. 184 cases were transported, while 33 cases were not, due to the lack of aircraft, weather condition, and patients' death before transported. Gender, age, disease group, patient severity, medical team, response time and transport time were not associated with one-day outcome after air transportation. Gender, age, disease group, medical team, response time and transport time were not associated with three-day outcome. Patient severity made a significant difference associated with the three-day outcome at the .05 statistical level ($p = .033$). Some factors were found to facilitate and obstruct this service.

Conclusion: Thailand has been developing public air ambulance service policy with good public concern. Patient severity before air transport is associated with delayed three-day outcome. Further study may be necessary to improve patient outcome, and develop public air ambulance service.

019

AEROMEDICAL EVACUATION IN 2011 THAI FLOODS

ÉVACUATION SANITAIRE EN 2011 INONDATIONS THAÏLANDAISES:

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Introduction: In October 2011, Thailand experienced a major disaster, due to several storms from July to October, resulting in major floods. The flooding affected many provinces in the lower northern and central regions of Thailand, causing great suffering. There was an urgent need to move hospital patients and their equipment to hospitals in a safe area.

Background: There were a total 82 air transport flights with estimated 150 cases.

I. The air transport operation was divided into 3 phases: A. Pre-Flight Management, B. In-Flight Management, and C. Post-Flight Management.

A. Preflight: 1) Ranking of urgency with the medical unit of origin; 2) Study the necessary patient information; c) Provide medical equipment for air transport; d) Planned emergency responses that may occur during flight; e) Arrange staff to fit the patient; f) Prepare knowledge and healthy body, g) Study the type of aircraft required for the mission.

B. In-Flight: a) Nursing care for patients; b) Follow up signs of change and monitor patient in flight; c) Caring for medical equipment in flight; d) Note patient symptoms and signs.

C. Post-Flight: a) Analyze problems that occurred during flight.

II. Type of aircraft used: Fixed wing aircraft - C-130H, CN-235, CASA212; Rotary wing aircraft - Bell412, Bell212, AS350.

Summary: Experiences from the operation include a) Process of air transport, b) Intensive care in flight, c) Editing problem in flight, d) Team management and e) Teamwork.

020

SURVIVAL OF MAJOR AND SEVERE TRAUMA PATIENTS TRANSFERRED TO TERTIARY CARE HOSPITAL BY AEROMEDICAL TRANSPORT

SURVIE DES PATIENTS TRAUMATISÉS MAJEURS ET SÉVÈRES TRANSFÉRÉS À L'HÔPITAL DE SOINS TERTIAIRES PAR TRANSPORT AÉRIEN

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Introduction: Major and severe trauma patients need timely management in designated trauma center for the best possible outcome. Aeromedical transport plays important role in trauma care in Thailand, by transferring seriously injured patients from local hospital to trauma center for higher level of care. We studied outcome of major and severe trauma patients transferred by air ambulance to Bangkok Hospital during 2014-2017.

Methods: Records of 949 trauma patients transferred to Bangkok Hospital during 2014-2017 were reviewed. Severity of trauma patients was classified by Injury Severity Score (ISS), major trauma defined by ISS 16-24, and severe trauma defined by ISS more than 24. The primary outcome is survival of major and severe trauma patients referred by aeromedical transport.

Results: 175 trauma patients were transferred by air ambulance as secondary mission. There were 28 major trauma cases and 39 severe trauma cases. Proportion of patients receiving aeromedical transport in major trauma group was 21.37%, and 24.22% in severe trauma group. All of 28 major trauma patients survived. 32 of 39 severe trauma patients survived, 82.06%. Overall survival of both major and severe trauma patients was 89.55%. Median ISS of non-survivors was higher than survivors. Common problems in severe trauma group, which were also the leading causes of death, were severe traumatic brain injury (TBI) and multiple organ failure (MOF) due to massive hemorrhage.

Conclusions: Overall survival rate of major and severe trauma patients receiving aeromedical transport in this study is acceptable. Survival of major trauma patients was significantly higher than severe trauma patients. Higher mortality rate in severe trauma patients likely to correlates with higher injury severity score, severe TBI and MOF.

021

THE EPIDEMIOLOGICAL ANALYSIS OF THE UNITED STATES AIR FORCE AEROMEDICAL EVACUATIONS (AE) OF ILL AND INJURED SUPPORTING OPERATION DEEP FREEZE IN ANTARCTICA

L'ANALYSE ÉPIDÉMIOLOGIQUE DES ÉVACUATIONS AÉRIENNES DE L'ARMÉE DE L'AIR DES ÉTATS-UNIS (AE) DES MALADES ET DES BLESSÉS OPÉRATION DE SOUTIEN DEEP FREEZE EN ANTARCTIQUE

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Introduction: Operation DEEP FREEZE is one of the military's most difficult peacetime missions due to the harsh Antarctic environment, its austere location and limited resources. Using its C-17 and LC-130 aircraft, the U.S. Air Force (USAF) performs the bulk of aeromedical evacuations of U.S. Antarctic Program (USAP) patients. There are no previous epidemiological studies looking at Antarctic patient evacuations. This study examines epidemiological trends in USAF Antarctic evacuations, with the intent of improving how the USAF equips and trains for its support of the USAP.

Methods: We reviewed all evacuation records, both paper and electronic, from the past 5 operational seasons between 2011 and 2016. These records were pulled from the U.S. Transportation Command's [TRANSCOM] Regulating and Command and Control Evacuation System (TRAC2ES) and Joint Task Force – Support Forces Antarctic Surgeon's (JTF-SFA SG) records.

Results: In the past 5 seasons, there were 89 patients evacuated. The top three diagnosis categories included musculoskeletal trauma (n=26, 29%), GI requiring general surgery (n=19, 21%), and acute cardiopulmonary disorder (n=15, 17%). The three most common individual diagnoses were fracture/dislocation (n=15, 17%), acute abdomen (n=14, 16%), and suspected Acute Coronary Syndrome (n=11, 12%). 12% of evacuations (n=11) required a physician on the transport team. Most of the evacuated patients were younger than 30 (n=23, 26%) or in their 50s (n=22, 25%). The distribution of injuries and illness requiring aeromedical evacuation (AE) was roughly consistent throughout the seasons, whereas the distribution of patient demographics varied more. There were no in-flight medical emergencies, and all the patients reached Christchurch, New Zealand without en-route deterioration.

Discussion: Although there are significant gaps in these data, this study presents a first step in understanding the epidemiology of AE from the Antarctic. Future data will further improve the efficiency of medical support both for the USAP specifically, but also advance other peacetime missions in austere locations.

022

AEROMEDICAL EVACUATION SYSTEM OF ROYAL THAI AIR FORCE (RTAF) IN HUMANITARIAN ASSISTANCE AND DISASTER RELIEF (HADR) MISSION

AEROMEDICAL EVACUATION SYSTEM OF ROYAL THAI AIR FORCE (RTAF) IN HUMANITARIAN ASSISTANCE AND DISASTER RELIEF (HADR) MISSION

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Introduction: In disaster areas; the ability to move large numbers of casualties is the urgent need. To complete the Aeromedical Evacuation (AE) mission in moving patient safely, we have to set up shelter, to provide temporary medical care and to re-evaluate patients' conditions for further airlift. Aeromedical Evacuation System (AES) with Mobile Aeromedical Staging Facility (MASF) of Institute of Aviation Medicine, Royal Thai Air Force (IAM;RTAF) increases capabilities of AE for Humanitarian Assistance and Disaster Relief (HADR) mission.

Background: Aeromedical Evacuation System (AES) consists of 4 components: 1. Aeromedical Evacuation Control Center (AECC): The AECC are coordinating airlift, validating patient requirements, aircrew management, ensuring adequate logistical support and coordinating all AE missions. 2. Mobile Aeromedical Staging Facility (MASF): A MASF is a deployable, tented asset used for temporary staging, casualty care, and administration support during contingency operations. It is located at an airfield capable of contracted aircraft. The MASF serves as an entryway to the AE system. The MASF team will prepare the patient, personnel, and medical equipment prior to the AE flight. 3. Aeromedical Evacuation Liaison Team (AELT): Establish liaison with originating medical facilities. So AELT is required to insure a smooth patients' flow into AES. 4. Aeromedical Evacuation Crews (AE CREWs): Aeromedical evacuation crew members provide in-flight patient care on any aircraft using medical equipment that meets airworthiness testing certification standards.

Summary: The Aeromedical Evacuation system (AES), a part of Royal Thai Air Force, is a highly disciplined function capable of transporting casualties or patients via C-130. AES of RTAF plays an important role in HADR because the outstanding ability of the Aeromedical Evacuation is moving large numbers of patients or casualties to medical facilities outside the affected area in short period of time.

023

TWO TRAINING INITIATIVES DOWN UNDER: SPECIALTY TRAINING ROTATION AND COMPETENCY-BASED DME TRAINING

DEUX INITIATIVES DE FORMATION EN AUSTRALIE: ROTATION DE FORMATION SPÉCIALISÉE ET FORMATION DES EXAMINEURS MEDICAUX AXÉE SUR LES COMPÉTENCES

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Introduction: Recognition of aerospace medicine as a specialty is well established in a number of Nations, however in the English-speaking world it has been unusual with the notable exception of the USA. In recent years specialty recognition has been achieved in Singapore and United Kingdom; in Australasia, a College has been established but Governmental recognition has not yet been sought.

Summary: The paper describes the establishment of a training rotation which is believed to be the first of its type, for trainee specialists in aerospace medicine to progress through 8-month posts with the Civil Aviation Safety Authority and two commercial airlines. This involved the establishment of a memorandum of understanding, a selection and review board, and a rigorous interview process. The first cohort of doctors has been selected and they have commenced in their positions. The second initiative is launching a training course for Designated Aviation Medical Examiners based and assessed on the ICAO Competency Framework, developed to harmonise DME training internationally. This follows similar efforts in both UAE and Singapore. The development of the course is presented together with a review of outcomes.

024

MEDICAL SELECTION OF THE FIRST GERMAN COMMERCIAL FEMALE ASTRONAUT

SÉLECTION MÉDICALE DE LA PREMIÈRE ASTRONAUTE ALLEMANDE POUR UNE MISSION COMMERCIALE

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Introduction: 60 women had been to space-none of them was German. That was the reason for a CEO of a German space personnel provider to advertise a vacancy for a first German female astronaut. 408 well-educated women applied.

Materials and Methods: The medical and psychological selection was performed by the German Aerospace Center and followed in the structure of the last European astronaut selection. 120 women were selected by the private company based on their application. They all had to fill out a pseudonymized questionnaire that was created by the Flight Medicine Clinic of the German Aerospace Center as an initial medical screening. 85 persons were recommended for further evaluation. They completed the first step of the psychological selection from which 30 women entered the second stage of the psychological selection. Eight applicants were finally psychologically selected and underwent medical examinations including haematology, internal medicine, stress ECG, ophthalmology, neurology, ENT, gynaecology, dentistry, psychiatry, bone density and anthropometry.

Results: During the initial medical screening phase applicants were denied because of metric, trauma or pregnancy reasons. In the end 6 applicants were considered medically fit by an experienced space medicine board for becoming a commercial astronaut. Reasons for rejection were the exclusion criteria mentioned in "Medical Standards and Certification Procedures For Space Flight Participants." No medical data were given to the private company. Finally 2 women were chosen by a panel to undergo commercial astronaut training. After six months one of the selected astronaut candidate quit and a new one was selected from the pool of the final six psychologically- and medically-fit candidates.

Conclusion: The international space agencies standards for commercial astronauts differ a lot from the requirements for professional astronauts. Therefore the rate of denials for medical reasons was much smaller compared to the last ESA astronaut selection. As many applicants came out of the space area it made sense to pseudonymize the medical information for decision making to exclude possible bias.

025

IMPLICATIONS OF PASSENGER ANXIETY AND MOTION SICKNESS FOR COMMERCIAL SUBORBITAL SPACEFLIGHT

*RÉPERCUSSIONS DE L'ANXIÉTÉ DES PASSAGERS ET DE LA MALADIE DES MOUVEMENTS DANS
LE SPACEFLIGHT SUBORBITAL COMMERCIAL*

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Introduction: A concern that faces operators of commercial human spaceflight is whether anxiety or panic during a flight has the potential to detract from the flight experience, cause disruption during flight, or put the mission, vehicle, or crew at risk. We designed this study to evaluate layperson responses to centrifuge-simulated spaceflight. Our goals were to identify predictive indicators for anxiety in commercial spaceflight participants and develop methods to prevent mission-impacting events.

Methods: Volunteers participated in centrifuge training programs of 2-7 centrifuge runs over one-half to 2 days, depending on the cohort group to which they were assigned. Each cohort protocol culminated in two simulated suborbital spaceflights. Suborbital spaceflight profiles included combined +Gx and +Gz (peak +6.0Gx and +4.0Gz). Two cohorts received dedicated anxiety-mitigation training. All cohorts completed psychological questionnaires which were evaluated for any predisposing factors that might correlate with poor tolerance. Test monitors observed subjects for signs of anxiety and motion sickness during their experience.

Results: Of the total of 148 subjects participating in centrifuge trials, test monitors identified 29 subjects as concerning for anxiety. Overall, 10 subjects opted out of one or more run or limited their G-exposure. Training length was not associated with subjects withdrawing from participation. Of note is that motion sickness was significantly associated with non-completion of the centrifuge runs. Various means were used to obtain feedback from subjects. Private, written format was the most likely method to receive reports of anxiety-related symptoms.

Discussion: It is unknown whether the correlation between motion sickness and anxiety will hold true in commercial spaceflight. Close observation and intervention during training for an upcoming space flight will be critical to lessening the risks from inflight anxiety. Written, private reporting may be a means of identifying issues during training and before a space flight. Enabling SFPs to develop a strong trust relationship with training and medical personnel will likely improve the ability to identify participants at risk before anxiety becomes detrimental to the flight experience.

RECORDING HUMAN HEMODYNAMICS DURING PARABOLIC FLIGHTS USING PHOTOPLETHYSMOGRAPHY

ENREGISTREMENT D'HÉMODYNAMIQUE HUMAINE PENDANT DES VOLS PARABOLIQUES À L'AIDE DE LA PHOTOPLETHYSMOGRAPHIE

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Introduction: Parabolic flights currently present one of the few possibilities to simulate alternating gravity conditions, including zero-g, under laboratory-type conditions. The special parabolic trajectory allows for approximately 22 seconds of zero-g, preceded and followed by a hyper-G phase. Parabolic flights are therefore excellent for examining rapid hemodynamic changes in humans under alternating G accelerations. Earlier studies of our group proved photoplethysmography (PPG) to be suitable even with high-Gz accelerations found in the human centrifuge and high-performance aircraft. PPG provides valuable information on circulatory parameters that are otherwise hard to obtain under said conditions. This study aimed at continuously recording the pulse wave during parabolic flights and drawing conclusions about blood volume distribution and changes in cardiac contractility from the derived DC and AC components.

Methods: 26 subjects performed a parabola series with hyper-g and zero-g phases. Among other physiological data the photoplethysmogram was continuously monitored, i.e. all subjects wore a forehead-mounted reflectance pulse oximetry sensor which was connected to the multisensor data-recording and analyzing system called HealthLab. Filtered PPG was used to derive DC and AC components. All signals were subsequently evaluated using commercial biological data processing software.

Results: Compared to baseline values determined before each parabola the PPGDC components increased during hyper-g phases and decreased during zero-g phases reflecting blood volume shifts from head to toe and vice versa. This was accompanied by PPGAC component decrements during hyper-g phases and increases during zero-g phases arguing for an increase of contractility of the heart due to increased filling.

Conclusions: Our study proved PPG to be suitable for obtaining relevant information on cardiovascular regulation even under inflight conditions with alternating accelerations. The findings obtained are in accordance with earlier studies demonstrating a blood volume shift in the body during hyper-g and zero-g phases, respectively.

027

CREW WELLNESS IN SHORT DURATION MARS ANALOGUE MISSION IN DESERT – A PILOT STUDY

BIEN-ÊTRE D'ÉQUIPAGE DANS MISSION D'ANALOGUE DE MARS DE DURÉE COURTE DANS DÉSERT - UNE ÉTUDE PILOTE

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Introduction: Habitable Mars environment is usually confined to limited space and close quarter interaction with the fellow astronauts. This has several implications on wellbeing of the astronauts. Crew assessment of mental wellbeing during Mars Analog Mission at Mars Desert Research Station (MDRS) would be an important tool in knowing the effect of isolated, confined environment.

Methods: The Warwick-Edinburg Mental Well-being Scale (WEMWBS) was utilized. Five Scientist-Astronaut candidates of Crew 192 were assessed during their rotation in Mars Desert Research Station (MDRS), Utah during pre-simulation and at the end of the mission. Effective simulation period was 12 days. The survey included a 5 point Likert scale of 14 statements.

Result: Mean average of crew wellness of the entire team is significantly higher ($p < 0.05$) between pre-simulation and at end of the mission. Individual analysis shows significant difference ($p < 0.05$) in one member and entirely same in one member. Two members showed higher crew wellness at the end of mission but is not statistically significant ($P > 0.05$). One member had significantly higher ($P < 0.05$) with W-value of 0 and not with Z-value -2.66.

Conclusion: The short duration Mars analog mission at the MDRS had a significant positive impact for the team with improved crew wellness. There was a positive impact in the individual crew wellness analysis with one being significant and one showing no difference.

028

NUTRITION ON THE MOON AND BEYOND

NUTRITION SUR LA LUNE ET AU-DELÀ

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Introduction: With next year's anniversary of Apollo 11, fifty years will have passed since human life was first supported on the Moon. Although nutritional research was not a primary objective of the Apollo lunar landings some data were obtained from biomedical experiments and the life support systems. The food system employed on the lunar surface was of particular interest.

Methods: The author drew from scientific papers, NAS-NRC recommendations, NASA reports and his own recollections to trace the Food and Nutrition Program during the Apollo era and to highlight more recent developments.

Results: Studies on how to feed astronauts in space and on the Moon were initially undertaken by NAS-NRC. Nutritional and psychological requirements were considered along with conventional and non-conventional foods. Biomedical studies prior to Apollo confirmed that humans could function for at least 14 days in 0 g. Experience gained on U.S. and U.S.S.R. missions formed a baseline for the Apollo food system. Improvements were made by testing on the ground and in parabolic flight. Concerns for the mechanical difficulties posed by eating at 1/6 g were allayed. During the actual Apollo flights no evidence was uncovered to suggest that nutritional requirements at either 0 g or 1/6 g were different from those established at 1 g, although electrocardiographic anomalies led to some adjustment of electrolyte intakes.

Conclusion: Biomedical data obtained during the Apollo Program confirmed the adequacy of the food system. Subsequent studies over many decades have refined knowledge of nutritional requirements, explored the potential of nutrients to counteract the adverse effects of spaceflight and led to improvements in space food technology. Experience gained on Mir and the International Space Station with water recycling, oxygen production and plant growth have vindicated some early NAS-NRC recommendations although possible advantages of carbohydrate recycling by chemical means remain to be demonstrated.

TRANSLATING SPACE MEDICINE TO EARTH: SYNERGISTIC BENEFITS OF MENTORSHIP

TRADUIRE LA MÉDECINE SPATIALE À LA TERRE: LES AVANTAGES SYNERGIQUES DU MENTORAT

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Introduction: The Bellagio International Summit on Space Medicine: Terrestrial Application for Human Health Performance and Longevity, resulted in more than 30 abstracts of mature science, translated for earthbound applications. A key objective of this summit was to mentor young investigators to become the next generation scientists. This project examined the experience of young investigators, to define the structure and elements of mentorship, and to determine the synergistic benefits.

Methods: Eleven young investigators participated in a three phase Bellagio initiative, which included a three month data retrieval process, a four day summit in Bellagio, and a presentation of scientific abstracts. A mentorship questionnaire was designed that included 12 synergistic variables of mentorship, which they rated on significance of impact on their mentoring experience. Participants answered four open-ended questions which defined variables with the strongest interactive synergy.

Results: Scientific merit was cited in five conceptual domains, where young investigators participated, including, Genetics and Space, Environmental Hazards, Nutrition in Space, Physiological Fitness and Behavioral Health. Strongest interactive synergy was felt in (1) scientific merit, (2) passion and alignment with personal goals, (3) personal achievement in actually delivering a paper, and (4) one on one mentoring. One example of delivery of countermeasures or mature science by a young investigator, who rated these four interactive variables as a 10, will be shown. Application of the National Institutes of Health Translation Science Model will be demonstrated in the laboratory--discovery of vitamin D through its five stages, leading to population health in preventing osteoporosis. On a 10 point scale for 12 synergistic variables, all were ranked 8 and above.

Conclusions. The mentorship questionnaire is an initial attempt to quantify the mentorship experience from the perspective of the mentee. It defines the synergistic variables that shape mentee satisfaction. This assessment will be replicated with a larger sample, in Bellagio III, to determine statistical inferential impact on the entire mentoring experience.

030

AIRCREW NECK PAIN: RECOMMENDATIONS OF NATO RESEARCH TASK GROUP 252

AIRCREW NECK PAIN: RECOMMANDATIONS DU GROUPE DE TRAVAIL DE L'OTAN 252

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Introduction: NATO nations' aircrews continue to report neck pain that impact not only their mission performance and effectiveness but also their health. This presentation will outline the work of the recent NATO Research Task Group (RTG): HFM 252 on Aircrew Neck Pain.

Background: Aircrew neck pain is a multifactorial problem that has plagued the aviation profession for decades. Initially more a problem of fixed-wing high performance aircrew, generally attributed to G-loading, neck pain has become a problem for rotary-wing aircrew as well. Factors such as added head-supported mass and increased maneuverability have contributed to the epidemic of neck pain, and related risks and consequences of acute and chronic effects. The HFM RTG 252 compiled the accumulated literature in support of aircrew neck pain in various environments, as well as surveying evidence for effective prevention and treatment strategies from the international team members, representing NATO and invited nations. Recommended measures include a) standardized survey methods and instruments to allow for combined datasets and improved statistical analyses; b) standardized EMG diagnostic methods and conventions; c) the 'professional athlete model' of psychological and physical health to ensure optimal short- and long-term performance and well-being.

Summary: The HFM 252 overall objective was to seek creative administrative, procedural, preventive as well as ergonomic and engineering solutions for reducing neck pain. The RTG has taken a multi-disciplinary approach that involves engineers, human system integration and ergonomics specialists, physiologists, medical officers, physiotherapists, helmet manufacturers, and operators. The presentation will outline the Group's conclusions and recommendations, which will be of interest to the international community.

031

PILOT QUESTIONNAIRE TO CHARACTERIZE NECK PAIN RELATED TO FORWARD HELMET CENTER OF GRAVITY (U.S. AIR NATIONAL GUARD)

QUESTIONNAIRE PILOTE POUR CARACTÉRISER LA DOULEUR EN COUCHE LIEE AU CENTRE DE GRAVITE DE L'AVANT (GARDE NATIONALE US AIR)

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Introduction: Neck pain in the fighter pilot community has been documented for over 30 yr. High +Gz maneuvers and awkward head and neck positions combined with large helmet weights and helmet modifications that displace the center of gravity all contribute to a high risk of fatigue, pain, and injury in the population. The overall goal of this effort is to characterize neck injury, collect prevention and treatment methods used, and assess effectiveness of these methods on preventing, reducing, and eliminating neck pain within the Air National Guard (ANG) fighter pilot community.

Methods: A questionnaire will be developed and administered to several ANG fighter pilot squadrons to collect data in the following five areas: 1) pilot information such as physical characteristics, age, rank, flying experience, etc.; 2) approved preventative activities performed prior to flying, such as stretching, exercise, and the perceived effectiveness of those activities; 3) neck pain history, including reported and unreported incidents, duration, severity, location, type, etc.; 4) flight-incurred or flight-related injury, its effect on performance, and possible causes/trends of neck pain; and 5) corrective actions taken, both standard and non-standard, and impact on completion of mission. The target populations are the ANG fighter pilot communities.

Results: Ninety four percent of the respondents reported neck pain in the past 90 days of completing the questionnaire, and 100% reported increased difficulty in performing within the jet due to neck pain. While 28% reported being on duties not to include flying, 59% reported removing themselves from the flight schedule due to neck pain. Respondents reported 78% knew other pilots who were receiving medical and therapeutic treatment outside of the U.S. Air Force (USAF) medical services.

Discussion: By collecting information on current preventive measures and the associated efficacy, possible prophylactic treatments or engineering solutions may be revealed that could change guidelines for pilot training and injury prevention.

032

RESUMPTION OF PROFESSIONAL AERONAUTICAL ACTIVITY AFTER SPINAL SURGERY IN AIRCREW

REPRISE DE L'ACTIVITÉ AÉRONAUTIQUE PROFESSIONNELLE APRÈS CHIRURGIE RACHIDIENNE CHEZ LES PERSONNELS NAVIGANTS

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Introduction: Spinal pathologies are common in Western populations as well as in aircrew (AC). Their treatment may require surgery, with the possibility of incomplete functional recovery. Flight fitness can therefore be questioned.

Method: At the beginning of 2017, the authors carried out a prospective, multicentric, anonymous questionnaire study within the 3 French military aeromedical centers (Bordeaux, Paris and Toulon). It includes 1,500 aircrew interviewed. The main objective is to estimate the impact of spinal surgery on the aeronautical activity of French civil and military aircrew.

Results: Of the 1,418 usable questionnaires, 950 people (67 %) reported having already had at least one spinal pain episode. Only 39 had surgery (2.75 % of the selected subjects and 4.1% of the painful aircrew). The three main pathologies that required surgery are lumbar and cervical disc pathologies and degenerative osteoarthritis. Five operated people (12.8 %) have an impact on their aeronautical fitness. After pairing by a propensity score on several factors, it appears that the operated subjects on a spinal pathology aircrew present a 4 times higher risk to not recover an aeronautical fitness identical to that which precedes surgery compared to painful patients without surgery. Going back to flight takes place on average 19 weeks after the surgery.

Conclusion: Spinal surgery seems to have a bigger impact on aeronautical fitness than medical treatment. This data, although it needs to be confirmed by other studies, must be taken into account before proposing spinal surgical treatment to aircrew.

033

MICROBIOMICS AND AEROSPACE MEDICINE

MÉDECINE MICROBIOMIQUE ET AÉROSPATIALE

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Introduction: The human microbiome is the population of microorganisms throughout the human body including the mouth, gastrointestinal (GI) tract, pharynx, respiratory system, middle ear, external ear canal, urogenital tract and skin. The human body has 10 times as many microorganisms as human cells. While the human genome has about 23,000 genes the human microbiome contains more than 1 million genes. The composition and functional impact of the microbiome in the human body jointly develops from birth and is affected by the person's nutrition, genetic composition, general lifestyle, self-imposed stress and exposure to environmental stress factors.

Background: The interaction of the GI microbiome with human cells influences the regulation of some metabolic pathways and immune-inflammatory pathways impacting the intestines, liver, muscle, and brain. A decrease in the desirable GI microbiome can lead to deterioration in GI, endocrine, neurologic or immune functions, and could lead to diseases. Probiotics are types of living friendly bacteria similar to those that inhabit the GI tract used to adjust the microbiome to protect the individual. Prebiotics are nutrients that feed the good bacteria.

Summary: Practical implications of the human microbiome on aerospace personnel health and safety involve: 1) Nutrition/Diet (pre/probiotics as alternatives to antibiotics, food-borne pathogens, bacteria and dietary-derived metabolites, role of plant/soil microbiome, microbiome-directed foods), 2) Diseases (inhibition of disease vectors, traveler's diarrhea, respiratory infections, asthma, drug metabolism, multidrug resistance, impaired immunity, irritable bowel syndrome, inflammatory bowel disease, multiple sclerosis, acute mountain sickness), 3) Injury (PTSD, TBI, wound infections, wound healing), 4) Environmental Exposure (chemicals, heavy metals, hypoxia, hypobaria, microgravity), 5) Neurological (neuronal activity, stress-performance, cognition, anxiety-fear, sleep/circadian rhythm disruption, neurochemical-neurotransmitter, microbiome gut-brain axis), 6) Other (microbiome biosensors for health/disease, microbiome forensic identity markers, antibiotics, chemotherapy effects on microbiome, role of pre-probiotics against foodborne pathogens, pre-probiotics and improved immune function, lung microbiome and health risks of particulate matter-emissions, human effects of indoor microbiomes).

034

"RULES FOR THE DARK SIDE OF THE MOON:" ATTENTION POINTS IN THE EASA ATCO MEDICAL CERTIFICATION

"REGLEMENTS POUR LE COTÉ NOIR DE LA LUNE:" POINTS D'ATTENTION DANS LA CERTIFICATION MÉDICALE DE EASA POUR LES CONTRÔLEURS DU TRAFFIC AÉRIEN

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Introduction: From 2017 on, the EASA rules c13 for medical certification of air traffic controllers became applicable in the European Union; they are an update of the former EUROCONTROL c13 requirements for medical certification of ATCO's. These rules foresee that these medical certificates can only be made by c13 AME's who have followed an advanced aeromedical training, and have knowledge and experience of the operational environment of these ATCO's. However, due to the shortage of this specific type of AME's, many examinations are done by AME's c11 (for professional pilots) which may lack specific knowledge of the operational environment. The wide variety of tasks done by different kinds of ATCO's (tower, approach and en route) have an important influence on the medical assessment of fitness or fitness with limitations (which is a typical European instrument replacing waivers).

Background: Therefore c11 AME's without experience of the ATCO environment and tasks, starting to do c13 medical certifications, should be trained in the differences of the medical assessment between pilots and ATCO's, and specific attention points should be highlighted. One important aspect is the risk for sudden or hidden incapacity (which is similar to pilots), another aspect is the sensorial functioning (vision, colour vision, hearing...). This process has started in several European countries via special training sessions for c11 AME's wanting to also examine ATCO's.

Summary: My presentation will give a short historical oversight how we came in Europe to a standardised medical assessment of ATCO's, highlight some important differences from pilot medical examinations, and mark specific attention points taking into account the different roles and tasks air traffic controllers can have, and their impact on the aeromedical assessment.

035

AN ERGONOMIC AND FUNCTIONAL APPRAISAL OF AVIATION FIREFIGHTERS: SPECIALIST CAPABILITIES OF AERODROME EMERGENCY RESPONDERS

*UNE EVALUATION ERGONOMIQUE ET FONCTIONNELLE DES POMPIER DE L'AVIATION: LES
COMPETENCES SPECIALISEES DES INTERVENANTS D'URGENCE EN AERODROME*

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Introduction: The Fleet Air Arm (FAA) recognises a need to maintain focus on "total aviation safety" as part of the Duty Holder construct. As such, RNAS Culdrose offers phase 2 training for all FAA aerodrome rescue fire-fighters (ARFF).

Background: These assets are trained in the School of Flight Deck Operations (SFDO) and subject to significant ergonomic and functional challenge given the loads and systems of work - including mobile platforms for the management of aviation fuel fires. Thus the trained service person should remain medically fit to assume a fully deployable (MFD) state. This is codified in terms of the Joint Medical Employment Standard (JMES). The JMES informs Command without divulging sensitive medical information. However if a medical condition causes function incapacity then JMES is "downgraded" and the Defence Medical Service works to rehabilitate the fire-fighter to ensure a return to full capability. Once rehabilitated the fire-fighter will be upgraded and expected to return to full firefighting duties. At present there is no system to prove capability in this highly specialist occupational environment, where fire-fighting equipment is at variance to that used in HM Warships. Thus, in order to demonstrate a safe and effective return to full operational capability there is need for a functional assessment with high fidelity to the aviation rescue environment.

Summary: This paper shows a full analysis of the key training elements in order to furnish a biodynamic assessment of ARFF assets. Operational and strategic recommendations were made to yield demonstrable evidence of fitness for use in returning the injured firefighter to full deployed capability. This evidence will be of significant utility to managers making a decision on whether it is safe to return a trained ARFF to a high risk work environment.

036

NAIVE HBSAG POSITIVE AND THAI PILOT SELECTION, STUDY OF RTAF POPULATION MODEL

NAIVE HBSAG POSITIVE ET SÉLECTION PILOTE THAÏ, ÉTUDE DU MODÈLE DE POPULATION DE LA ROYAL THAI AIR FORCE.

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Introduction: In Thailand, pilot selection policy for positive HBsAg is still inconclusive; some AMEs consider this to be disqualified. There is no adequate optimal research information or support evidence available to make decision of Issuance. The Civil Aviation Authority of Thailand have medical assessment guidelines for viral hepatitis as infectious hepatitis—the recommendation is that infectious hepatitis is disqualifying, and assessment after full recovery may be considered acceptable.

HBsAg in Thailand is quite common with pooled prevalence of 5.1% in 2015. Interestingly, national policy or health promotion programs to incorporate routine screening of HBV in Thailand to prevent CHB complications is still not widespread--only in 9% of the total population. Even in Royal Thai Air Force (RTAF) population, annual medical checkup has no HBsAg screening. This study is the first study of naive HBsAg in Thai community base with full investigation, in order to provide more information about pilot selection and HBsAg to support aeromedical management in this group of population.

Method: All RTAF personnel having an annual medical checkup from 1 November 2016 to 1 November 2017 were screened with HBsAg test. All naive positive HBsAg carrier were investigated. Collection of history, epidemiological data, blood test, ultrasonography of liver and fibroscan assessment of hepatic elasticity were all done.

Result: In a total of 15491 RTAF population (11957 male, 3533 female), 471 were HBsAg positive (3.04% of prevalence rate). Advanced asymptomatic hepatocellular carcinoma (HCC) in this screening was positive in 3 cases (prevalence rate of 817 per 100000 persons). Active viral replication with HBeAg was positive in 42 cases. One third of high risk group with active viral replication and active disease should be disqualified.

Discussion: This study is the first population-based screening of naive HBsAg carrier in Thailand. Recommendation for pilot licensing should be considered after a full risk assessment, categorizing into three main groups.

039

UPDATED CRITERIA FOR CLOSURE OF PATENT FORAMEN OVALE IN PATIENTS WITH CRYPTOGENIC STROKE - ARE THEY ALSO VALID FOR PILOTS?

CRITERES ACTUALISES POUR LA FERMETURE DU FORAMEN OVALE PERMEABLE CHEZ LES PATIENTS AVEC ACCIDENT VASCULAIRE CEREBRAL - SONT-ILS AUSSI APPLICABLES CHEZ LES PILOTES?

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Background: A patent foramen ovale (PFO) is a risk factor for paradoxical ischemic stroke. Because of a high prevalence of PFO in the general population, it is difficult to prove a causal relationship between PFO and stroke. Percutaneous closure of PFO has been debated for more than a decade in ischemic stroke of unknown etiology, and no significant benefit has been demonstrated until recently. Three long term follow-up trials published in 2017 clarified this issue.

Case report: A 54 year-old man asked for an initial EASA-class 2-Medical. He had multiple examinations four years ago because of a transient ischemic attack. A PFO with a grade III right to left shunt and a mild hereditary thrombophilia were found. A closure of the PFA was not performed. He had annual cardiological examinations. A Swiss Civil Aviation Authority cardiology expert recommended reanalysis. Transesophageal echocardiography confirmed the previous findings. Closure of the PFO was regarded as indicated, considering the newest literature data. The closure was performed by implanting a 25 mm Amplatzer PFO-device. Two months later a medical certificate will be issued after a follow-up without any complications.

Discussion/Conclusion: Newest scientific data show that percutaneous closure of PFO is beneficial and safe for a defined class of patients with cryptogenic stroke. Fitness to fly must not be limited per se in pilots undergoing this procedure.

SIMPLE CONDITION WITH COMPLICATED DIAGNOSIS*ÉTAT SIMPLE AVEC UN DIAGNOSTIC COMPLIQUÉ*

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Background: Renal tubular acidosis with hypokalemia associated with Sjogren's syndrome manifesting with an initial presentation of hypokalemic periodic paralysis is rare. In a cabin crew, this condition even if adequately treated does pose a risk of incapacitation and can jeopardise flight safety.

Case Report: A young female cabin crew during initial days of training presented with an episode of hypokalemic periodic paralysis after reportedly irregular eating habits. A detailed workup revealed non-anion gap metabolic acidosis – renal tubular acidosis, positive autoimmune markers, normal complement levels, high globulin levels, elevated ESR, proteinuria and a positive Schirmer's test. The exact autoimmune diagnosis was not established since she was unwilling for a renal biopsy. Sodium bicarbonate was prescribed indefinitely, potassium chloride when indicated and was treated symptomatically for Sjogren's Syndrome.

Discussion: The nature of cabin crew duties in a commercial airline can pose risks to aggravate the underlying condition since maintaining regular and conscious dietary requirements may be difficult especially during emergency situations. The aircraft cabin environment can also aggravate the sicca symptoms. These conditions could lead to recurrence and jeopardise flight safety. The risks of the underlying condition were not sufficiently mitigated and a decision of unfitness was taken.

Conclusion: The autoimmune condition with systemic involvement in this cabin crew presents some hazards in her role as cabin crew. There are multiple issues, which include aggravation and precipitation of hypokalemia, complications of the syndrome itself, no definitive cure and limitations of maintaining her condition in a commercial airline environment.

041

AN ANALYSIS OF MEDICAL CONDITIONS IMPACTING FITNESS IN FEMALE AIRCREW OF THE INDIAN AIR FORCE

UNE ANALYSE DES CONDITIONS MÉDICALES IMPACTANT L'APTITUDE À L'AÉRONEF FEMME DE LA FORCE AÉRIENNE INDIENNE

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Introduction: Studies providing data and analysis of health issues affecting female military aircrew are practically nonexistent, especially in developing countries. Currently, women are employed only as officers in the Indian Air Force. The aim of this study was to analyse various medical conditions impacting fitness to fly, in serving women aircrew of the Indian Air Force and compare these trends with those in female ground duty and male aircrew officers.

Methods: This cross sectional study involved collation and analysis of medical data in respect of all serving women aircrew of the IAF. Records of a total of 108 women aircrew in the age group of 23 to 40 years, were reviewed and analysed between Oct 2015 to Jan 2016. Of these, 93 were from the Transport and Helicopter stream and 15 from the Navigator stream. These were then compared with trends in female ground duty and male aircrew officers, who ranged between 21 to 60 yrs of age. The data was statistically analysed.

Results: 21.29% (n=23) of female aircrew were in low medical category (classification). When compared to low medical category trends in female ground duty and male aircrew officers across all age groups, this difference was statistically not significant. However, when compared to male aircrew officers of similar age group, i.e., 20 to 40 yrs, the difference was statistically significant (p=0.0015). The leading cause of medical unfitness in women aircrew was pregnancy (35%), followed by diseases due to endocrine causes, PIVD, injuries and anaemia.

Conclusion: In a highly male-dominated aviation industry, little is known about specific health issues impacting women aircrew. This study highlights a significant difference in medical fitness of female aircrew viz a viz male aircrew in the age group of 20 to 40 years. Continuing trend analysis is essential to understand health issues affecting female military pilots so as to enable formulation of suitable human resource and training policies world-over.

042

MEDICAL REASONS OF DISQUALIFIED PROFESSIONAL COMMERCIAL PILOTS IN THAILAND

RAISONS MÉDICALES DES PILOTES COMMERCIAUX DISQUALIFIÉS EN THAÏLANDE

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Introduction: In Thailand, flight commercial business is extensively expanding as well as pilot requirement. Pilot's retirement in Thailand is at the age of sixty years-old and could be extended to 65 years maximum. Permanent loss of commercial pilot license in Thailand has never been studied.

Method: Data have been collected from the RTAF Institute of Aviation Medicine and The Civil Aviation Authority of Thailand (CAAT) for 8 years (2010-2017). Files of all disqualified pilots were reviewed and analysed to group in categories. Rates of each disqualification reason were calculated.

Results: In a total of 25,806 pilot years, there were 17 cases of permanent loss of commercial pilot license. The average of 8 years disqualification rate is 0.659 per 1,000 pilot-years. The causes were 11 case of somatic diseases and 6 cases of mental and personality disorder.

Discussion: Compared with international data from Sweden and Norway, the permanent loss of pilot license in Thailand is rather very low but the ratio of mental problems to somatic diseases is higher than the international data. For somatic diseases in Thailand, the disqualification rate for cancer and visual problems are higher than in the international data. For cardiovascular diseases, the disqualification rate in Thai commercial pilot is lower than the international data.

Conclusion: This is the first study regarding permanent loss of commercial pilot license in Thailand. The results should bring us to seek specific target prevention and health promotion for Thai commercial pilots.

043

RETURN TO FLY AFTER ANAPLASTIC LARGE CELL LYMPHOMA: A CASE REPORT

RETOUR À LA MOUCHE APRÈS ANAPLASIQUE LYMPHOME À GRANDES CELLULES: UN RAPPORT DE CAS

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Background: Non-Hodgkin's Lymphomas are treated individually certification purposes. An assessment of incapacitation risk can be undertaken when full clinical details are known. Known prognostic factors at presentation such as age, stage, number of extranodal sites involved and performance status, related to mobility impairment, and full oncology report should be obtained. Medical certification is possible if remission is sustained for a minimum of one year after chemotherapy.

Case Report: A 53-year-old commercial pilot developed prolonged fever with dyspepsia. His initial work up included a CT scan, which showed abnormal retroperitoneal and left diaphragmatic lymphadenopathy. Intra-abdominal lymph node core biopsy and fine needle aspiration biopsy showed malignant round cell neoplasm--Anaplastic Large Cell Lymphoma-ALCL stage 2 was diagnosed. He was treated with chemotherapy (CHOP regimen x 6 cycles) last in 24 February 2016. Re-evaluation was done after 4th cycle. CT of whole abdomen showed resolution of retroperitoneal lymphadenopathy and left diaphragmatic lymph nodes, and he was followed up every 2-3 months. 18F-FDG PET with non-diagnostic CT studies performed on 31 January 2017 showed no hypermetabolic intra-abdominal lymph node, and uptake in bone marrow was unremarkable. The patient's condition improved, and returned to flying duties Class 1 OML

Discussion: Possible medical certification for Non-Hodgkin's Lymphoma needs a case-by-case discussion on the evaluation of incapacitation risk. Any central nervous system involvement would be permanently disqualifying.

Conclusion: The demonstration of cured disease with no distracting discomfort and a satisfactory low risk of sudden incapacitation should be the criteria used to confirm fitness to return to duties.

044

THE INCIDENCE OF NON-HODGKIN'S LYMPHOMA IN THAI COMMERCIAL PILOTS BETWEEN 2015-2017

L'INCIDENCE DE LYMPHOME NON HODGKINIEN DANS LES PILOTES DE LIGNE THAÏ DE 2015 À 2017

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Introduction: Non-Hodgkin's lymphomas are tumors that usually originate in the lymph nodes, but they may originate in any organ of the body. Like other malignancies, the aviators may be disqualified from flying. There are a few reports about Non-Hodgkin's lymphoma among Thai pilots. During this era, availability of newer modalities of therapy has made complete remission more common.

Methods: Retrospective analysis of available medical documents of Institute of Aviation Medicine Royal Thai Air Force between 1 Jan 2015 and 31 Dec 2017

Results: A total of four cases of non-Hodgkin's lymphoma were detected. All of the four were male; 2 were diagnosed as follicular lymphoma, 1 anaplastic large B cell lymphoma and 1 diffuse large B cell lymphoma. At first, they were unfit to fly and all received waivers. The evaluations for returning to fly were considered after completed therapies and their disease status were in complete remission. Re-fighting was based on the guidelines issued by ICAO, EASA and FAA. Three of them were evaluated physically and mentally as fit to fly and received medical certificates as Class I OML. Only one pilot was permanently grounded because of his mental illness.

Conclusion: This study reveals small incidence of non-Hodgkin's lymphoma in Thai commercial pilots between 2015-2017. Certificatory assessment should commence after the disease is in complete remission. Both physical and mental re-evaluations are required.

045

VOLATILE ORGANIC COMPOUNDS (VOC) AND ORGANOPHOSPHATES IN BLOOD AND URINE SAMPLES OF FLYING PERSONNEL AFTER "FUME AND SMELL EVENTS"

ORGANOPHOSPHORÉS ET COMPOSÉS ORGANIQUES VOLATILS (COV) PRÉSENTS DANS LES ECHANTILLONS DE SANG ET D'URINE DE PERSONNELS VOLANTS FAISANT SUITE À UNE EXPOSITION LIÉ A LA PRÉSENCE DE FUMÉE ET D'ODEUR

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Introduction: The term "Fume and Smell Events" (FuSE) describes the sudden appearance of fume and/or smells in aircraft cabins. The source of some of these events may be engine oil, because in most aircraft, the cabin air is supplied with bleed air, which is assumed to be a possible reason for a complex of symptoms that is not acknowledged as a disease--the postulated "aerotoxic syndrome."

Publications proposed that FuSE are associated with an elevated level of VOC and organophosphates or their metabolites in blood and urine. In former studies we could show that metabolites of tricresylphosphate isomers (TCP) were not elevated in the urine of exposed flight crews. To provide reliable scientific data for the current discussion, we offered exposed flight crews a standardized examination including biological monitoring of blood and urine. We also investigated prospective flight attendants before start of their training. In addition, we had to rule out exogenous contamination of samples.

Method: Implementation of a standard preanalytic protocol and questionnaires. Blood and urine samples were transferred to gas tight glasses immediately after donation. Metabolites of 9 out of 10 possible TCP isomers were analyzed in urine using an a-GC-MS procedure. VOC were analyzed using a headspace GC-MS method with enrichment on a solid Phase Phase micro extraction fibre (SPME).

Results: We will contribute to the discussion whether cabin air may lead to relevantly elevated levels of toxins in blood or urine. For the time being, sampling is still in progress and we expect data for interpretation in time. In preparation of the analytic methods we could show that n-Hexane as one of the discussed VOC is able to contaminate the biological material in some of the test tubes and also disinfection fluid may influence the results. Therefore, a standardized preanalytic procedure is mandatory to achieve reliable results.

046

AN ICASM DEBATE: IS IT SAFE FOR PRIVATE AND COMMERCIAL PILOTS TO FLY AFTER CVA?

UN DEBAT ICASM: EST-IL SECURITAIRE POUR LES PILOTES PRIVES OU COMMERCIAUX DE SURVOLER CVA?

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Introduction: Transient ischaemic attack (TIA) is one end of the spectrum in cerebrovascular accident (CVA) with sudden death as the other extreme, and 'stroke' in the middle. While residual neurological deficits are likely to result in functional impairment, there remains a risk of sudden incapacitation. A diagnosis of CVA may spell doom, both physically and economically, for a pilot. TIA is "a brief episode of neurologic dysfunction caused by focal brain or retinal ischaemia, with clinical symptoms typically lasting less than one hour and without evidence of acute infarction" [Easton JD, et al., *Stroke* 2009;40:2276-2293]. While the term, "stroke," should be broadly used to include all of the following: "CNS infarction is brain, spinal cord, or retinal cell death attributable to ischaemia, based on 1. Pathological, imaging or other objective evidence of cerebral, spinal cord or retinal focal ischaemic injury in a defined vascular distribution; or 2. clinical evidence of cerebral, spinal cord or retinal focal ischaemic injury based on symptoms persisting > 24 hours or until death, and other etiologies excluded." [Sacco RL, et al., *Stroke* 2013;44:2064-2089] While very few aviation regulators may allow a pilot to return back to flying with mitigating factors after a defined period of observation on ground, most regulators deny a return to cockpit for pilots with a diagnosis of CVA/Stroke/TIA. The proposition to be debated is: "It is safe for private and commercial pilots to fly after a CVA."

Method: The moderator of the debate will introduce the motion and the rules to the audience, which will case a pre-debate motion. Two speakers each will speak for and against the motion. Each speaker will present an opening statement, followed by questions from the audience. Finally, two speakers will deliver closing statements, for and against.

Summary: The proposed motion will be put to a vote again at the end of the session to decide the final outcome.

047

AEROMEDICAL SUPPORT TO MULTI-RECORD WINNING WINGSUIT ATTEMPT

AEROMEDICAL SOUTIEN A LA TENTATIVE DE WINGSUIT GAGNANTE RECORD DE MULTI

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Introduction: In 2017, Fraser Corsan, a very experienced wingsuit pilot planned to break several World records, relating to altitude, duration, speed and distance covered whilst flying a specially designed wingsuit. This was fitted with associated equipment assemblies to protect him from the many environmental and aerodynamic stressors associated with this attempt. He approached QinetiQ to provide him on advice on the stressors he would encounter, the equipment he should use, and the training he should have, for his attempts from altitudes up to 42,000 feet.

Methods: The key aeromedical risks associated with the attempts were hypoxia, decompression sickness and cold. Fraser was provided with detailed advice on the physiology of these stressors and minimising risk during the record attempts, followed by training including pressure breathing and personal experience of hypoxia. Assistance was given in the selection and design of the breathing and thermal protection systems. Two attempts were subsequently to be conducted in May 2017, the first in Davis, California from a light aircraft, the second from a piloted hot air balloon in Ontario, Canada.

Results: Fraser was very unlucky with the weather in that very high temperatures in California during late May restricted the maximum altitude the light aircraft could achieve, and a long period of very windy & rainy weather prevented the balloon launch and hence cancellation of the 2nd attempt. Nevertheless, five records were broken including the World record for greatest peak speed flown in wingsuit (246.6mph; 396.86kph), FAI UK National record and European record for highest altitude and the FAI longest freefall distance record by a UK National and European (31,959ft; 9,741m). There were no significant aeromedical issues.

Conclusions: The successful record breaking wingsuit flight showed that the protection afforded by the equipment used, and the teaching and training provided resulted in no significant aeromedical issues during the record attempt. Had weather conditions been more favourable, more World records would have been broken safely.

048

EFFECTS OF EXTREME HYPOBARIC ENVIRONMENTS UPON THE BRAIN IN SPECIALIZED OPERATORS

EFFETS DES ENVIRONNEMENTS HYPOBARES EXTRÊMES SUR LE CERVEAU DANS LES OPÉRATEURS SPÉCIALISÉS

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Introduction: Repeated exposure to extreme hypobaria is associated with increased white matter hyperintensities (WMH), degradation of axonal integrity, and neurocognitive processing decrements. The goal of our research studies is to characterize the pathophysiologic response of the brain to high altitude and maximize the safety of our aircrew and special operators.

Methods: Brain MRI fluid-attenuated inversion recovery data from 41 astronauts (ASTR) were quantified for WMH volume, subcortical and periependymal. This was compared to previously reported data from 106 U-2 pilots (U2P) and to 320 health-matched control subjects (nonparametric group comparisons). 96 U.S. Air Force aircrew trainees were evaluated while undergoing initial occupational hypobaric exposure. Standard USAF procedure is a 30-minute exposure to 25,000 feet (7,620 meters). Quantitative arterial spin labeling (ASL) and proton magnetic resonance spectroscopy (MRS) data were acquired on subjects at T-24 hours, T+24 hours, and T+72 hours. Controls were 68 healthy subjects meeting the same physical and physiological criteria minus hypobaric exposure.

Results: ASTR mean WMH total volume (mL) was 0.6618 +/- 0.1289 compared to 0.8663 +/- 0.0502 for U2P and 0.2353 +/- 0.0100 for controls. Both U2P and ASTR have a significantly higher WMH volume compared to controls, with no significant difference between ASTR:U2P. Statistically significant increases in cerebral blood flow (CBF) in white matter in aircrew personnel with hypobaric exposure was observed (white matter p except glutathione, in aircrew personnel with hypobaric exposure: glutamate, choline, N-acetylaspartate, myoinositol $p < 0.05$; creatine, glutamate+glutamine $p < 0.01$).

Conclusion: Astronauts demonstrate similarly increased WMH burden to high-altitude pilots. There is a highly significant increased CBF response after a single exposure to hypobaria and significant differences in most neurometabolites after exposure to hypobaria. These differences may be representative of cellular level effects which are associated with changes in CBF.

049

WHITE MATTER HYPERINTENSITIES AND IMPLICATIONS FOR FUTURE ALTITUDE CHAMBER RESEARCH

HYPERINTENSES DE LA SUBSTANCE BLANCHE ET IMPLICATIONS POUR LA RECHERCHE FUTURE SUR LA CHAMBRE D'ALTITUDE

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Introduction: Repeat exposure to non-hypoxic decompression stress is associated with increased white matter hyperintensities (WMH) on brain magnetic resonance imaging (MRI) of U-2 pilots, altitude chamber workers and divers. However, retrospective survey of altitude chamber participants in low intensity decompression stress associates excess WMH in a minority with past mild traumatic brain injury (MTBI). Further data are available following prospective study of brain MRI before and after altitude chamber studies in 2017.

Methods: Volunteers for hypobaric oxygen system assessments underwent entry (screening) and exit MRI (high resolution volumetric FLAIR) at the University of Nottingham, UK. For test-retest validity and to avoid bias, MRI data were analysed independently for total subcortical WMH number and volume at the University of Maryland, USA. Entry criteria were <6 WMH up to 0.08 mL total volume. The survey findings were updated and outcomes reviewed to consider implications for future altitude chamber research.

Results: Eleven research participants in 160 hypobaric exposures up to equivalent altitudes between 18,000 ft and 40,000 ft pressure altitude had eight WMH (total volume 0.166 mL) on study entry and five (0.184 mL) on exit. To date, 28 participants in 1577 hypobaric exposures over 15,000 ft do not manifest altitude-associated WMH. Excess WMH in four UK participants screened to date (12%, N=33) remain attributable to past MTBI, Fisher Exact Test statistic 0.0031 ($P < 0.05$).

Conclusions: Low intensity (brief, infrequent) hypobaric exposure, including occasional hypoxia familiarisation, has not promoted WMH in healthy UK volunteers. The chosen altitude study entry criteria appear pragmatic, with just one screening failure (63 WMH occupying 2.38 mL); it may remain prudent to exclude volunteers with excess WMH from altitude research. A negative history of MTBI has 100% sensitivity and 100% negative predictive value for excess WMH (zero false negatives) in UK volunteers scanned to date (N=33).

050

OCCUPATIONAL RISK ASSESSMENT FOR AIRCREW IN FIXED WING TRANSPORT AIRCRAFTS OF THE ISRAELI AIR FORCE

ÉVALUATION DES RISQUES PROFESSIONNELS RELATIFS AUX AVIONS DANS LES AVIONS DE TRANSPORT AILES FIXES DE LA FORCE AÉRIENNE ISRAËLIENNE

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Introduction: Long-term exposure to high levels of noise presents potential health risks. Exposure to Volatile Organic Compounds (VOC) is also known to have many health effects. Most research for occupational risk assessment to aircrew were conducted in airliners.

Aims: To examine exposures to noise and VOC in seven aircraft types, constituting the military fixed wing transport platforms in the Israeli Air Force: Beech Super King Air 200 (two configurations – Kukia and Tzufit), Beech A36 Bonanza, Boeing 707, C-130 Hercules, Gulfstream V, and C-130J Super Hercules.

Methods: Noise levels and VOC concentrations during flight were measured in the cockpit of all platforms and in the cabin of the airplanes where the cockpit is separated. The measured values were compared with the threshold values for VOC and noise set by ACGIH.

Results: All the measurements of VOC were found meaningfully lower than the occupational threshold limits, most of them below detection levels. Harmful noise levels were measured in the cockpit of Beech Super King Air 200 (Kukia configuration), Beech A36 Bonanza and C-130 Hercules and in the cabin of Boeing 707, C-130 Hercules, Gulfstream V, and C-130J Super Hercules.

Conclusions: The fixed wing transport aircrew is not exposed to harmful VOC concentrations in the air. Harmful noise levels are present in three of the platforms in the cockpit, and in the cabin of all heavy fixed wing transport in the IAF. Aircrew and passengers should take note and take preventive measures in long flights.

051

OPERATIONAL EPIDEMIOLOGY: AN OUTBREAK INVESTIGATION APPROACH TO F-22 PHYSIOLOGIC INCIDENTS

French: ÉPIDÉMIOLOGIE OPÉRATIONNELLE: UNE APPROCHE D'INVESTIGATION FIDÈLE DES INCIDENTS PHYSIOLOGIQUES F-22

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Introduction: From 2008-2012, multiple U.S. Air Force F-22 pilots reported physiologic incidents with no known cause. A team at the 711th Human Performance Wing assisted in the investigation, utilizing an outbreak investigation approach to help identify the root causes of the incidents. This presentation will review the basic steps of an outbreak investigation, explain how each step was applied to the F-22 investigation, and propose a modified approach for use in future scenarios.

Background: Outbreak investigations are typically described as having 10 steps: 1. Prepare to investigate; 2. Verify the diagnosis and confirm the existence of an outbreak; 3. Create a case definition; 4. Identify cases; 5. Perform descriptive epidemiology; 6. Develop hypotheses; 7. Evaluate hypotheses through statistics; 8. Refine hypotheses; conduct additional studies; 9. Implement control/prevention measures; and 10. Communicate findings. In general, the traditional outbreak investigation approach provided a good framework for the F-22 investigation--epidemiologic statistics such as case-control studies were valuable tools for the investigation, and descriptive epidemiology played a key role. However, not all steps directly applied to the F-22 scenario. While most classical epidemiology is based on infectious disease models, the F-22 incidents had an unknown diagnosis as well as an unknown origin. Because both the cause and the effect were unknown, several modifications to the traditional approach were necessary. For instance, it is not possible to verify a diagnosis for an unknown outcome. Similarly, case definitions must be fluid, which makes quantifying the outbreak difficult.

Summary: The traditional outbreak investigation approach provided a template to investigate a novel problem. However, the need to describe an unknown outcome was not fully met by the outbreak investigation approach, nor was the need to mitigate operational risk where possible. The authors propose modifications to the traditional approach that may be more relevant to operational settings and/or to outbreaks with novel, unknown outcomes.

053

THE ROLE OF PSYCHOLOGICAL PROVISION OF RECRUITMENT, TRAINING AND PROFESSIONAL ACTIVITIES OF CIVIL AVIATION PILOTS IN CONNECTION WITH FLIGHT SAFETY MEASURES IN THE RUSSIAN FEDERATION

RÔLE DE L'APPROVISIONNEMENT PSYCHOLOGIQUE DU RECRUTEMENT, DE LA FORMATION ET DES ACTIVITÉS PROFESSIONNELLES DES PILOTES DE L'AVIATION CIVILE DANS LE CADRE DES MESURES DE SÉCURITÉ DES VOLS EN FÉDÉRATION DE RUSSIE

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Introduction: The existing system of psychological provision in Russia is an integral part of flight safety measures in civil aviation and is regulated by "Manual on Psychological Provision of Recruitment, Training and Professional Activities of Civil Aviation Personnel" in compliance with Federal Aviation Regulations, ICAO, the Air Code of the Russian Federation, the Rules for the Investigation of Accidents and Incidents with Civil Aircraft in the Russian Federation, and "Methodological Recommendations on Qualification Requirements for Experts and Psychologists of Flight Expert Medical Commissions of Civil Aviation."

Background: The assessment of psychological compliance is carried out with a battery tests (printed forms and automatic versions, group and individual). I. Personal psychological features assessment of mental stability is the core one, conducted with standardized method of personality assessment (SMPA). II. Assessment of higher mental functions and cognitive skills: switching capability and attention distribution, working and short-term memory, arithmetic, spatial orientation, manipulation with images, memory capacity and attention stability, logical and analytical skills.

Summary: The system of psychological provision is focused on psychological assessment, psychological training of aviation staff, analysis of psychological factors in frames of accident and incident investigation, supportive psychological measures and development of professionally significant features. It is necessary to develop a new paradigm of psychological provision based on the following pillars: Corporate Culture Development, Psycho-diagnostic Assessment, Training, Follow-up Support and Analytical Activities.

054

EMERGING BEST PRACTICES IN PILOT PEER SUPPORT PROGRAMS

MEILLEURES PRATIQUES ÉMERGENTES DANS LES PROGRAMMES PILOTES DE SOUTIEN PAR LES PAIRS

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Introduction: Following the Germanwings tragedy, aviation advisory bodies including the EASA Germanwings Task Force and the FAA Pilot Fitness Aviation Rulemaking Committee made recommendations for air carriers and pilot groups to establish pilot peer support programs (PPSP's). Program goals are to remove barriers to pilots seeking assistance with mental health stressors, increase awareness of resources available to pilots, to reduce the stigma of seeking help and to improve aviation safety.

Background: Several longstanding PPSP's and newly created PPSP's have adopted a variety of strategies to assist pilots with many "routine" psychological stressors as an initial response. This reduces fears and stigma of seeking help from mental health professionals, employer resources or involving regulators in psychological fitness evaluations. Well-established PPSP's increased the number of peer support volunteers (PSV's) available, augmented awareness marketing efforts, and improved vetting and training of volunteers.

Newly established programs emulated previously successful PPSP's and added elements to improve pilot access and mental health oversight. Because of variations in company and pilot union resources, collective bargaining agreements, national health and insurance systems, regulatory requirements, privacy and notification laws, airline medical department involvement and other factors, there is no single best PPSP model for a particular airline or country. PPSP data collection is challenging.

Summary: Best practices include comprehensive initial and recurrent PSV training. This training includes listening skills, mental health awareness, suicide evaluation, resources available to pilots, scope limits and referral thresholds, women's issues, safety of flight/fit for duty assessments and confidentiality limits. 24/7 PSV availability for telephone or online contact is essential. Vetting and disenrollment protocols for PSVs are needed. Support of the employer, union and regulator without direct involvement is critical. Triage and referral mechanisms for complex or urgent situations should be well established. Successful PPSP's require continuous effectiveness analyses. Extension to general aviation and ATC is desirable for safety.

055

PRELIMINARY SURVEY OF ATTITUDES & USE OF INTERNET AND SOCIAL MEDIA AMONG AIRCREW

ENQUÊTE PRÉLIMINAIRE SUR LES ATTITUDES ET L'UTILISATION D'INTERNET ET LES MÉDIAS SOCIAUX PARMIS LES AÉRONEFS

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Introduction: The advent of internet initially, and then other social media applications, has brought with it various socio-psychological issues ranging from inadequate sleep to daytime sleepiness. There has been concern regarding aircrew engagement in social media use in the night affecting performance in the air the next day. Towards developing an understanding of social media use among aircrew and its effects, this questionnaire study was carried out.

Material & Methods: Aircrew reporting to IAM IAF for training participated in this questionnaire study. A questionnaire was developed for the purpose. Participation in the study was voluntary and anonymous. A total of 93 aircrew completed the questionnaire form.

Results: On a typical working day, more than half of the aircrew spend 30 minutes or less watching TV, whereas almost one fourth did not watch TV. This proportion increased to 62% watching TV for one or more hours over the weekend. Approx 66% spent 30 minutes or less during the week day on social media. The majority of the aircrew began sleep between 10-11 pm, fell asleep within 30 minutes, and graded their sleep quality as sound. A large majority use the internet every day. Approx one third of the respondents got the urge to check their social networking updates during social gatherings. A small percentage of the aircrew felt that spending between 1-3 hrs per day in front of a screen is acceptable. Aircrew feel that internet usage in the night affects performance on ground work at the squadron more than flying.

Discussion: This is the first ever study, to our knowledge, to understand the attitudes of aircrew towards internet & social media use. This use and inadequate sleep quantity is leading to daytime sleepiness. It may be affecting performance of both ground crew as well as aircrew. It has provided interesting insights for interventions. Future studies will explore and focus on specific segments of this questionnaire to develop relations between specific media use and performance.

056

EXCESSIVE DAYTIME SLEEPINESS IN THAI AVIATION PERSONNEL

SOMNOLENCE DIURNE EXCESSIVE DANS LE PERSONNEL DE L'AVIATION THAÏLANDAISE

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Introduction: Excessive daytime sleepiness (EDS) is a significant public health problem, with prevalence in the community estimated to be as high as 18%. EDS is a non-specific but highly prevalent cardinal symptom of sleep disorders. EDS led to decrease work productivity, increase accidents in the workplace, increased inter-personal problems, and may reduce the quality of work and life. EDS is associated with obesity, extremes of age and insufficient sleep. The objectives of this study were to determine 1) the prevalence of EDS in Thai aviation personnel, and 2) the factors that are associated with EDS in Thai aviation personnel.

Methods: Personnel from the Thai aviation community were sampled using a cross-sectional study design. The sample size was 284. The Epworth Sleepiness Scale (ESS) was used to determine the level of excessive daytime sleepiness. A questionnaire included general demographic data, weight, height, occupation, and the ESS. The ESS is a self-reported questionnaire composed by 8 items, which assess the level of sleepiness in daily situations, rated on a 4 point , ranging between "0 - no probability of falling asleep" and "3 - high probability of falling asleep." The total score is obtained by adding all items, ranging between 0 and 24. ESS at or above 12 points was used to define EDS. QR code was used to collect the data.

Results: EDS (ESS>12) was reported by 17.37% in this study. Persons with higher Body Mass Index (BMI) were associated with a high prevalence of EDS.

Conclusion: The prevalence of EDS in the Thai aviation community is 17.37%, and ESS score is associated with BMI. Aviation community should be aware of EDS as it is debilitating and has potentially dangerous consequences.

057

EFFECTS OF ALTERNATING ROTATIONS EAST-WEST ON AIRCREW FATIGUE

EFFET DES ALTERNANCES EST-OUEST SUR LA FATIGUE DES PERSONNELS NAVIGANTS

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Introduction: Alternating rotation East-West is a common complaint in aircrew. The main effects claimed concern sleeping disorders and fatigue. The Air France FRMS asked his occupational medicine department to provide data on the effects of cumulating 1 or more east-west alternating rotations.

Methods: We proposed to fill up an online questionnaire after the periodic fitness exam. The main outcomes were the sleepiness Epworth score, sleep quality for the last two weeks on a 5 levels scale (1 = "very good" to 5 = "very bad") and the Samn-Perelli fatigue score. We controlled for different confusion factors like age, gender, commuting time, awakening duration at the time of the test. East-West alternation was characterized by an ad hoc index (product of the sum of time zone crossed by the number of alternations).

Results: From March 2016 to March 2018, 452 long-haul aircrew completed the questionnaire: 295 cabin crew, 96 first officers and 61 captains. The mean Epworth scores were 9.7 (captains), 10.8 (cabin crew) and 11.2 (F/O), and mean sleep quality was 2.3/5 (captains) 2.5/5 (F/O) and 2.6/5(cabin crew). 219 (48.5 %) flight crew had no alternation, whereas 127 (28.1%) had one 81 (17.9%) had two, and 25 (5.5%) had three or more alternations. In univariate analysis daytime sleepiness (OR 1.37[0.95-2.02]), fatigue (OR 1.14 [0.58-2.22]), and sleep quality (OR 1.05 [0.72-1.52]) are slightly but not significantly associated with having at least one alternation in the 6 last weeks.

Conclusion: In contrast with clear complaints about alternating East-West rotations, our study shows only limited effects on several classic sleepiness and fatigue scores. Taking into account confusion factors even lowers these limited associations. However, our questionnaire reveals that quite all flight crew consider that no more than two alternations should be scheduled in a month.

CORRELATES OF FLIGHT TIME LIMITATIONS, FATIGUE, AND EMPLOYMENT CONDITIONS IN AIRLINE PILOTS' MENTAL FITNESS

CORRÉLATS DES LIMITES DE TEMPS DE VOL, DE LA FATIGUE ET DES CONDITIONS D'EMPLOI DANS LA SANTÉ MENTALE DES PILOTES DES COMPAGNIES AÉRIENNES

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Introduction: Only after the Germanwings crash in 2015, EASA and aviation industry became aware that mental disorders and emotional stress in pilots can have disastrous consequences. Before that, fatal crashes like LAM470, EgyptAir990, and SilkAir185 were also caused by psychiatric disease and acute stress. Accident investigators also proved that pilot fatigue can have fatal consequences, like ColganAir3407, KoreanAir801 and ChinaAirlines006. This research focuses on the correlates of flight and duty times, fatigue, employment conditions in airline pilots' health and common mental disorders, depression, anxiety, and quality of sleep.

Methods: This cross-sectional study analysed demographic data and working conditions of mostly Europe-based pilots. The sample (N=166) consisted of 7.9% female pilots, the average age was 40.7 years (SD=10.64), with M=8766 flight hours (SD=5756). 50% of the airline pilots were captains, 50% were first officers. 65% of the airline pilots worked for legacy carriers, 25% for low cost carriers, 11.4% flew air cargo, 8.6% flew charter services. 7.14% of the professional pilots fly only short-haul (up to two hours), 54.3% short and medium-haul, 15% short- and long-haul, 22.9% fly only long-haul. 86.43% have an employment contract directly with the airline, 7.86% are employed by a manning agency, and the rest is "self-employed" (2.86%).

Results: The average number of duty hours in the last month was 117.2 (SD=42.36), containing 66.32 (SD=21.89) flying hours. All of the following measures were self-assessed: The average WHO5 score was 57 (SD=21), airline pilots' PHQ8 score (depression) was M=5.92 (SD=5.15). General Anxiety M=4.04 (SD=4.1), SRQ20 (CMD) M=3.81 (SD=3.9), PHQ-Stress M=5.04 (SD=3.6), Jenkins Sleep Scale M=1.93 (SD=1.24), Fatigue Severity Scale M=4.6 (SD=1.02). GLM results with these dependent variables will be presented.