



## Abstracts – E-Posters

### PO 1 - HOW ACCELERATION AFFECT DISTRIBUTED ATTENTION

Theme: PHYSIOLOGY -- Acceleration and ejection

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**INTRODUCTION:** The aim of this study was to find how cerebral ischemia caused by acceleration affect individual's ability to distribute attention between visual and auditory channels.

**METHODS:** Sixteen young males were divided into two groups. The experimental group receiving 50 mmhg of lower body negative pressure (LBNP) to simulate the effects of cerebral ischemia induced by acceleration. The control group completed the experimental task in a lying position. Both groups were required to complete a distributed attention task with EEG recording. Distributed attention assessment adopts an audiovisual dual-task paradigm. The visual channel task is the visual color discrimination task, and the auditory channel task is the sound loudness discrimination task.

**RESULTS:** The power spectrum value of the alpha band in LBNP state in the time window of 300~400ms at FT9 position ( $0.31 \pm 1.22$ ,  $\mu\text{V}^2/\text{Hz}$ ) was significantly higher than that at the baseline state ( $0.29 \pm 0.81$ ,  $\mu\text{V}^2/\text{Hz}$ ),  $Z=2.201$ ,  $P<0.05$ . The power spectrum value of the Alpha band in LBNP state in the 0~100ms time window at F3 position ( $0.47 \pm 1.44$ ,  $\mu\text{V}^2/\text{Hz}$ ) was significantly higher than that of the baseline state ( $0.30 \pm 0.59$ ,  $\mu\text{V}^2/\text{Hz}$ ),  $Z=2.207$ ,  $P<0.05$ . No significant difference in functional connectivity indexes (Phase Lag Index and Phase Locking Value) between LBNP and normal baseline state was found.

**CONCLUSIONS:** The consistency of neuronal activity in the alpha band was enhanced when individuals completed distributed attention tasks under LBNP state, suggesting that under the influence of acceleration stress, the cognitive resources invested by individuals in completing distributed attention task decreased.



## PO 2 - TRANSITIONS IN PHYSIOLOGICAL FITNESS; IN AEROSPACE

Theme: PHYSIOLOGY -- Disorientation

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**INTRODUCTION:** Nineteen-nineteen to Nineteen thirty-eight (1919-38) were the Golden years of Aviation Medicine and, 'The examination of Aviation Candidates for the RAF'; issued under the Authority of the Air Council, by R. C. Munday. The commonest symptom with flying, was 'Wind up', the primordial apprehension of danger of the unknown, and Anxiety Neurosis as defined by Rivers. A School of Aerospace Medicine (US) in 1961, explored newer paradigms of Fitness as a Gravity response and Human Performance, in an Unknown Environment.

**GRAVITATION AND HUMAN PHYSIOLOGY:** Sea/Motion/Canal/Sickness, were described in the 1960s, and Space Motion sickness is perhaps an artifact of Sickness Induced by Centrifugation (SIC). The fixation in the visual field is kept steady, by the semicircular canal system, in Gravity; or Earth vertical. The upright posture and gait, even in the dark, is by the primordial Otolith organs, the vestibular cortex, and the ocular otolith reflex, with experiential reorganization of body-position, axial-orientation and perception, alongwith proprioceptive, kinesthetic and postural control. Flying by the 'seat of your pants' and 'the pit of your stomach' as in Gliding, result from an intermodality sensory conflict of vestibular and visceral graviceptor signals including diaphragmatic and respiratory kinematics. Hearing and movement in dancers and mind-body yogic practitioners, with Autonomic and Systemic responses, in musical and meditative idling-mode, are Force re-configuring, fluid wave bodily-forms in Weightlessness.

**CONCLUSIONS:** The choreutic conception of kinesthetic-motor and dynamic equilibrium need be recomposed in kinespheric nets oscillating like cobwebs in Space and Time.



### **PO 3 - VESTIBULAR STIMULATION AND VISUOSPATIAL ABILITIES**

Theme: PHYSIOLOGY -- Disorientation

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The aim of this study was to investigate the effects of a vestibular stimulation (obtained by periodic bidirectional movements of a rotating chair) on visuospatial and attentional abilities in a sample of pilots ( N 16) and non pilots (N16). Participants underwent to two visuospatial tests: the Perspective Taking Ability (PTA) test and the Mental Rotation (MR) and an attentional test the Stroop Task. Each test was administered twice : during vestibular stimulation and in a static condition. Response times and accuracy were recorded for each test. The results show that vestibular stimulation improves response times in both groups, while accuracy tends to improve. Nevertheless there are differences between visuospatial tests and the Stroop test. Indeed, in the PTA and MT accuracy improves for non pilots and remains stable or decrease for pilots, in the Stroop task no significant differences in accuracy emerge between the two groups. As in previous studies pilots exhibit a superior performance compared to non pilots and are likely less sensitive to the facilitating effects of vestibular stimulation as a result of non associative learning habituation to the phenomenon



## PO 4 - PILOTS RESPONSE TO HYPOXIA IN HYPOBARIC CHAMBER

Theme: PHYSIOLOGY -- Hypoxia and hypobarism

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**INTRODUCTION:** Under high altitude conditions, low-pressure atmospheric oxygen reduces power generation, thus inducing a decrease in oxygen availability. Hypobaric chamber experience is fundamental to aviation training. We evaluated the effects of the hypobaric-hypoxic environment on the human organism as a cardiorespiratory responses (HR, RR, SpO<sub>2</sub>) and as a cellular response (blood biomarkers of oxidative stress and metals).

**MATERIALS/METHOD:** We enrolled 31 young healthy military male pilots homogeneous in terms of age, BMI, life style and educational level. Hypobaric chamber training for student pilots involves an ascent to altitude with 2 exposures to acute hypoxia: at 25,000 feet (ft) and at 18,000 ft. A subgroup made the ascent to 35,000 ft. Physiological parameters were taken. The blood sample was collected before and post training. Blood biomarkers of oxidative stress (TXB<sub>2</sub>, AOC, IsoP, 3-NT) and metals (Ca, Cu, Mg, Zn) were measured.

**RESULTS:** Individual variation in IsoP and TXB<sub>2</sub> levels were negatively correlated with SpO<sub>2</sub> at 18,000 ft ( $r=-0.41, p=0.0228$ ) and at 25,000 ft ( $r=-0.39, p<0.05$ ). We performed the statistical analysis on the 25,000 ft group and the 35,000 ft group. In the first group, a significant difference was observed between pre and post-training in Ca and Cu assays. In the second group was observed a  $p=0.064$  for the TXB<sub>2</sub> assay and a highly significant reduction between pre and post-training Zn assay ( $P<0.0001$ ).

**CONCLUSION:** Hypobaric chamber training induces an increase in IsoP and TXB<sub>2</sub> in subjects with low SpO<sub>2</sub>. Hypoxia could be the cause of the decrease Zn levels. The action of stress linked to anxiety cannot be excluded, which could have contributed to the reduction of circulating Zn.



## PO 5 - ALTITUDE-INDUCED DECOMPRESSION SICKNESS PROTOCOLS

Theme: PHYSIOLOGY -- Hypoxia and hypobarism

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**BACKGROUND:** Evolving research suggests cockpit decompression at altitude occurs more frequently and at lower altitudes than previously reported. Aerospace decompression sickness (DCS) can present subtly and lead to morbid neurological sequelae, requiring high clinical suspicion maintained by pilots, first responders, and physicians. This report intends to address knowledge gaps by reviewing published guidelines to develop treatment decision protocols for medical providers.

**OVERVIEW:** Aviation DCS mechanistically overlaps with its well-studied correlate in divers with a growing literature body stimulated by prior serial fatal aviation accidents within the United States Air Force U-2 community. Following narrative literature review on the occurrence of decompression injuries resulting from altitude exposure, best clinical practices were formatted as flow charts for algorithmic and universal approaches to medical care. Inflection points in decision-making incorporate both telephone/virtual and face-to-face evaluation with progressive escalations of treatment according to tiered level of care indicated. Three flow charts were developed for procedure following rapid decompression at altitude.

**DISCUSSION:** Cockpit decompression at altitude occurs relatively infrequently, though the potential for morbid resulting injury mandates high clinical suspicion when indicated. Clinical sequelae overlap with correlates in the hyperbaric environment, which should be recognized by aircrew and those who provide medical services to them. The proposed schema in this report thus serve to prevent related adverse medical incidents while guiding clinical decision making.





## **PO 6 - ECG T-WAVE INVERSION IN PILOTS EXPOSED TO HYPOXIA**

Theme: PHYSIOLOGY -- Hypoxia and hypobarism

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Hypobaric chamber training is the most widely utilized method to enable military pilots to experience the effects of altitude exposure. Reports of ECG changes induced by acute hypoxia in previous studies involve the decrease of the amplitude of the P/QRS/T waves and the prolonging of QT interval. This case report describes repolarization changes occurred in few pilots during hypobaric training.

Participants are healthy individuals exposed to 25000/18000ft simulated altitudes to induce the symptoms of hypoxia; ECG (peripheral leads) and O<sub>2</sub> sat were constantly monitored.

Temporary changes in T-wave (biphasic and inverted) were observed during hypoxia in few young pilots (10 out of 948). These changes were followed by full recovery occurring shortly after restoring the oxygen supply. No participant reported myocardial ischemia symptoms such as dyspnea or chest pain. These abnormalities were referred to the flight surgeon.

In healthy subjects with no coronary disease, ST segment depression and T-wave inversion can occur after intense sympathetic stimulation. Furthermore sitting position and hyperventilation together could explain such findings, while at altitude the concurrent expansion of abdominal gas could enhance such phenomenon. In worst cases, these signs can reflect a transient microvascular ischemic condition. Hypobaric training has been widely utilized for decades, however concurrent ECG recording during altitude exposure is not common practice, limiting the possibility to compare findings.

Repolarization changes observed during simulated hypoxia are difficult to interpret. Even if our participants showed no medical abnormalities afterwards, our findings warrant further investigation.



## PO 7 - RED BLOOD CELLS AND G6PDH IN AVIATION PERSONNEL

Theme: PHYSIOLOGY -- Hypoxia and hypobarism

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**INTRODUCTION:** During the aero-medical examination aviation personnel undergoes a series of tests including the analysis of haematological parameters and the measurement of the enzyme Glucose 6 phosphate dehydrogenase (G6PDH). The great variety of the G6PDH enzyme leads to pay attention in the assessment of hypoxic risk, as a function of oxidative stress and alterations in microcirculation.

**MATERIALS:** Whole blood samples were collected from personnel undergoing aeromedical examinations during the year 2024. Samples, showing G6PDH enzymatic activity greater than 2000 U/L were selected reporting the measurements of hematological parameters for mean corpuscular volume (MCV), red blood cell concentration (RBC), and white blood cell concentration (WBC).

**RESULTS:** The haematological parameters of the personnel at the aero-medical examination ( $n=145$ ) who had a G6PDH measurement greater than 2000 U/L, have been analysed. The results showed a moderate correlation between MCV and G6PDH ( $R=-0,55$ ;  $R^2=0,30$   $p$ -Value $< 0,005$ ), explaining a weak association with the activity of the enzyme, and then indicating a possible phenotypic profile. In addition, we have proposed to increase the dilution of the microcythemic samples by 25%, testing it on a small number of specimens ( $n=5$ ), in order to normalize the enzymatic measurement.

**CONCLUSION:** Some haematological parameters correlate with the activity of the enzyme G6PDH that requires further studies in order to evaluate further risk classes or protective factors, in conditions of stress related to flight activity and aerophysiological training activity in hypobaric chamber or centrifuge.



## PO 8 - NEUROINFLAMMATION AFTER HYPOBARIA AND HYPEROXIA

Theme: PHYSIOLOGY -- Hypoxia and hypobarism

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Hypobarica, hypoxia, and hyperoxia are among the inherent risks of high altitude aviation, but the pathophysiology of these insults is unclear. To address those knowledge gaps, the objective for this study was to determine systemic biochemical outcomes following exposure to hypobaric hypoxia, isolated hypobarica, and concomitant hyperoxia. Mice were maintained within either 760 mmHg (sea level), 546 mmHg (2438.4 m), or 429 mmHg (4572 m) barometric environments for three 90-minute sessions per day for five consecutive days. Some experimental groups also received supplemental oxygen to maintain and exceed arterial partial pressure of oxygen of 95 mmHg, to isolate hypobarica and induce hyperoxia, respectively. Mice were euthanized, and brains were extracted and flash frozen. Tissue levels of 10 cytokines were measured using electrochemiluminescence technology. Hypobaric hypoxia revealed an increase in anti-inflammatory and decrease in pro-inflammatory markers. Isolated hypobarica revealed a significant increase in pro-inflammatory markers. Additionally, concomitant hypobarica and hyperoxia revealed a stark increase in pro-inflammatory markers. These findings suggest a potential inflammatory response in the mouse neural tissue, in both isolated hypobaric and hyperoxic conditions. A relative decrease was observed in connexin-43 protein at 4572 m. Significant inflammation was found in neural tissue after exposure to hypoxia, hypobarica, and hyperoxia. Through these studies, we can assess the integrity of the blood-brain barrier after exposure to these extreme environments, and how its breakdown can subsequently exacerbate neuroinflammation through an increase in proinflammatory cytokines.





## **PO 9 - CARDIOVASCULAR RISK FACTORS AMONG MILITARY PILOTS**

Theme: CLINICAL -- Cardiology

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Cardiovascular diseases and their associated risk factors stand as a central focus within aviation medicine. The primary prevention of these diseases has become an imperative for aircrew, as the significant impact on health, career prospects and flight safety are important.

This study aims to assess the prevalence of cardiovascular risk factors among military pilots and to emphasize the critical need of implementing a pragmatic strategy focused primarily on primary prevention.

This study involved a cross-sectional analysis of one hundred Tunisian military pilots, gathering data on factors such as age, family history, smoking habits, physical activity levels, body mass index, blood pressure, blood glucose levels, cholesterol levels, triglycerides, and the presence of metabolic syndrome. Overall cardiovascular risk was estimated according to the Framingham model.

All our pilots were male, with a mean age of 42 years [26-59 years], categorized as follows: 12% were fighter pilots, 33% were transport pilots, and 55% were helicopter pilots. The prevalence of smoking was 42%. The prevalence rates for hypertension, hypercholesterolemia and diabetes were 8, 23 and 4% respectively. 19% of our pilots had a metabolic syndrome and 22% were obese. Overall, 12% had a moderate cardiovascular risk, while 3% had a high risk.

The prevalence of cardiovascular risk factors remained relatively lower among military pilots when compared to the general population. The implementation of a strategy focused mainly on primary prevention with a global approach to these risk factors remains one of the main objectives of aviation medicine, aiming to decrease cardiovascular morbidity and mortality and ensure flight safety.



## PO 10 - PRIORITIES FOR UPDATE OF CARDIOVASCULAR GUIDELINES

Theme: CLINICAL -- Cardiology

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Physicians need guidance on how to assess cardiovascular risk in pilots especially with an increasing number of aging pilots. In addition to an increasing risk of developing cardiovascular disease, older pilots accumulate other chronic conditions, which must also be taken into consideration. There is a growing cohort of adults with congenital heart disease, many of which aspire to obtain a licence to fly. With a rapidly expanding body of knowledge, there is a need to maintain guidelines current.

A review of cardiovascular guidelines with input from invited specialists is underway in Canada with the following areas prioritized for consideration:

- screening resting ECGs – pre-excitation, early repolarization, prolonged QT intervals
- cost effective assessment of risk factors, taking age into consideration
- use of risk scores appropriate for special populations
- post COVID cardiac complications including pericarditis and myocarditis
- low ejection fraction with very good exercise tolerance
- paroxysmal arrhythmias
- cumulative risk with multiple conditions even if well-controlled
- risk tolerance given advances in automated flight, more sophisticated backup systems etc.

The updated guidelines will focus on minimal information requirements, cost effective testing where appropriate and clear statements about the level of risk that is admissible for solo activity, or requires an accompanying safety pilot. The final document will be available on-line with public access. Assessment of cardiovascular risk cannot be undertaken in isolation without taking into consideration comorbid conditions. A particular challenge is when to include a cognitive assessment because of possible cardiovascular determinants.



## **PO 11 - PLACE OF CMR IN AERONAUTICAL FITNESS**

Theme: CLINICAL -- Cardiology

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In cardiovascular pathology, cardiovascular magnetic resonance has emerged over time as a test with single potential. This non-invasive, non irradiating, with few contraindications, and economically reasoned examination, finds all its interest in aeronautical expertise of flight crew, in addition to first line examinations, including electrocardiogram and echocardiography, which don't always allow to decide on the absence of underlying cardiac disease, which would have a consequent impact on the decision of aptitude either in admission or revisional visit. through this work, we will focus on the technical aspects of CMR, namely: different sequences, safety, physical principles, then its main indications according to international learned societies, and finally its interest in aeronautical expertise.



## PO 12 - PREVALENCE OF OBESITY AMONG AIR TRAFFIC CONTROLLERS

Theme: CLINICAL -- Cardiology

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<sup>1</sup>Civil Aviation Directorate of the Republic of Serbia

**INTRODUCTION:** Obesity has recently been listed as a major independent risk factor for heart disease and stroke. Obesity is a product of genetic predisposition and environmental factors. Eating patterns, physical activity levels and sleep routines can play a major role in the development of obesity.

**METHOD:** We retrospectively reviewed the findings of 324 air traffic controllers between March 2023 and March 2024 from our COMPIC database. We analysed BMI (body mass index) as the standard by which obesity and healthy weight are measured. Then we compared it with the statistical data of the Institute for Public Health of Serbia. We divided the candidates into 3 categories of obesity: overweight (BMI greater than or equal to 25 to 29.9 kg/m<sup>2</sup>), obesity (BMI greater than or equal to 30 kg/m<sup>2</sup>) and severe obesity (BMI greater than or equal to 40 kg/m<sup>2</sup>).

**RESULTS:** Out of 324 air traffic controllers 201 (62%) were overweight and obese. 76 (23%) air traffic controllers were overweight, 125 (39%) were obese and 2 (1%) were severe obese. Data obtained from the Institute of Public Health of Serbia says that 50% are overweight, of which 1/3 (17%) are obese. Comparing with the data we obtained in our research, there is a statistically significant difference compared to the rest of the population.

**CONCLUSION:** Considering that air traffic controllers are more obese than the rest of the population, it is necessary to find the causes. Rotating nightshifts, sleep deprivation and leads to change in the circadian rhythm. Eating pattern is disturbed. High demand of attention at work very often lead to stress. All together influence the increase in obesity.



## PO 13 - POST-COVID CARDIO COMPLICATIONS ON PILOTS

Theme: CLINICAL -- Cardiology

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**INTRODUCTION:** Cardiovascular (CV) complications of COVID-19 are quite common and aviation and space medical professionals are greatly concerned by this problem.

**THE OBJECTS:** This study enrolled an observer pilot, male, 56 years old.

**LABORATORY AND INSTRUMENTAL EXAMINATION METHODS:** Chest X-ray, ECG, echocardiography, cycle ergometer test, Holter monitoring test, 24-hour blood pressure monitoring test, complete blood count, urinalysis, biochemical blood test, coagulation test, HbA1C test, PSA test, TSH test.

**RESULTS:** In March 2020, he suffered COVID-19 with a moderately severe course. In 2022 and 2023, he underwent inpatient evaluation for fitness to fly.

COVID-19 suffered in 2020 did not cause any mechanical heart valve dysfunction with no evidence for thrombotic complications on anticoagulant therapy. However, the post-COVID period showed new-onset indolent atrioventricular conduction disorders and supraventricular heart rhythm disorders. The occurrence of cardiac rhythm disorders in the post-COVID period is often associated with direct viral exposure causing myocarditis.

The SARS-CoV2 virus penetrates endotheliocytes through interaction with its ACE 2R and it triggers a chain of reactions up to the activation of the immune system – a cytokine storm, which is characteristic of COVID-19.

**CONCLUSION:** The results of long-term observation and examination showed that these cardiac rhythm and conduction disorders neither caused disturbances of general hemodynamics nor triggered significant paroxysmal cardiac rhythm disorders. The assessment commission passed a resolution on admission to work to the observer pilot with an official medical report.





## PO 14 - HEART MURMUR AND ECG CHANGES IN ATCO REVALIDATION

Theme: CLINICAL -- Cardiology

Alberto de Sousa Prata<sup>1</sup>, Tatiana Santiago<sup>1</sup>, Flora Rodrigues<sup>1</sup>

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Medical certification is part of the air traffic controller's licensing process. The aviation medical examiner gathers all the clinical information necessary for aeromedical disposition, in accordance with applicable regulations. As per protocol, some ancillary diagnostic exams are routinely performed, based on their potential to detect significant conditions that can impact flight safety.

This is a case report concerning a 52-year-old air traffic controller, with no relevant previous medical history, and who presented with *de novo* systolic murmur and nonspecific ventricular repolarization changes on his revalidation examination ECG. An echocardiogram showed a right ventricular cardiac mass which was excised and revealed to correspond to a small intestinal neuroendocrine tumor metastasis .

This case study underscores the importance of the routine aeromedical exam in screening for cardiac disease, and even sometimes detecting unusual but relevant pathophysiology.



## **PO 15 - GLYCOSURIA IN A CLASS 1 REVALIDATION EXAM**

Theme: CLINICAL -- Diabetes

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Medical certification is part of the pilot's licensing process. The aviation medical examiner gathers all the clinical information necessary for aeromedical disposition, in accordance with applicable regulations. As per protocol, some ancillary diagnostic exams are routinely performed, based on their potential to detect significant conditions that can impact flight safety.

Here we report the case of an airline pilot with no relevant previous medical history, who presented with abundant glycosuria during his revalidation exam. During the consultation he informed that he had started weight loss medication – dapaglifozin + metformin - 2 weeks before.

An indication was given to suspend the medication, and to carry out a new collection of urine and blood for analysis. The results showed normal blood glucose and HbA1c levels, with absent glycosuria

This case study underscores the importance of the routine urine test in screening for metabolic disease, as well as of possible confounding factors such as novel weight loss. The authors propose a simple protocol to exclude spurious glycosuria.



## **PO 16 - AERONAUTICAL CONSTRAINTS AND RISKS IN AGED PEOPLE**

Theme: CLINICAL -- Medication safety

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<sup>1</sup>Aircrew Medical Expertise Center of Rabat

Due to fragility of the elderly people's health status, air travel and aeronautical constraints constitute a real risk to the onset of pathology or the aggravation of an already failing state of health in the elderly subject, so, despite the trivialization of air transport, it must be remembered that it presents risks and even contraindications in aged people; Through this article, we will try to spread the main aeronautical constraints that may lead to contraindications to air travel in the elderly subject.



## PO 17 - MANDATORY MENTAL HEALTH QUESTIONNAIRES IN SPAIN

Theme: CLINICAL -- Mental health

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**INTRODUCTION:** The accident of Germanwings flight 9525 in 2015 was a turning point in the mental health of air crews. French and German authorities confirmed the suicide of copilot Andreas Lubitz who deliberately crashed the plane killing 149 people on board.

The French air accident investigation commission (BEA) recommended periodic examinations to check the mental health of pilots. It recommended that the European Aviation Safety Agency (EASA) include in the European Aviation Safety Plan mechanisms to establish analyzes that anticipate incapacitation in flight due to psychological or psychiatric aspects and the continuous review of medical evaluation criteria, data incapacitation in flight and validate the effectiveness of these criteria.

**METHODS:** The Spanish State Aviation Safety Agency (AESA) established a mandatory mental health tool based on a questionnaire and a semi-structured interview. A quantitative study is carried out with n=500 of its twenty variables, with five response levels, using analysis of variance (ANOVA) to analyze the variability between four groups (C1, C2, C3 and CC).

**RESULTS:** A sequential sampling of groups are compared using SPSS, we will see the homogeneity of the variances of each group and if conditions such as the normality of the data and the independence of the groups are met. After the analysis of variances, the significant differences between groups will be shown presented as tables, graphs and statistical descriptions.

**CONCLUSIONS:** The results will be carefully interpreted to provide conclusions with a complete, meaningful and reliable view of the study. Significant differences can help to the Air Medical Examiners (AMEs) beyond an intuitive evaluation.



## PO 18 - THE MAIN MECHANISMS OF DEVELOPMENT OF LAP IN PILOT

Theme: CLINICAL -- Neoplasia

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**INTRODUCTION:** Lymphadenopathy syndrome (LAP) comes across with a large group of different diseases and represents an increase in one or several groups of lymph nodes with structure disturbance and function. LAP could be the first and even only cause of a serious life-threatening condition. It is very important to learn how to diagnose this syndrome in pilots in time, as flight longevity will depend on it.

**THE OBJECTS AND METHODS:** Analysis of the etiology and pathogenesis of LAP in various diseases in line pilots.

**RESULTS:** LAP of viral etiology is caused by Epstein-Barr virus, cytomegalovirus, hepatitis A,B,C, Measles, HIV etc. Protection contra viral infection mainly provided by a cytotoxic cellular immune answer. Thus, detected LAP during first examination, may usually have viral etiology and grow as a result of cytotoxic cellular immune answer combined with inflammation directly in the node.

LAP may also develop amid various bacterial infections (streptococcal, staphylococcal, syphillis, tuberculosis etc.) Humoral immunity plays crucial role in organism resistance against bacterial infections. It is provided by B-lymphocytes derivatives. Involvement of these cells into primary immune response is possible only in the secondary lymphoid organs, which have conditions of antigen, B-cells and Th2 cells interaction. Enhanced B-lymphocytes proliferation at early stage of infection is morphologically expressed in increasing of the size and number of lymph node follicles, what leads to its enlargement.

**CONCLUSION:** The detection of LAP in pilots requires a doctor to find out its cause, due to the fact that this syndrome can be a sign of a serious diseases that can subsequently lead to airworthiness.





## **PO 19 - HYDATID DISEASE IN A PILOT :A CASE REPORT**

Theme: CLINICAL -- Neoplasia

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**BACKGROUND:** Hydatid disease is an endemic infection in Tunisia. It develops especially in areas of traditional pastoral sheep farming. It's rare in aeronautical environment.

**CASE REPORT:** We report the case of a 49-year-old civilian pilot in whom we discovered fortuitously during an abdominal ultrasound several hepatic cysts suggestive of biliary cysts or polycystic liver disease. Three months later, radiological examinations (pelvic ultrasound and MRI) discovered a pelvic cystic mass (13.5cm) and three cystic liver lesions. Hydatid serology by indirect hemagglutination came back negative while the CA125 tumor marker elevated. A First surgical intervention showed a hydatid cyst ruptured and adhering to the caecum and small intestine. The pathological examination confirmed the hydatid nature of the cyst and the absence of histological signs of malignancy. A second intervention confirmed the presence of 4 uncomplicated hydatid liver cysts. The patient benefited from a resection of the protruding dome of the 3 cysts of segments VIII, V and VI with a total peri cystectomy of segment VI. She was declared temporarily unfit for hepatic and pelvic hydatids. Currently after a 3-month follow-up, clinical and paraclinical examinations do not show any hydatid recurrence or other locations. The patient has obtained a temporary fitness of 6 months with abdominal ultrasound control.

**CONCLUSION:** The periodic visit plays an important role in early detection of such as rare pathology in order to guarantee a good state of health and the fitness to fly of pilots.



## PO 20 - THE MAIN MECHANISMS OF DEVELOPMENT OF LAP IN PILOT

Theme: CLINICAL -- Neoplasia

David Rosenwald<sup>1</sup>, Nini Kuchava<sup>1</sup>, Karina Lukashova<sup>1</sup>

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**INTRODUCTION:** Lymphadenopathy syndrome (LAP) comes across with a large group of different diseases and represents an increase in one or several groups of lymph nodes with structure disturbance and function. LAP could be the first and even only cause of a serious life-threatening condition. It is very important to learn how to diagnose this syndrome in pilots in time, as flight longevity will depend on it.

**THE OBJECTS AND METHODS:** Analysis of the etiology and pathogenesis of LAP in various diseases in line pilots.

**RESULTS:** LAP of viral etiology is caused by Epstein-Barr virus, cytomegalovirus, hepatitis A,B,C, Measles, HIV etc. Protection contra viral infection mainly provided by a cytotoxic cellular immune answer. Thus, detected LAP during first examination, may usually have viral etiology and grow as a result of cytotoxic cellular immune answer combined with inflammation directly in the node.

LAP may also develop amid various bacterial infections (streptococcal, staphylococcal, syphilis, tuberculosis etc.) Humoral immunity plays crucial role in organism resistance against bacterial infections. It is provided by B-lymphocytes derivatives. Involvement of these cells into primary immune response is possible only in the secondary lymphoid organs, which have conditions of antigen, B-cells and Th2 cells interaction. Enhanced B-lymphocytes proliferation at early stage of infection is morphologically expressed in increasing of the size and number of lymph node follicles, what leads to its enlargement.

**CONCLUSION:** The detection of LAP in pilots requires a doctor to find out its cause, due to the fact that this syndrome can be a sign of a serious diseases that can subsequently lead to airworthiness.



## PO 21 - SIMULATED SPACEFLIGHT AFFECTS ALZHEIMER'S GENES

Theme: CLINICAL -- Neurology

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Exposure of the central nervous system (CNS) to higher levels of radiation has been associated with a number of malignancies, including Alzheimer's disease (AD). As spaceflight exposes humans to heightened radiation, we sought to investigate expression of AD-associated genes in mice during and after an experimental spaceflight analog.

We retroactively analyzed mice transcriptomics and epigenomics data through NASA's open-access OSD-202 dataset. The mice in this study underwent hindlimb suspension while simultaneously being exposed to low-dose whole-body gamma radiation (0.04 Gy) through <sup>57</sup>Co plates. Also, anti-orthostatic suspension of the tail was used to further mimic conditions of microgravity, which includes unloading, shifting of fluids, as well as other related stressors. Tissue samples were collected at 7 days and at 1, 4, and 9 months following. A scatter/volcano plot was generated with the sensitivities predicted via Log2Fc against -log<sub>10</sub>(adjusted p).

A number of genes that are associated with AD were identified as being differentially expressed and statistically significant ( $p < 0.05$ ). Included in these genes were IL-16, Prl, Barhl1, and Slc6a3. Secondary databases validated high expression for each of these genes in the brain relative to other tissues.

Our analysis indicates that genes associated with an increased risk for AD are significantly elevated during and after space travel. This finding corresponds with the prevalent hypothesis that spaceflight, despite low-dose radiation settings, may increase the risk of developing AD. Future investigations may benefit from the implementation of an immunostain for AD markers to verify the expression of aberrant proteins in brain tissue.



## PO 22 - ISCHAEMIC STROKE RISK DURING SPACEFLIGHT

Theme: CLINICAL -- Neurology

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Ischaemic stroke (IS) is caused by oxygen deprivation in the brain due to reduced blood flow often as a result of thrombosis. This results in profound neuronal cell death and irreversible brain damage if left untreated. In this study, we investigate the risk of developing IS due to the harsh conditions of spaceflight.

We first performed an exhaustive literature search to find RNA and protein marker panels for IS. In particular, we utilized the peripheral blood mononuclear cells (PBMCs) 22 RNA panel identified by Moore *et al.* in 2005 for this study. Then we analyzed both publicly-available human (Inspiration4 snRNA-Seq and JAXA RNA-Seq) and mouse (RR-6, RR-7, and RR-9) spaceflight mission data for modulation of such markers.

Our findings reveal that all 22 PBMCs RNA markers were significantly upregulated in space flight vs. pre-flight data from the Inspiration4 mission (LFC>1.5, p<0.001). Interestingly, many of these markers were also upregulated in mice thymus tissue during spaceflight compared to control in JAXA (OSD-457), RR-6 (OSD-244), and RR-9 (OSD-421) data (LFC>0.75, p<0.05 for all datasets). Similarly, these markers were upregulated in mice kidneys (RR-7) that were on the ISS for 75 days relative to ground control (LFC>1.0, p<0.05).

In summary, we evaluated the use of Moore *et al.*'s PBMCs-based 22 RNA markers for IS and found these markers to be significantly upregulated during spaceflight in human PBMCs data from the Inspiration4 mission. Overall, our findings warrant further investigation of ischaemic stroke risk as a result of spaceflight.



## PO 23 - THE USE OF MULTIFOCAL INTRAOCULAR LENSES IN PILOTS

Theme: CLINICAL -- Ophthalmology

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The selection of the appropriate intraocular lens in cataract surgery often raises questions for ophthalmologists, especially when the patient is a pilot. The incorrect choice of lens type or corrective capacity can affect the pilot's visual performance.

This work aims to draw attention to the specificities of cataract surgery in pilots, review recommendations from various aviation regulatory agencies, and provide guidance for pilots and ophthalmologists, with the goal of promoting updates to existing recommendations regarding the use of multifocal intraocular lenses in airline commercial and military pilots. This relevance is heightened by the increasing age of pilots and the rising retirement age.

A literature review of the various aviation regulatory agencies, as well as bibliographic research was conducted.

There are no unanimous recommendations regarding the use of multifocal intraocular lenses or the period of unfit assessment after cataract surgery. The use of multifocal intraocular lenses is allowed by some aviation regulatory agencies. Among the five regulatory agencies included in the review, three permit the use of multifocal intraocular lenses in airline commercial pilots. The European agency appears to be one of the more restrictive ones. The period of unfit assessment varies between six and twelve weeks.

**CONCLUSIONS:** The use of multifocal intraocular lenses in aviation pilots remains a topic of discussion. There is no consensus among different regulatory agencies, with some being very permissive, leaving the decision to the patient and surgeon, and others being very restrictive, allowing only monofocal intraocular lenses.





## PO 24 - OPHTHALMOLOGICAL EVALUATION IN AVIATION PERSONAL

Theme: CLINICAL -- Ophthalmology

Suzana Konjevoda<sup>1</sup>, Ljiljana Belošević<sup>2</sup>, Mirko Karačić<sup>2</sup>, Samir Čanović<sup>3</sup>, Petra Kovačević<sup>4</sup>,  
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Glaucoma is an optic neuropathy that is characterized by the progressive degeneration of the optic nerve, leading to visual impairment, but typically remains asymptomatic until very severe. The pathophysiology of POAG is not well understood, but it is an optic neuropathy that is thought to be associated with intraocular pressure (IOP)-related damage to the optic nerve head and resultant loss of retinal ganglion cells (RGCs). POAG is generally diagnosed during routine eye examination, which includes fundoscopic evaluation and visual field assessment (using perimetry). Management of POAG includes topical drug therapies and surgery to reduce IOP, although new therapies targeting neuroprotection of RGCs and axonal regeneration are under development.

**CASE REPORT:** Case presentation of an 58y old air traffic controller that underwent cataract surgery on the both eyes. After surgery he was presented with unexpected low visual acuity. During the ophthalmological examination the bilateral optic neuropathy caused by high intraocular pressure was diagnosed. The treatment was administered but the visual field damage caused by glaucoma is irreversible. The professional status of this candidate is uncertain and doubtful.

**CONCLUSION:** It is important to emphasize the need for selection and monitoring of ophthalmological status of aviation personnel.



## PO 25 - AME'S EMPOWERING IN THE EYELID CARCINOMA SCREENING

Theme: CLINICAL -- Ophthalmology

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**INTRODUCTION:** The solar radiation to which aircrew and ground personnel are exposed can be considered a risk factor for the development of malignant skin lesions, occurring in the eyelid, for instance. That should condition a regular assessment of suspected lesions. The AME is the first line health professional to examine these workers, therefore should be capacitated with effective screening tools for these lesions, and know when to refer to other medical specialties, preventing its underreporting and late diagnosis. The purpose of this study is to demonstrate how the ABCDE rule could be a facilitating tool on empowering AMEs on a first approach of suggestive malignant skin tumors, aiming an earlier detection and treatment.

**METHODS:** This study consisted in a literature review where data was obtained, selected, and analyzed from *PubMed*, following selection criteria. The research englobed the words ABCDE, skin lesions, prevention and eyelid tumors. The inclusion criteria englobed articles in English and Portuguese, from 2010 to 2023, specifically adults (19-64 years).

**RESULTS:** Among the 276 articles initially screened, a total of 49 articles were eligible. Data analyses showed that the “ABCDE” rule is an effective tool, defended by dermatology specialists, for the screening of suggestive malignant skin lesions made by general practitioners, guiding patients towards an earlier detection and treatment.

**CONCLUSION:** The results provide a positive insight on targeted strategies like the ABCDE rule as a valuable tool, that can be promptly applied in a first evaluation of suggestive eyelid tumors by AMEs in aircrew personnel, aiming an early detection of malignant lesions and patient care optimization.



## **PO 26 - FIGHTER PILOT, ASTHMA AND FITNESS TO FLY**

Theme: CLINICAL -- Pneumology and allergology

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Asthmatic disease is characterized by chronic inflammation of the airways with an exaggerated response to different stimuli. This bronchial hyper reactivity may lead to bronchospasm and can cause sudden incapacitation in flight.

This study aims to review the decision-making and the management of fitness to fly of a fighter pilot diagnosed with asthma during his career.

In this clinical case we will describe the medical history, the medical investigations and we will also discuss the management of fitness to fly.

A 28 year-old fighter pilot class 1 with an aeronautical experience of 710 hours of flight. His initial medical test was performed in 2009. He is non-smoker and has no medical history. He didn't present any problem during his cadet training.

In 2017 he experienced a discomfort during a flight without dizziness or any other symptoms. He also reported an anxiety during missions, suggesting a disorder of adaptation with flight. He also reported some wheezing and dyspnea during flights. The pilot was referred to pulmonary disease department and a psychiatry consult, meanwhile, he was declared temporary unfit to fly. Asthma was confirmed by positive methacholine challenge test. The pilot was treated by inhaled corticosteroid and beta 2 long-acting bronchodilators. He also was declared permanently unfit to fly as a fighter pilot.

Fitness to fly can be maintained for transport or helicopter pilots. Asthma is a medical condition which is not acceptable in fighter pilots because of its risk of sudden incapacitation and its impact on aviation safety.



## PO 27 - HORMONES CAN BE BIOMARKERS FOR CRD EVALUATION

Theme: CLINICAL -- Sleep disorders

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Melatonin, rhythmically secreted by the pineal gland, is the most circadian endogenous hormone in mammals. In addition, steroid hormones, which are regulated by the hypothalamic–pituitary–adrenal (HPA) axis, are also rhythmically secreted.

In this study, a single accurate method by UPLC-MS/MS has been developed. Nine endogenous hormones (melatonin, 6-hydroxymelatonin, 6-sulfatoxymelatonin, cortisol, corticosterone, cortisone, testosterone, epitestosterone and androsterone), in human overnight urine, were quantified after solid phase extraction (SPE). Excellent linearity ( $r^2 \geq 0.99$ ) of this method was observed within the concentration range of 0.0002~1.0 ng/mL for melatonin, 0.0025~2.5 ng/mL for 6-hydroxymelatonin, 0.004~20.0 ng/mL for 6-sulfatoxymelatonin, 0.02~100 ng/mL for cortisol, 0.05~50.0 ng/mL for corticosterone, 0.2~200.0 ng/mL for cortisone, 0.01~10.0 ng/mL for androsterone and 0.001~5.0 ng/mL for testosterone and epitestosterone. The mean recovery of all analytes ranged from 86.67% to 112.0%. The relative standard deviations (RSDs) of intra-day and inter-day precision were within  $\pm 15\%$  at all of the quality controls.

This method was successfully applied to the analysis of 596 overnight urine (23:00-9:00) samples from 94 air traffic controllers during working hours in Beijing area. In particular, the results indicate that there is a clear correlation not only between melatonin and its metabolites; cortisol expected metabolites, but also between melatonin metabolites and endogenous metabolites upstream and downstream of cortisol, suggesting that these two hormones can be used as potential biological rhythm indicators to provide data support for subsequent studies on circadian rhythm disorders.



## **PO 28 - ENT AEROMEDICAL INCAPACITY TO WORK FOR AIRCREW AFTER COVID-19**

Theme: AEROMEDICAL EVACUATIONS AND TRAVEL MEDICINE -- Emerging infectious diseases

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After the onset of the 2020 pandemic, we started observing COVID-19 associated ENT pathologies in all-comer patients. This presentation's purpose is to explore potential links between COVID infection and incapacity for work among aircrew population since 2021. We therefore investigated ENT causes of civil aeromedical unfitness in various french Aeromedicals centers from march 2021 to march 2024. Files submitted to the authority and resulting final decisions whether to impose permanent grounding or unfitness were studied. Preliminary results during this 36 month period.





## **PO 29 - STUDY ON THE EFFICACY OF CARBON DIOXIDE IN PEST CONTROL IN AIRCRAFT FIELD**

Theme: AEROMEDICAL EVACUATIONS AND TRAVEL MEDICINE -- Emerging infectious diseases

jinhui FAN<sup>1</sup>, yanmin QI<sup>1</sup>, yujin ZHOU<sup>1</sup>, yinjuan DUAN<sup>1</sup>, junjie HU<sup>1</sup>

<sup>1</sup>civil aviation medicine center of CAAC

**OBJECTIVE:** To investigate the killing effect of carbon dioxide gas on SD rats and wild rats.

**METHODS:** To understand the killing effect of carbon dioxide gas on SD rats and wild rats, direct inhalation poisoning method was adopted. Experimental hanging cages (containing an experimental rat with food and water) were placed in the cockpit of the aircraft, in front of the passenger cabin, in the middle, in the rear cabin, and in the cargo warehouse respectively to observe the poisoning time and death of the test target animals, and the aircraft field test was conducted.

**RESULTS:** Fumigation with carbon dioxide at a concentration of 50% killed the rats on the floor of cargo warehouse and cabin within 60 min. The SD rats in the middle compartment of the luggage rack were not killed. Fumigation with carbon dioxide at a concentration of 55% killed all the pests within 240 min.

**CONCLUSION:** There is a relationship between the dose and the duration of action in terms of the efficacy of the gas in killing the target pests, providing a scientific basis for setting the correct dosage and time of aircraft fumigation.

**Key words** Aircraft, carbon dioxide, pest, Killing effect



## PO 30 - MISSIONS OF THE AIR EVACUATION MEDICAL UNIT 2023

Theme: AEROMEDICAL EVACUATIONS AND TRAVEL MEDICINE -- Training and operational aspects

P. Salvador Sánchez<sup>1</sup>, J.A. Galán Enríquez<sup>1</sup>, A.L. Ortiz Sáez<sup>2</sup>

<sup>1</sup>Ministry of Defence, <sup>2</sup>Ministry of Defence

**INTRODUCTION:** The purpose of this study is to show the statistics and variability of the missions carried out by the Aeroevacuation Medical Unit coinciding with the second year of the war in Ukraine, and where the centenary of the first medical aeroevacuation in Spain is still being celebrated, a year in which multiple medevacs and NEO missions (Noncombatant Evacuation Operations) have been carried out, as well as support for the civilian population.

**METHODS:** The information available in the database of the Aeroevacuation Medical Unit on the 53 evacuations carried out during the year 2023 has been compiled.

**RESULTS:** During 2023, 730 people have been transported, with a total of 486 flight hours. The Unit's medical crew has been deployed in 44 of the 53 missions, carried out on 5 different Air Force aircraft and on commercial airlines.

**CONCLUSIONS:** Medical evacuation by air in all its variants has proven to be a useful tool that adapts to multiple scenarios, assuming the challenge of providing specialized healthcare during the flight, whose fundamental principle is to save the patient's life, considering the challenging physiology of the environment, and with the capacity to adapt to the sociopolitical changes that have occurred one hundred years after its implementation in the Spanish Air and Space Army.



## **PO 31 - CASUALTY AEROMEDICAL EVACUATION: LESSONS -LEARNED**

Theme: AEROMEDICAL EVACUATIONS AND TRAVEL MEDICINE -- Training and operational aspects

I. DEKHIL<sup>1</sup>

<sup>1</sup>General Directorate of Military Health

The Tunisian Aeromedical Evacuation Unit is located in Tunis at El Aouina Air Base; It's main mission is to manage tactical and strategic Aeromedical evacuation operations for military personnel. It is also responsible of the aeromedical evacuation training and exercises and of the coordination with evacuation teams from other air base.

In this work , we would like to share one of the latest experience and lessons learned from a casualty evacuation performed by our unit. It is a strategic evacuation performed in May 2023 after the attack of the Ghriba's synagogue in Djerba's island. We were called to arrange the air transport of 5 patients with gunshot injuries: one intubated and seriously injured patient with multiple gunshot wounds, another conscious polytrauma, with gunshot wounds at the elbow and in the abdomen. One patient with stabilized injury in the thigh and two patients with lightly injuries in the elbow and the leg.

The air transport medical team was composed of two doctors and three nurses. The Aircraft used during this mission was a C130-J. The patients were transported by ambulance to the airport of Djerba then, they were transported by air to the military hospital of Tunis.

We faced different challenges during the flight regarding the physiological constrains, patient medical monitoring and psychological support of conscious patient.

All our patients arrived well after 1 hour and 15 minutes of flight.

They all survived to the attack despite very serious injuries in the first case.

An established contingency plan, a good coordination with the medical personnel on site and the readiness of the aeromedical evacuation team were the three key elements of the missions's sucess.



## PO 32 - AEROMEDIC TRAINING AND BIOIMPEDANCIOMETRY

Theme: AEROMEDICAL EVACUATIONS AND TRAVEL MEDICINE -- Training and operational aspects

Roberto González Martín<sup>1</sup>, Laura Osuna Esteban<sup>2</sup>, Gabriel Sánchez López<sup>2</sup>

<sup>1</sup>Ejército del Aire y del Espacio, <sup>2</sup>Ejército del Aire y del Espacio

**INTRODUCTION:** Bioimpedanciometry is an precise system(method) to study body fitness and cardiovascular risk.

Is accurate, easy to perform, harmless and economic.

We use this technique to study the fitness shape and the cardiovascular(CV) risk of Spanish military flight crews and to promote a healthy lifestyle.

**METHODS:** Analysis of data obtained from 516 people that took aeromedical training at CIMA in 2023, with in body 770 device.

A systematic review of related literature was made to study the results.

**RESULTS:** 516 participants: 76%male of which 54,93 had overweight and moderate to high CV risk. and 14% female of which 11,43 had overweight and moderate to high CV risk.

We found that 18% of the male and 5'7 of the female had obesity and high CV risk.

**CONCLUSION:** The use of bioimpedanciometry with in body 770 device, determined that only 33% of the male with a body mass index (BMI)over 25 has a body shape compatible with obesity. As it is shown in the parameters FVA y de WHI. We can conclude that from all the male crew trainees that have performed the Aeromedical training program (AMT) in 2023, only the 18% has high CV risk. All the female crew trainees in the same period that have an elevated BMI match with a body shape compatible with obesity after ICC index, and the 5,7% of has a high CV risk.

This conclusion allow us to work on healthy lifestyle education, singular and personalized, promoting a healthy diet and regular exercise.



## PO 33 - AEROMEDICAL EXAM AND ALCOHOL: THE LAB EXPERIENCE

Theme: AIRLINE -- Alcohol and drug testing

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Alcohol is a psychoactive substance with dependence-producing properties (WHO). The effect is to alter perception with an influence on the ability to make rational decisions. The blood alcohol concentration should not exceed the lower of the national limit or 0.02% (0.2 grams of alcohol per litre of blood) whilst performing duties related to operating an aircraft, including flight preparation (EASA). In Italy the acceptable blood alcohol limit for crew members is 0.0 grams of alcohol concentration per liter of blood (ENAC Disposition\_12/2021). But it is lawful to sell (under license)/buy or drink alcohol, even outdoors.

Carbohydrate-deficient transferrin (CDT) was the specific indirect test used to screen military pilot for chronic alcohol consumption at the Institute of Aerospace Medicine in Rome until 2023. Now we use non-specific indirect markers (MCV, AST, ALT, GGT) to detect alcohol consumption because they are signs of organ damage from alcohol. The aim of the study was to evaluate the correlations between specific and non-specific indirect markers in alcohol consumption.

From September 2021 to December 2023 we dosed approximately 4000 CDTs in the blood. Of these, 90% were negative (<1.7%). CDT was positive (>2%) in 1.15% of patients. No correlation was found between positive CDT and other indirect non-specific markers.

Nonspecific indirect markers do not allow us to objectively distinguish occasional drinkers from non-drinkers. If we are to look for the pilot who does not drink and who does not drink when he flies, we must use another test. This could be ethyl glucuronide, which can be detected in urine for up to about 24 hours even after consuming small amounts.





## PO 34 - CULINARY CONSIDERATIONS FOR AVIATION OPERATIONS

Theme: AIRLINE -- Performance

Daniel A Shoor<sup>1</sup>

<sup>1</sup>US Air Force (however, not on behalf of the Air Force)

**BACKGROUND:** In aviation, considerable attention has been devoted to the science of fuels for aircraft, yet a noticeable void exists for human fuel. Recognizing the lack of training in traditional educational, we'll endeavor to unravel the nexus between aviation medicine and culinary science.

**OVERVIEW:** This presentation will illuminate the untapped potential at the intersection of aviation and the culinary arts. We'll examine the nuanced ways in which culinary choices can impact human alertness and GI well-being in flight. The scope extends beyond military and civilian operational performance considerations to encompass enhancing the passenger experience, considerations based on airframe limitations, and the need to make adaptations to maximize objective and subjective quality of the fuel...err, food.

**DISCUSSION:** Exploring the connection between food, aviation, and the GI system, we'll start by examining the transit timing to include how food choices affect stool bulk and residue. Subsequently, we'll look to enhance performance and comfort. Transiting to alertness, we will identify components and propose menu choices aligned with the goals of both operators and passengers. In addressing these concerns within aviation, we will question whether chefs are adequately informed about the challenges presented by the aviation environment. Also, we will review factors such as temperature, pressure, and noise for their impact on food quality. Additionally, we'll review factors for holding and preparing food, including challenges related to bulk and disposal. Our aim is to provide advice for aircrew, passengers, and oversight for maximizing performance and product satisfaction through food choices.



## PO 35- ENZYMES IN PHYSICAL EXERCISE OF PILOTS

Theme: AIRLINE -- Health promotion

Zbigniew Wochoński<sup>1</sup>

<sup>1</sup>Polish Air Force University

Cadet pilots complete a special period of physical preparation using Special Aviation Gymnastic Instrument (SAGI).

**OBJECTIVE:** The aim of the study was to investigate the effect of special training on SAGI in cadet pilots on the concentration of enolase (ENL), pyruvate kinase (PK) in red blood cells and glucose (GL) in blood serum and physical fitness.

**MATERIAL AND METHODS:** The study involved 55 cadets (men) with an average age of 20, divided into two groups. Group A (n=41, subjects) included cadets trained at SAGI. In group B (n= 14), cadets constituted the control group. Blood samples were taken - before and after training I, II and III. GL (mmol/l) was determined in blood serum, and ENL (U/gHb) and PK (U/g Hb) in red blood cells using commercially available tests.

**RESULTS:** In group A, after training I and II, there was a statistically significant increase in PK concentration and after training III there was a decrease, respectively, at  $p < 0.002$ ,  $p < 0.05$  and  $p < 0.01$  in relation to the pre-training values. ENL and GL values had a decreasing tendency during the training period, but not significantly. In group B, an increase in GL was observed after three training sessions, but only significant after training II ( $p < 0.05$ ) and III ( $p < 0.002$ ) compared to the pre-training values. ENL and PK showed non-significant changes with a decreasing trend.

**CONCLUSIONS:** At the end of the training process (training III), significantly higher pre- and post-exercise PK values were demonstrated in group A than in group B. In group B, a significantly high GL concentration value was observed after training III than in group A.



## PO 36 - THE INCIDENCE OF CATARACT IN AIRCREW POPULATION

Theme: AIRLINE -- Occupational medicine in aviation

Camilla Sigurtà<sup>1</sup>, Edoardo Marelli<sup>2</sup>, Alessio Mazzuca<sup>1</sup>, Paola Velati<sup>1</sup>, Anna Fachinetti<sup>1</sup>

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**INTRODUCTION:** Cataract is an opacification of the lens of the eye that results in a progressive loss of visual acuity.

**OBJECTIVE:** The study was conducted with the scope of estimating the incidence of cataract in a homogeneous population of aircrew.

**MATERIALS AND METHODS:** A sample of 304 patients between 2022 and 2023 underwent comprehensive ophthalmologic examination as part of occupational surveillance for cosmic radiation. The sample was selected to be as homogeneous as possible in terms of gender, age, type of work and exposure. Cataract diagnosis was assessed for each patient by slit-lamp examination. Annual effective doses were collected and the average exposure in mSv was evaluated for each patient.

**RESULTS:** The sample consisted of 162 males (53.29%) and 142 females (46.71%), with an average age of 40 years. The ophthalmologist identified lens changes in 7 workers corresponding to 2.3%. Analyzing the patients with lens alterations in detail, it was observed that six workers had initial changes in the nucleus of the lens defined as nuclear sclerosis. One pilot was diagnosed with initial posterior sub capsular cataract. In all patients the visual acuity was sufficient to continue the privileges of their licenses. The effective dose was 2.69 mSv year for workers with lens changes, not significantly higher than the mean dose of the total sample, which was found to be 2.37 mSv year.

**CONCLUSIONS:** the incidence of cataract was found to be 2.3%. In relation to the low incidence we can consider it sufficient to perform a comprehensive eye examination every 2 years as per the indications of the Italian Association of Medical Radiation Protection even for aircrew exposed to cosmic radiation.



## **PO 37 - PHYSICAL FITNESS OF PILOTS AND ACCELERATION**

Theme: AIRLINE -- Occupational medicine in aviation

Damian Długosz<sup>1</sup>, Jakub Witkowski<sup>1</sup>, Kinga Malec<sup>1</sup>, Zbigniew Wochoński<sup>2</sup>

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The aim of this study was to verify the exercise capacity based on the conclusions on increasing the tolerance to acceleration in pilots based on the literature on the subject and our own research. The pilot's physical training is very complex and complicated in preparation for the L-I maneuver due to other factors that must be trained, e.g. psychomotor skills. The conclusions from scientific works on the issue of increasing tolerance to accelerations are not clear. Some authors claim that aerobic training does not increase the tolerance to +Gz accelerations, and others claim that training increasing muscle strength increases the time to tolerate +Gz. The authors of this work propose a modern training process that optimizes the complexity of pilots' motor skills and load (dynamic exercises). For many years, they have been using the Aero-Synthetic Efficiency Test (ASET) to control the training process. ASET showed a significant correlation with the distance of 100 m, 1000 m and pull-ups in pilots, using this test at the beginning and end of the training process. Our own research shows that a significant effect of pilot training is training on an overload centrifuge monitored with a biochemical marker, which confirmed the validity of the authors' view. As a result of the training process, the achieved optimization of motor skills measured using ASET has a positive effect on the increase in tolerance to acceleration in military pilots.



## PO 38 - SUN PROTECTION ATTITUDES AMONG AIRCREW

Theme: AIRLINE -- Occupational medicine in aviation

Erdinc Ercan<sup>1</sup>, Burak Turgut<sup>2</sup>, Tugba Ozuari<sup>1</sup>, Hamza Yildiz<sup>3</sup>

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Ultraviolet radiation is a non-ionizing radiation. Seasonal and daily variations of the sun's rays, altitude, latitude, cloudiness, ozone layer thickness, and ground reflectivity affect UV exposure. Aviators are exposed to high altitudes during flights and there is a higher UV rate with increasing altitude. Additionally, airplane windows cannot completely block UVA radiation. We aimed to investigate aircrew's knowledge and attitudes about the harmful effects of the sun and protection methods and to reveal the relationship between sociodemographics. The questionnaire was categorized to establish 3 scores: risk score(0-24), knowledge score (0-30), and attitude score (0-24). 64(71.91%) male and 25(28.08%) female participated in the study. Statistically significant positive correlations were found between age and knowledge score (male:p<0.001,r=0.519, female:p<0.001,r=0.665); attitude score and knowledge score (male:p=0.002,r=0.383, female:p=0.004,r=0.560) and education level and knowledge score (male:p<0.001,r=0.458, female:p=0.001,r=0.640) in both genders. The risk score was lower in the female group (female:8.48±2.72; male:10.11±2.73,p=0.006), knowledge score was similar in both genders (female:17.80±4.79; male:18.19±5.31,p>0.05) and attitude score was lower in the male group (female:12.56±3.31; male:9.13±4.48, p=0.001). In both genders, an increase in knowledge score (male: Independent T-Test, p<0.001, female: Mann-Whitney U, p<0.001) and an increase in attitude score (male: Mann-Whitney U, p=0.049, female: Mann-Whitney U, p=0.029) were found as the education level increased. It is thought that gender, age, and education level affect knowledge level, attitude, and risk scores.





## PO 39 - SPACEFLIGHT AND UPPER EXTREMITY ORTHOPAEDIC HEALTH

Theme: SPACE -- Clinical considerations

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**INTRODUCTION:** Injuries to the upper extremity are the most common musculoskeletal injuries sustained in spaceflight. With increased access to commercial spaceflight and space tourism, plus an increased push for longer distance and duration space flights, it is vital to understand the impact of spaceflight on orthopaedic health. The purpose of this study is to examine the current state of knowledge on the impact of spaceflight on upper extremity orthopaedic health.

**METHODS:** A literature review was performed on the impact of spaceflight on the upper extremity. Studies and reports that amassed data on shoulder, elbow, wrist, and hand soft tissue and bone health were included.

**RESULTS:** Spaceflight decreases bone mineral density (BMD) in the upper extremity and increases risk of fracture, especially upon return to full or partial gravity environment. The effects of spaceflight do not uniformly affect all shoulder muscles; the deltoid experiences a greater degree of atrophy than the rotator cuff muscles. Spaceflight also affects the peripheral nervous system, with astronauts frequently experiencing hand numbness and loss of dexterity, but cause of these symptoms is yet to be determined. Spacesuits have been implicated in causing upper extremity orthopaedic injury, especially while training for or performing extravehicular activities (EVA), with up to 10-20% of these injuries requiring surgery.

**CONCLUSION:** While the impact of spaceflight on upper extremity orthopedic health is incompletely understood, the known reductions in BMD, muscular atrophy, peripheral nervous system changes, and impact of current spacesuit design increases risk for weakening and injury during and after spaceflight.



## **PO 40 - IMPACT OF SPACEFLIGHT ON ORTHOPAEDIC HEALTH**

Theme: SPACE -- Clinical considerations

Benjamin Fiedler<sup>1</sup>, Robert Lee Satcher<sup>2</sup>, Abdullah Ghali<sup>1</sup>, Douglas Dirschl<sup>1</sup>

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With NASA's plans for longer distance, longer duration spaceflights such as missions to Mars, and the surge in popularity of space tourism, the need to better understand the effects of spaceflight on the musculoskeletal system has never been more present. However, there is a paucity of information on how spaceflight impacts orthopedic health. This review surveys existing literature and discusses the impact of spaceflight on each aspect of the musculoskeletal system. Spaceflight reduces bone mineral density at rapid rates due to multiple mechanisms. While this appears to be recoverable upon re-exposure to gravity, concern for fracture in spaceflight remains as microgravity impairs bone strength and fracture healing. Muscle, tendon, and enthesis similarly undergo microgravity adaptation. These changes result in decreased muscle mass, increased tendon laxity, and decreased enthesis stiffness, thus decreasing the strength of the muscle-tendon-enthesis unit with variable recovery upon gravity re-exposure. Spaceflight also impacts joint health; unloading of the joints facilitates changes that thin and atrophy cartilage similar to arthritic phenotypes. These changes are likely recoverable upon return to gravity with exercise. Multiple questions remain regarding effects of longer-duration flights on health and implications of these findings on terrestrial medicine, which should be the target of future research.



## PO 41 - PORTABLE STOOL ANALYZER: DIAGNOSIS AND MONITORING

Theme: SPACE -- Clinical considerations

P. Juárez Rodríguez<sup>1</sup>, K. Luna Abundis<sup>1</sup>, A. Lopez Cardona<sup>1</sup>, F. González Chavez<sup>1</sup>, E. Moya de la Cruz<sup>1</sup>, K. Basulto González<sup>1</sup>, G. Villaseñor Castañeda<sup>1</sup>, G. Rayas Martinez<sup>1</sup>, Z. Lopez Vizcarra<sup>1</sup>, M. Guzmán Diaz<sup>1</sup>, J. Gómez Gómez<sup>1</sup>

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**BACKGROUND:** In microgravity, fluid displacement affects astronauts' digestion, altering fecal composition and indicating potential health concerns. Monitoring fecal matter is crucial for astronauts' well-being during extended space missions. The Portable Stool Analyzer (PSA) meets this need by swiftly analyzing fecal samples in space. Its compact, user-friendly design and segregated reagent compartments prevent cross-contamination. Transparent windows display colorimetric results, and its 3D-printed, lightweight structure makes it ideal for space missions.

**OVERVIEW:** The PSA enables on-site fecal analysis, facilitating prompt detection and management of digestive issues in microgravity. Tests include detecting hidden blood for gastrointestinal problems, analyzing reducing sugars to assess nutrient absorption, and measuring pH to evaluate acid-base balance. Additional tests can be incorporated as needed.

**DISCUSSION:** These tests not only address immediate concerns but also support long-term research on space's effects on human gastrointestinal physiology. The PSA aims to diagnose gastrointestinal, hepatobiliary, or nutritional adherence system function by implementing suitable fecal biomarkers. This approach enhances understanding of pathophysiology in relation to diet, environmental stress, and pathology.



## PO 42 - MAGNESIUM IN ASTRONAUTS: A SYSTEMATIC REVIEW

Theme: SPACE -- Clinical considerations

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**INTRODUCTION:** Magnesium plays a role in maintaining cardiac activity, bone health, neuromuscular function, and the circadian rhythm. There have been no previous attempts to summarize the current data on magnesium levels during spaceflight. The goal of this systematic review was to assess magnesium intake and changes that occur to both serum and urine magnesium before, during, and after spaceflight.

**METHODS:** A systematic review of PubMed, Scopus, Ovid Medline, Cochrane Library, OCLC, and NASA-specific databases was conducted. Inclusion criteria included studies in any language with adult male or female astronauts in spaceflight, and measurements of urinary/serum magnesium or oral magnesium intake before, during, or after flight. Exclusion criteria specified any non-spaceflight environments, like analog, bedrest, and centrifuge studies. All eligible studies were inputted into Covidence. Two co-authors reviewed every article and differences in classification were settled by a third co-author. Non-English articles were translated by certified linguistic PhD students at UNC.

**RESULTS:** Of the 3,666 articles meeting inclusion criteria, 314 duplicates were removed. 51 studies were selected for full text review and ultimately, 11 studies were extracted. 3 of these studies were written entirely in Russian.

**DISCUSSION:** The majority of extracted studies noted increased urinary magnesium excretion and decreased serum magnesium levels for astronauts, without clear evidence if these astronauts experienced any symptoms. The implications of magnesium levels in astronauts should be considered in future research, particularly to explore the necessity of oral magnesium supplementation in space.



## PO 43 - OXIDATIVE STRESS GENES IN LIVER POST SPACEFLIGHT

Theme: SPACE -- Clinical considerations

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**INTRODUCTION:** Spaceflight increases the reactive oxygen species (ROS) load in humans which has implications for astronauts on long-duration missions. As heightened levels of ROS evoke cellular toxicity and may lead to metabolic dysfunction, this effect must be mitigated by the protective antioxidant functions encoded by genes such as those of superoxide dismutase (SOD), thioredoxin reductase (TXNRD), and glutathione-s-transferase (GST) families. Currently, only one study has examined the response to high ROS levels by sampling mice heart tissue after spaceflight. Our study hypothesized that key genetic elements responsible for cellular redox homeostasis in the mouse liver would similarly be disrupted.

**METHODS:** We evaluated three mice liver RNA-Seq datasets from three experimental groups whose livers were harvested after missions to the ISS (RR-3, RR-6, and STS-135), each with corresponding ground control groups housed in identical hardware on Earth.

**RESULTS:** Transcriptomic analysis revealed statistically significant, differentially-expressed genes related to redox homeostasis. We observed diminished expression of genes in the SOD family (LFC<-0.5; p<0.005), TXNRD family (LFC<-1.0; p<0.005), and GST family (LFC<-1.0; p<0.005), each responsible for distinct functions in ROS metabolism. Of note, the majority of the GST family of genes, responsible for the detoxification of various pharmaceuticals and pollutants, was markedly attenuated.

**CONCLUSIONS:** Our findings of downregulated key components of redox stabilization in the mouse liver due to spaceflight underline the need for investigating the dysregulated liver response to ROS with a comparable inquiry in human astronauts.





## PO 44 - MITIGATING ICP COMPLICATIONS IN SPACE TRAVEL

Theme: SPACE -- Clinical considerations

Anushka Gupta<sup>1</sup>

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**INTRODUCTION:** The shift from Earth's gravity to microgravity in space induces physiological changes in astronauts, affecting cerebral vasculature and intracranial pressure (ICP). This abstract synthesizes current literature on Earth-based vascular knowledge and proposes ways to reduce complications of space travel, such as stroke and cardiovascular events.

**TOPIC:** Space travel alters the nervous system through microgravity, cosmic radiation, hypercapnia, isolation, and disrupted circadian rhythms. Microgravity can distort brain vasculature, compromise the blood-brain barrier, alter cerebral blood flow, and elevate ICP, increasing the risk of brain ischemia, strokes, and vascular dementia. Cosmic radiation adds risks like DNA mutations, cancer, and atherosclerosis. Isolation can lead to depression and anxiety, while hypercapnia may impair cognitive function. Monitoring astronauts with conditions like hypertension is crucial. Preventive measures include venous return-enhancing garments, optimized sleep positioning, psychological counseling, and medications like diuretics, aspirin, and statins.

**APPLICATION:** As commercial space travel grows, health protocols must adapt. This includes pre-flight screening for vascular risks, in-flight ICP monitoring, and emergency response protocols for cerebrovascular events. Strategies should encompass medications, physical fitness routines, specialized diets, and post-flight care. Applying Earth-based vascular knowledge to space is vital for safe human space exploration.



## PO 45 - MITIGATING NEUTRON-INDUCED BIO-EFFECTS IN SPACE

Theme: SPACE -- Deep space exploration

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A major concern of deep space exploration and extended duration human space missions is mitigation of radiation exposure. Proposed fast transit to Mars using low energy nuclear reactions (LENR), conventional nuclear electric (NEP) or thermal propulsion (NTP) systems may be in the near future, thus limiting time and level of human exposure. Additionally, secondary Galactic Cosmic Ray (GCR) induced neutrons are an additional significant hazard to human health. In summary, early neutron detection is an essential element of crew health monitoring, environmental protection, safety and mission sustainability. Both acute, potentially chronic and transgenerational exposure-induced bio-effects are difficult to detect and improved detection technologies are a potential game-changer.

ALARA (As Low as Reasonably Achievable) is the gold standard for human exposure, and the Q factor, which weighs an absorbed radiation dose against its biological effect ranges from Q=1 for x-rays, gamma rays and betas to Q=5 for thermal neutrons and Q=10 for fast neutrons and alpha particles. Since neutrons only have an 11 minute half-life, and are constantly produced by fast charged particles or photon shattering atoms terrestrially, in planetary atmospheres and on planetary surfaces. Terrestrial spallation neutron spectra originating from atmospheric GCR interactions produce a more pronounced effect on Earth in aircraft and in spacecraft including the International Space Station (ISS) and NASA's near-future Lunar Gateway habitat.

Since the Q value varies with energy, neutron spectroscopy, or at least the energy range, is preferred over other methods and will be described with an approach to countermeasures.



## PO 46 - SPACE MEDICINE: SYSTEMATIC REVIEW OF CALCIUM SALTS

Theme: SPACE -- Pharmacology

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**INTRODUCTION:** Calcium is essential for bone and dental formation, neuromuscular function, and cellular process regulation. In the context of space, astronauts face accelerated calcium loss due to the microgravity environment, with an average loss rate between 1% and 2% per month. This paper reviews various calcium salts and forms in supplements and nutraceuticals, aiming to develop an effective treatment for bone mineral density loss in astronauts through pharmaceutical testing and experimentation.

**METHODS:** This systematic review conducted an exhaustive literature search in databases like PubMed, Medline, and NML to identify relevant studies on the use of calcium salts for treating bone demineralization, particularly in astronauts. The search was limited to articles published from 2014 onwards.

**RESULTS:** The prophylactic and therapeutic treatments used on Earth demonstrate great potential for their use in space, although this involves taking into account other factors that can modify their effectiveness. A strategy to prevent bone demineralization in astronauts involves calcium and vitamin D supplementation as per space standards.

**CONCLUSIONS:** This review provides a solid basis that allows comparison between the benefits and characteristics of each treatment and prophylactic management of bone demineralization.

**RELEVANCE:** Preventing bone demineralization in astronauts is critical for their health in space. Strategies such as calcium and vitamin D supplementation, exercise in microgravity, and continuous monitoring are essential for maintaining bone integrity. Ongoing research is also crucial for developing effective therapies and improving astronauts' bone health.



## PO 47 - FIGHTER PILOTS AND ANTRAL TEETH: WHAT TO DECIDE ?

Theme: SPACE -- Multidisciplinary interfacing

YOUSSEF HAJER<sup>1</sup>, BENGOUISSEM AFEF<sup>1</sup>, MIZOUNI KAHENA<sup>1</sup>, OBAID GAROUACHI<sup>1</sup>,  
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<sup>1</sup>Tunisian Ministry of national Defense

**INTRODUCTION:** In military aviation ,fighter pilots are exposed to maximum aeronautical stresses such as acceleration, altitude hypoxia and barotrauma.

This is why the medical expert takes more"draconian" decisions with these patients, and the dental examination is no exception to this rule.

**OBJECTIVE:** The aim of our study was to illustrate,through a case report,the problem of the choice of treatment compatible with the aeronautical aptitude of a student fighter pilot, whose anomalous dental position was discovered fortuitously during a radiological examination.

**METHODS:** The authors reported the case of a student fighter pilot who had a dental anomaly position during an examination, and presented the approach and the treatment chosen to preserve his medical aptitude for fighter piloting.

**RESULTS AND DISCUSSION:** We were faced with a dilemma in the case of 20- year- old student pilot Y.J his clinical examination was unremarkable,but on radiological standard examination we suspected that tooth28 was antral.A Cone Beam was ordered and confirmed our doubts.In the end, we decided to extract the tooth to avoid any risk of dental sinusitis.The pilot returned to flying after receiving appropriate medical treatment,rest and rigorous clinical and radiological monitoring.

**CONCLUSION:** In conclusion, it is important to emphasise the rigorous and severe nature of expert examinations of fighter pilots , particularly indental medicine.



## PO 48 - MODULAR PORTABLE ECOSYSTEMS: A SPACE HYDROPONIC

Theme: SPACE -- Multidisciplinary interfacing

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**INTRODUCTION:** As space exploration advances, space nutrition becomes increasingly important. This paper proposes the Modular Portable Ecosystems (MPE), a hydroponic system under controlled and automated conditions, whose aim is to provide astronauts with fresh food to complement their diet during deep space missions.

**METHODS:** The MPE comprises 1m<sup>3</sup> hydroponics bioreactor modules that provide adequate conditions for cultivation of crops that were selected based on their nutritional value. Each module can be linked, scaling it as required. It includes a Nutrient Film Technique for continuous recirculation, tubular polyethylene containers, phenolic foam substrate, nutrient solution, bioreactor submodule, temperature sensor, artificial lighting, pressure pump and silica aerogel barrier for radiation protection.

**RESULTS:** The most effective nutrient solution has factors like nitrogen, phosphorus, and potassium concentrations, yielding fresh weights within a range of 450-500g. The system aims to maintain optimal conditions, considering temperature, light, nutrient solution, and pH.

**CONCLUSIONS:** The MPE is an alternative for small-scale agriculture in adverse conditions and water scarcity, allowing the production of fresh and nutritious food. Updates, improvements and techniques for residue recovery or transformation, will be presented to ensure optimal performance.

**RELEVANCE:** The MPE has the potential to improve astronaut's overall well-being during long missions addressing challenges associated with traditional space foods that lead to nutritional deficiencies and deteriorated health. Additionally, the modular and scalable design offers adaptability to varying requirements and resource constraints.





## PO 49 - INTERVENTIONAL RADIOLOGY IN DEEP SPACE TRAVEL

Theme: SPACE -- Multidisciplinary interfacing

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<sup>1</sup>Aga Khan University, <sup>2</sup>University of Texas Medical Branch

**BACKGROUND:** Ambitious plans for space travel must also account for medical emergencies that need to be managed in flight. This is challenged by strict limitations in crew number and medical equipment weight and size. Surgical emergencies without access to anesthesia and a controlled environment demand specialists who provide medical management via minimally invasive procedures with limited equipment. Given these constraints, IR is uniquely capable of providing such comprehensive care.

**DISCUSSION:** Interventional radiologists can provide real-time diagnosis, basic medical care, and life-saving interventions with scarce resources. As a specialty, IR has always led technological advancements in medicine, providing safer & more cost-effective alternatives to surgery.

Most of the IR equipment required to manage medical emergencies is compact and lightweight in comparison to even basic surgical instruments. Furthermore, IR procedures can be performed with local anesthetics alone, or under minimal sedation at the bedside. Medical emergencies that may be encountered in space missions such as pneumothorax, effusions, abscess, biliary and urinary obstruction are all manageable with IR.

With ongoing advances such as the rollout of increasingly compact X-ray machines, fluoroscopy units, and portable CT scanners the size of a small window AC unit, one can envision the scope expanding even beyond existing horizons.

**CONCLUSION:** IR provides a balanced skillset that could be best fitted for providing comprehensive medical care in challenging and isolated situations such as space travel. Further research in zero-gravity environments is warranted to establish the role of IR for future use in space exploration.



## **PO 50 - SPATIAL ORIENTATION MODELING FOR MOTION CUEING**

Theme: SPACE -- Training/simulations/space analogues

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Motion flight simulators aim to induce the motion perceptions associated with in-flight vehicle maneuvers to enhance authenticity of experience. Advanced motion systems, such as the Disorientation Research Device (DRD), are unable to replicate exact simulated flight maneuvers. Motion cueing algorithms aim to leverage known aspects of human motion perception to best induce appropriate perceptions within the motion device constraints. Historically, validation of a motion cueing algorithm has been done through feedback from subject matter experts (e.g., pilots of an aircraft platform). This approach is subjective, often tedious, and for novel vehicles or domains (e.g., piloted lunar landing), there may not be appropriate subject matter experts. Here, we explore using previously well-established computational models of human spatial orientation for validating motion cueing algorithms (Dixon, et al. 2019). The process involves two pathways: 1) simulating a flight vehicle motion trajectory to predict what a pilot may perceive in flight and 2) simulating a motion cueing algorithm's corresponding ground-based motion system (e.g., the DRD) motions to predict what perceptions are likely to be induced. The goal is for the predicted perceptions resulting from the two pathways to converge through optimizing the motion cueing algorithm. Using a model of spatial orientation, this process can be done rapidly, quantitatively, and for novel vehicles/domains. . Long-term, this has applications for pilot spatial disorientation in both terrestrial and space environments (for lunar and even Martian landings) and would enhance crew safety and survivability, while advancing spatial orientation models.



## PO 51 - AEROSPACE MEDICINE TRAINING OPPORTUNITIES

Theme: SPACE -- Training/simulations/space analogues

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**OBJECTIVE:** This review aims to identify current aerospace medicine training opportunities available at undergraduate and postgraduate levels internationally.

**Introduction:** There has been rapid expansion in the training opportunities available internationally in the field of aerospace medicine in recent years. Despite this, many students remain unaware of their existence or their eligibility criteria.

**METHODS:** This review was conducted in accordance with the JBI protocol. Inclusion criteria were undergraduate and postgraduate aerospace medicine training opportunities accepting applications during the period 2014 - 2024 inclusive, not limited to English. Search strategy included databases Medline OVID, SCOPUS, Cochrane, CINAHL as well as grey literature. Search results were imported into Covidence where duplicates were removed. Quantitative and qualitative studies, including observational and case reports were incorporated.

**RESULTS:** 53 studies were identified through review of the databases of which 2 were duplicates. Searches of the grey literature identified 26 relevant studies after removal of 3 duplicates. A total of 1 part time and 9 full time aerospace medicine training opportunities were identified internationally. The team identified 36 opportunities that were not recorded in the literature via manual searches of college websites and course catalogues.

**CONCLUSIONS:** Identifying the current opportunities in aerospace medicine training allows students to compare available options they may not previously had visibility of. It also assists in identifying training gaps for educators.

**Keywords:** aerospace; aviation; education; residency; space.



## PO 52 - FRONTIERS OF MEDICINE: ASCLEPIOS PROJECT INSIGHTS

Theme: SPACE -- Training/simulations/space analogues

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A comprehensive understanding of the space medicine principles is crucial for the success of any human mission into deep space. Microgravity, radiation exposure, isolation, confinement, and distance from Earth all pose significant risks to astronauts' health and mission success. As humanity ventures into a new era of dynamic space exploration and commercial spaceflight, further insights into changes in human physiology and innovation in medical care are essential.

Within the last decade, there has been significant growth in the field of space medicine, partly due to the commercialization of space flight. Insights gained from space exploration hold promise for advancing diverse fields on Earth, from preventive to extreme medicine, and from psychology to chronic disease management. Asclepios Project is dedicated to educating the next generation of space explorers in the principles of space medicine while collecting data from analog astronaut missions that can be used to better prepare for human missions into deep space.

Since 2021, Asclepios has executed an analog mission every year. Prior to each one, the astronauts train in extreme environments and zero-gravity flights. They are educated about various simulated and real emergencies they may encounter throughout the mission. The routine during missions poses myriad physiological and psychological challenges, underscoring the importance of comprehensive medical monitoring. Nutrition is also critical, so lyophilized food is consumed during the mission to simulate deep space conditions. This work will focus on life sciences projects, the importance of the Medical Team and the Lessons learned in the context of Asclepios missions



## PO 53 - ADAPTING OCCUPATIONAL BREATHING APPARATUS FOR LDM

Theme: HUMAN FACTORS AND PERFORMANCE -- Human Protection

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**INTRODUCTION:** Challenges of long-duration space missions (LDM), such as microgravity, limited resources, and isolation from Earth-based medical care, necessitate respiratory support for astronauts. This study investigates adapting breathing apparatus technologies from high-risk occupations, like firefighting and diving, to improve astronaut health, safety, and performance during LDMs and extravehicular activities.

**METHODS:** A scoping review of existing breathing apparatus technologies, including closed-circuit rebreathers, self-contained breathing apparatus (SCBA), oxygen systems, air-purifying respirators, ventilators, and respiratory muscle training devices, was conducted to identify those with potential for adaptation to space conditions. Each technology was evaluated based on performance, reliability, and adaptability to microgravity and vacuum environments. Modifications were focused on weight reduction, compact design, and increased durability.

**RESULTS AND CONCLUSIONS:** Results identified technologies for adaptation to space environments. Lightweight, compact rebreathers and SCBAs with integrated communication systems were beneficial for emergency support scenarios. Compact ventilators and enhanced air-purifying respirators maintained optimal respiratory function in microgravity and closed-loop environments. Respiratory muscle training devices reduced fatigue, and integrated health monitoring systems enabled early detection of respiratory issues. Collaboration across occupational health, aerospace engineering, and medical fields is essential for the adaptation of these systems.





## PO 54 - PARANASAL SINUS IMAGING IN PILOTS ADMISSION – IS IT NECESSARY?

Theme: HUMAN FACTORS AND PERFORMANCE -- Human Protection

Mariana Filipa Saraiva Correia<sup>1</sup>

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**INTRODUCTION:** Pilot candidates have to meet the necessary medical requirements (both physical and psychological), to carry out their duties safely. One of the exams they currently have to do in admission is a paranasal sinus (PNS) radiography to check if there are any signs of chronic inflammatory disease, like chronic rhinosinusitis, as this can have some risks in aviation due to pressure changes, with uncompensated pressure changes within the sinonasal cavities causing barotrauma.

**METHODS:** We present a bibliographic review on the usefulness of paranasal imaging in pilot admission.

**RESULTS:** According to EPOS 2020 Position Paper (a very broad international consensus document), rhinosinusitis is described as an inflammation of the nose and paranasal sinuses, and the diagnosis on community settings is clinical, and is based solely on symptoms (two out of nasal obstruction, rhinorrhea, hyposmia, headache) for this set has high sensitivity for this diagnosis when compared to CT scan. Furthermore, radiography of PNS, that is the currently used image study for candidate's evaluation, has a limited role on the diagnosis of rhinosinusitis, for in comparison to CT, plain sinus radiographs have shown poor sensitivity and specificity. Correlation of CT scans with plain sinus radiographs for maxillary sinusitis was reasonable (78%) but was only 52% for the ethmoids. Imaging obviously helps in understanding normal sino-nasal anatomy, evaluation of extent of sinus disease and identifying anatomic variants that may narrow or obstruct sinus drainage pathways. However, in the absence of symptoms or alterations on examination, it is consensual that imaging (especially radiography) is not needed to exclude neither anatomical nor inflammatory sino-nasal disease.

**CONCLUSIONS:** Sinus imaging for screening pathology on admission is unnecessary and may be excluded from the medical admission exams set, as it is a source of extra financial costs and radiation exposure.



## PO 55 - LIVERPOOL JET LAG QUESTIONNAIRE - PORTUGUESE

Theme: HUMAN FACTORS AND PERFORMANCE -- Fatigue and alertness

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**INTRODUCTION:** The aviation sector is one of the most regulated in the world. The demands placed on those involved meet high standards to maintain high levels of safety. Jet lag refers to a set of side effects that occur in the days following a flight that crosses two or more time zones. There is no tool available, translated, and validated to Portuguese, to study jet lag, particularly in pilots. This study aims to translate and validate the Liverpool Jet Lag Questionnaire (LJLQ) to Portuguese.

**METHODOLOGY:** The translate - translate back methodology was used to translate the LJLQ. Validation was achieved through analysis of the feasibility of all dimensions that make up the questionnaire and internal consistency was assessed with Cronbach's alpha. Participants included 8 non-aviation individuals in the pretest and 33 airline pilots in the remainder of the study. Sociodemographic and work-related data was collected from the participants during completion of the questionnaire.

**RESULTS:** The translated questionnaire showed good internal consistency, with a Cronbach's alpha identical to that reported in the literature. There was a positive correlation between the number of time zones crossed and the perception of jet lag. This was not confirmed for the variable "flight direction".

**CONCLUSION:** Through this study, we have validated an instrument adequate assessment of jet lag (along with related signs and symptoms), particularly in airline pilots.

**Keywords:** jet lag, circadian rhythm, pilot, translation, validation, questionnaire



## **PO 56 - CERTIFICATION OF HELI PILOT WITH LIMB AMPUTATION**

Theme: CERTIFICATION -- Aeromedical certification

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29-year-old male, commercial helicopter pilot with no relevant past medical history, who in 2013, while undertaking a Low Altitude Operation (LALT), suffered a helicopter crash caused by a collision with a power cable. – The accident resulted in traumatic brain injury, as well as upper and lower limb trauma including right knee-level, transtibial amputation. One month later, after hospital discharge and full, sequela-free recovery of his brain injury, the pilot was referred to the Alcoitão Rehabilitation Medicine Centre for pre-prosthetic training, prosthetic manufacturing and post-prosthetic training. He was temporarily put on pregabalin for ghost pain, which later remitted. There was excellent clinical and functional evolution, with good adaptation to the below-knee prosthesis – a Re-FlexSchock with Evo. Muscle strength was recovered to such an extent that the pilot was able to resume daily life and even intensive sports activities in a safe and fully autonomous manner. The pilot came in to our Aeromedical Centre for renewal of his EASA Class 1 medical certificate seven months after the crash. Per regulation, in line with EASA AMC1 MED.B.050, he was referred to the Portuguese CAA with a proposal for a fitness disposition. A possible APL limitation was considered and a medical flight test was indicated, which was undertaken on a AS350B2(CS-HFI). The pilot demonstrated fully functional and safe operational capabilities, and was assessed as fit. Ten years on he remains fit with no limitations. We further discuss the medical flight test arrangements, as well as the characteristics of the prosthesis and issues of adaptation to the physically demanding environment of rotary wing aircraft operations.



## PO 57 - SURVEY ON REPORTS OF DECREASE IN PHYSICAL CONDITION

Theme: CERTIFICATION -- Aeromedical certification

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**INTRODUCTION:** The Korean government requires obligatory reporting of decrease in physical condition under the Aviation Safety Act. In relation to this, the researcher conducted survey to determine the current status of related working environment

**METHOD:** Researchers visited and interviewed seven airlines and air traffic control agencies in Korea.

**RESULTS:** 102 pilots and 109 controllers responded to the survey. The average working hours per week was 41-51 hours(56%). The most common number of night work days per month was 6-8 (72%). Among pilots, the highest number of flight hours per year was 500-800 hours(37%). 21% of pilots responded they had experience of not being able to perform scheduled flight duties in the past year, with the main reason being flight leave. Visiting medical institution was 31% of pilots and 45% of controllers. The experience and period of being unable to perform flight duties due to health problems were significantly higher in the controller group, at 4.6% and 3.6 days for pilots, while 14.7% and 16.4 days for controllers, respectively. Among the diseases that prevented flight work, respiratory diseases were the most common. There is a significant difference in the percentage of pilots who believe that deterioration in physical condition must be reported, with 75% of pilots and 36% of controllers. The reason for not reporting was fear of being affected by job retention in 17.3% of pilots and 12.3% of controllers.

**CONCLUSION:** Air crews in Korea appear to take appropriate measures when physical condition decline occurs. It appears that pilots are taking a more strict stance in adhering to the rules.



## **PO 58- WORSENING HEADACHE IN A PILOT**

Theme: CERTIFICATION -- Aeromedical certification

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Colloid cysts of the third ventricle are rare intraventricular brain tumors. They are generally benign and with very insidious evolution. They are often asymptomatic until they reach dimensions above 3 cm in diameter, due to obstruction of the flow of the cerebrospinal fluid to the lateral ventricles. Symptoms, when present, are generally nonspecific, headaches being the commonest. Treatment of choice is surgical.

We present the case of a class 1, 39 years old, male pilot, with a history of smoking and hypertriglyceridemia, who developed a headache of increasing severity, and which were eventually complicated by facial paralysis and brief hemiparesis. An MRI scan revealed a colloid cyst of the third ventricle, which was causing hydrocephalus of the lateral ventricles. The cyst was surgically removed, and the pilot was discharged without focal neurological defects. Neurological follow-up culminated in an aeronautical medical fitness assessment without limitations.

This condition has a very favourable prognosis. Recurrence is extraordinarily rare. There are no neurological sequelae or increased risk of epilepsy since surgical transgression of cortical structures is generally not necessary, which means that the aeromedical risk of sudden or insidious incapacitation is not significant.





## PO 59 - THE IMPORTANCE OF THE QUALITY OF PILOT CLINICAL EXAMINATIONS

Theme: CERTIFICATION -- Aeromedical certification

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**INTRODUCTION:** Aeromedical examiners (AMEs) are specialist healthcare professionals who specialise in evaluating the health and fitness of individuals involved in aviation. These examinations play a vital role in maintaining air travel safety.

**CASE REPORTS:** We will cite the example of two candidates who came for the initial examination class 3. The first candidate was 23 years old. She had no complaints and denies any previous illnesses. At the clinical examination, the AME established a murmur grade of 2/6. The candidate is referred for cardiological evaluation. Echocardiography: anterior mitral cusp is more voluminous, myxomatously altered, it bends in mesosystole 4 mm in the left atrium, MR 1+. Conclusion: mild prolapse of the anterior mitral cusp with MR 1+. In accordance with the adopted medical documentation and EASA regulations the candidate is assessed as fit for Class 3 (TML-6 months and SIC). The other candidate is 24 years old. He also had no complaints. AME have registered a systolic murmur at the apex. Cardiological examination was performed. Echocardiography: EF 60%, PMK elongated, prolapses A2 MR 1-2+. 24-hour ambulatory ECG: during sleep, several episodes of AV block II degree, type I and II, with 2 pauses of up to 2.8 seconds. Exercise ECG was normal. Since the candidate had two associated conditions, he was assessed as unfit.

**CONCLUSION:** We see from these two examples that the importance of AME is great. Detection of asymptomatic disease is challenging. AMEs need to be very dedicated and knowledgeable. Tools are needed to regularly educate doctors and check their knowledge from different fields of medicine.



## **PO 60 - EXTRA-PROTOCOL TESTS IN AEROMEDICAL CERTIFICATION**

Theme: CERTIFICATION -- Aeromedical certification

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Medical certification is part of the pilot's licensing process. The aviation medical examiner gathers all the clinical information necessary for aeromedical disposition, in accordance with applicable regulations. As per protocol, some ancillary diagnostic exams are routinely performed, based on their potential to detect significant conditions that can impact flight safety. In certain cases further (extra-protocol) ancillary tests or specialty assessments may be indicated to support an aeromedical decision.

This observational study assessed the reasons for requesting extra-protocol complementary diagnostic tests (ECD) in EASA class 1 pilots at an aeromedical centre. The data was collected retrospectively and anonymously from all EASA Class 1 exam records between January and June 2021. The requested ECDs and the implications of their results for the aeronautical medical decision were analysed.

Out of 636 records reviewed, there were 106 instances (17%) where follow-up exams or reports were requested. We studied all the positive findings and their impact on medical certification.

The authors hope this study can help our understanding of the real impact and usefulness of extra-protocol ECDs and reports for aeronautical medical decisions in the context of EASA class 1 pilot certification.



## **PO 61- RELEVANCE OF A URINE TEST FOR AEROMEDICAL DECISION**

Theme: CERTIFICATION -- Aeromedical certification

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Medical certification is part of the pilot's licensing process. The aviation medical examiner gathers all the clinical information necessary for aeromedical disposition, in accordance with applicable regulations. As per protocol, some ancillary diagnostic exams are routinely performed, based on their potential to detect significant conditions that can impact flight safety.

This observational study assessed the results of the routine urine analysis in EASA class 1, 2, 3 and cabin crew at the UCS AeMC. Data were collected retrospectively and anonymously from all Exam records between January and June 2021.

The results show that the most frequent positive finding was ketone bodies presence, associated with prolonged fasting and of no significant relevance for the aeromedical certification process. The most impactful finding for aeronautical medical decision was glycosuria.

This study suggests that in this day and age a simple urine test is still useful for aeronautical medical decisions, in the context of pilot, air traffic controller and cabin crew certification.



## PO 62 - FEMORAL NECK STRESS FRACTURE IN AVIATION TRAINEE

Theme: CERTIFICATION -- Aeromedical certification

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Femoral neck stress fractures (FNSFs) are uncommon in young adults but can result from repetitive stress, particularly in athletes such as marathon runners. These fractures pose a serious risk, with exercise-related groin pain being a common symptom. The etiology involves sub-maximal mechanical loads exceeding bone repair capabilities, leading to fatigue fractures. Initially documented in military personnel, FNSFs are increasingly recognized in sports-related settings, requiring a high degree of suspicion among non-military medical professionals.

We present the case of a 26-year-old male, an aviation trainee and long-distance runner, who experienced acute groin pain during an 11 km run, ultimately diagnosed with a left femoral neck stress fracture. This case challenges the notion that FNSFs are exclusive to military or elderly populations. The patient underwent successful surgical left hip osteosynthesis without complications, demonstrating the efficacy of early intervention. The patient followed 4 weeks of non-weight bearing and 2 weeks of partial weight bearing, becoming fit-to-fly 10 weeks post-operatively.

This case highlights the importance of considering FNSFs in young, active individuals with acute groin pain, emphasizing prompt diagnosis and intervention to prevent complications such as osteonecrosis. It advocates for comprehensive evaluation and timely treatment to optimize outcomes, particularly in populations with high occupational demands like aviation trainees. Early surgical intervention and tailored rehabilitation protocols are crucial for expediting recovery and facilitating a timely return to training and work duties, ensuring compliance with fit-to-fly standards.



## **PO 63 - EVALUATION OF AEROSPACE MEDICINE TRAINING PROGRAM**

Theme: CERTIFICATION -- Educational programmes

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Exposure to environmental factors such as hypoxia, hypothermia and fatigue led to the need for medical selection in pilots. Examinations are performed by aeromedical examiners and aerospace medicine specialists.

The purpose of this review is to evaluate the aerospace medicine specialty training programs (AMTP) hold in USA, UK, Canada, Australia, and Turkey worldwide.

Searches were conducted in English and the keywords of aerospace medicine, curriculum, education, PhD, civilian, military, and aeromedical were used in the search engines such as Google, googlescholar and PUBMED.

In terms of admission requirements AMTP is a separate specialty program conducted as add-on or combined curriculum with other specialty training in UK, Canada, Australia, and USA. In Turkey, AMTP is a discrete program that can be applied by physicians after succeeding the national medical proficiency exam. The duration of the programs are 1 year in Canada, 2 years in USA, 3 years in Turkey and 4 years in UK and Austria.

While both civilian and military AMTP are available in Turkey, USA, and UK, it has been determined that military examinations are carried out by military flight surgeons in Canada and Australia. In the United States, military AMTP's have joint rotations with civilian AMTP. In Turkey, civil and military AMTP is given at the University of Health Sciences Turkey and rotations performed at TuAF Aeromedical Center.

Aviation examination, aeromedical training and research are carried out mostly by the physicians trained in aeromedicine field. It has been evaluated that specialization will have positive results, as in other branches of medicine. So, encouraging AMTP in more countries is recommended.