ICAM2026
1-3 OCTOBER 2026
İSTANBUL, TÜRKİYE
"meeting point of continents"

ABSTRACT BOOK

3RD INTERNATIONAL CONGRESS OF

AEROSPACE MEDICINE

1-3 OCTOBER 2026

Istanbul, Türkiye



The Future is in the Sky

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20–176 Oral Presentations

177–245 Poster Presentations

WELCOME

Foreword

3rd International Congress of Aerospace Medicine

1–3 October 2026 | Hilton Bosphorus Istanbul | Türkiye

Dear Colleagues and Distinguished Guests,

It is a great pleasure to present the Abstract Book of the 3rd International Congress of Aerospace Medicine (ICAM 2026), held in Istanbul, Türkiye, on 1–3 October 2026. After the previous editions in Paris and Lisbon, the Congress marked a historic milestone as the first international civil aerospace medicine meeting organized in Türkiye. This gathering reflects both the country's longstanding contributions to aerospace medicine and the growing importance of international scientific cooperation.

Jointly supported by the Aerospace Medical Association (AsMA), the International Academy of Aviation and Space Medicine (IAASM), the European Society of Aerospace Medicine (ESAM), and the Turkish Aerospace Medical Association (TAMA), ICAM 2026 also hosted the 72nd International Congress of Aviation and Space Medicine (ICASM), the 9th European Congress of Aerospace Medicine (ECAM), and the 5th Turkish Aerospace Medical Platform Congress (TAMP).

The three-day programme brought together specialists in clinical aviation medicine, aerospace physiology, human factors, aviation safety, mental health, travel medicine, artificial intelligence and space medicine. Keynotes, thematic panels, scientific oral sessions, and electronic posters provided opportunities to share new findings and strengthen multidisciplinary collaboration.

138	53	585	81
Oral presentations	Posters	Participants	Countries

We extend our sincere appreciation to the organizing and scientific committees, reviewers, speakers, authors, chairs, supporting societies, partner institutions and sponsors. We hope that the research presented in this volume will advance evidence-based practice, flight safety, and human health in aerospace environment.

Prof. Dr. Hasan Fehmi Töre
Chair of the Scientific Committee, ICAM 2026

ICAM 2026

3rd International Congress of Aerospace Medicine

and jointly held with

72nd ICASM	9th ECAM	5th TAMP
International Congress of Aviation and Space Medicine	European Congress of Aerospace Medicine	Turkish Aerospace Medical Platform Congress



HILTON ISTANBUL BOSPHORUS

DATE & VENUE

1–3 October 2026

Hilton Istanbul Bosphorus
Istanbul, Türkiye

EXECUTIVE COMMITTEE

Prof. Dr. Muzaffer Çetingüç
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Prof. Dr. Hasan Fehmi Töre
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Physiol. Plt. Hüsnü Onuş
Vice President

CONGRESS SECRETARIAT

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Under the Auspices of

Directorate General of Civil Aviation, Türkiye

Organising Societies

AsMA
Aerospace Medical Association

ESAM
European Society of Aerospace Medicine

IAASM
International Academy of Aviation and Space Medicine

TAMA
Turkish Aerospace Medical Association

Affiliated Institutions

Republic of Türkiye
Ministry of National Defence

Republic of Türkiye
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Turkish Air Force

University of
Health Sciences

Turkish Aerospace
Medical Platform

ICAM 2026

Sponsors & Supporters

To the organisations supporting ICAM 2026.

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ORGANISATION

Committees

Honorary Committee

Prof. Dr. Cevdet Erdöl

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Mustafa Yıldız
Oya Bozkurt

NATIONAL & INTERNATIONAL

Reviewers

In alphabetical order

01 Abdurrahman Engin Demir

02 Adam Sirek

03 Ahmet Arınç Sönmez

04 Andrew Bellenkes

05 Anthony Sverre Wagstaff

06 Berkay Ekici

07 Claudia Stern

08 Eilis Boudreau

09 Elizabeth Wilkinson

10 Erdinc Aydın

11 Erik Hohmann

12 Felice Strollo

13 Hasan Fehmi Töre

14 John V. Barson

15 Kenneth L. Fong

16 Menduh Savaş İlbasmış

17 Mevlüt Cengiz

18 Mustafa Yıldız

19 Nazim Ata

20 Oya Bozkurt

21 Punita Masrani

22 Susan Fondy

LECTURE

André Allard Lecture

01 October 2026 | 11:00 – 12:00 | Ambassador Hall

CHAIR **Francisco Rios Tejada**

INVITED SPEAKER

Prof. Russell G. Foster

Light and Circadian Rhythms: Mechanisms, Health and New Applications for Aerospace Medicine

FRS	**CBE**	**300+**
Royal Society Fellow, 2008	Services to science, 2015	Scientific papers

Brief Biography

Professor Russell Foster is the Head of Oxford's Nuffield Laboratory of Ophthalmology, the founder and Director of the Sleep and Circadian Research Institute and is a Fellow of Brasenose College Oxford. His research addresses how circadian rhythms and sleep are generated and regulated and what happens when these systems fail as a result of societal pressures, age and disease. A key finding has been his discovery and characterisation of an unrecognised light-detecting system within the eye that regulates circadian rhythms and sleep and, most recently, the translation of these findings to the clinic.

For his work, Russell was elected to the Fellowship of the Royal Society in 2008, the Royal Society of Biology in 2011 and the Academy of Medical Sciences in 2013. Russell was honoured by being appointed as a Commander of the British Empire (CBE) in 2015 for services to science. Russell has published over 300 scientific papers and has received multiple national and international awards. He has written five popular science books. His fifth for Penguin (Yale University Press in the USA), entitled LifeTime was published in March 2023 and became a bestseller in both hardback and paperback. His new book entitled How Light Gives Us Life will be published in March 2027.

ABSTRACT · ANDRÉ ALLARD LECTURE

Light and Circadian Rhythms

Mechanisms, Health and New Applications for Aerospace Medicine

Prof. Russell G. Foster Invited Speaker

01 Introduction

We assume that we can do what we want, at whatever time we choose. This assumption is wrong. Our biology is governed by a 24-hour biological (circadian) clock that advises us when it is the best time to sleep, eat, think, and undertake a myriad of other essential tasks. This daily internal adjustment allows us to function optimally in a dynamic world, “fine-tuning” our biology to the profound demands imposed by the 24-hour day. For our bodies to function correctly we need the correct materials in the right place, in the right amount, at the right time of day. Thousands of genes must be switched on and off in a specific order. Proteins, enzymes, fats, carbohydrates, hormones and other compounds have to be absorbed, broken down, metabolised and produced at a precise time for growth, reproduction, metabolism, movement, memory formation, defence and tissue repair. All this requires a biology that is prepared and ready for action at the right time. And without the precise regulation by an internal clock – a circadian clock – our entire biology would drift into chaos. Progress in understanding the fundamental nature of circadian biology has been astonishing. In addition, there has been an emerging realisation of the fundamental importance of circadian rhythms to our health and wellbeing.

02 Light Regulation

Following the introduction, I will focus on the role of light in regulating circadian rhythms and sleep. Light is the primary regulator (photoentrainment signal) for the circadian system which is detected by photoreceptors within the eye. But in addition to the visual photoreceptors, the rods and cones, there is a “third” photoreceptor, based upon a population of photosensitive retinal ganglion cells (pRGCs). Because many human populations spend much of their time inside and are detached from the natural light/dark cycle, artificial lighting systems are being designed to replicate the light signals that bring about effective photoentrainment. However, this is not easy as photoentrainment is based upon a complex set of ill-defined pRGC, rod and cone interactions. For example, there is a dynamic relationship between stimulus duration and intensity, the circadian system can detect dim light but only if exposure is over many hours. The timing of light exposure is critical. Light exposure at dusk will delay the circadian system, whilst early evening light exposure will advance the circadian system, and exposure to bright light in the middle of the day will de-sensitise the circadian system to light in the evening. These key factors, along with the wavelength (colour) of the light signal, illustrate the fact that attempts to develop evidence-based “Human Centric Lighting” to enhance consciousness and promote sleep is difficult. Recommendations for optimal light exposure are emerging, but the validity of these recommendations will be discussed within the context of what we actually know, what we don’t know and what we need to know for artificial lighting design.

03 The Development of New Drugs

The final part of the talk will address how light activation of the pRGCs regulates the molecular clockwork and sleep/wake timing. We have identified key elements of this signalling pathway. For example, we now understand the molecular basis of jet lag and are targeting this pathway with the development of new drugs. In addition, one of our drugs can effectively “mimic” the effects of light on the circadian system and is being developed to correct circadian rhythm misalignment spanning conditions that include profound blindness, severe mental illness, jet lag and night shift work.

> These interconnected topics will be reviewed in my presentation. Making the point that curiosity driven research is now being translated into new therapeutics for human health and performance, not least within aerospace medicine.

PANEL

Ernsting Panel

02 October 2026 | 08:30 – 10:00 | Ambassador Hall

Medications in Aviation

Examine issues and approaches to the approval and use of medications in airmen and air traffic control specialists.

MODERATOR **Dr. John V. Barson** Chair, IAASM Scientific Sub-Committee · Introduction

- **Dr. Ansa Jordaan**
  Chief, ICAO Aviation Medicine Section
  The ICAO approach regarding the use of medications in Airman and Air Traffic Control Specialists.
- **Dr. Kate Manderson**
  Principal Medical Officer, Australia Civil Aviation Safety Authority (CASA)
  The CASA policy regarding the use of medications by Australian Airman and Air Traffic Control Specialists and the development of the process by which Selective Serotonin Reuptake Inhibitors (SSRIs) were approved for use.
- **Dr. Cristian Panait**
  Medical Expert, Aircrew & Medical Dept, European Union Aviation Safety Agency (EASA)
  The EASA policy regarding the use of medications in the European Union.
- **Dr. Ewan Hutchison**
  Lead Consultant, United Kingdom Civil Aviation Authority
  The UK policy regarding the use of medications by UK Airman and Air Traffic Control Officers and the development of the process by which Insulin Dependent Diabetics were cleared to perform Airline Transport Pilot duties.
- **Dr. Susan Northrup**
  Federal Air Surgeon, Federal Aviation Administration
  The FAA policy regarding the use of medications by United States Airman and Air Traffic Controllers.
- **Dr. Vinh N. Kieu**
  Pharm. D., FAA Clinical Pharmacologist, Federal Aviation Administration
  The FAA Pharmaceutical Database and the process for addition of new medications to the database.

PANEL

EASA Panel: Research Studies

01 October 2026 | 15:30 – 16:30 | Ambassador Hall

CHAIRS **Claudia Stern · Cristian Panait**

- **Pedro Caetano**
  146 Diabetes in Aviation: Safety, Performance, and Aeromedical Certification Implications for Pilots and Air Traffic Controllers
- **Mateja Kotnik Kerbev**
  156 Cardiovascular Disease in Pilots and ATCOs: New Treatments and Diagnostic Measures
- **Alfred Roelen**
  Colour vision in aviation safety – EASA VISION study
- **Cristian Ionut Panait**
  Recent regulatory updates in aeromedical certification of pilots and ATCOs in Europe

PANEL

ESAM Space Medicine Panel

03 October 2026 | 08:30 – 10:00 | Ambassador Hall

CHAIRS **François Bernard · Joerg Hedtmann**

- **Claudia Stern** DLR
  197 Spaceflight Associated Neuro-ocular Syndrome Research
- **Pedro Caetano** EASA
  144 Aero-medical Fitness of Aircrew Members and Passengers Health Standards Related to Higher Airspace Operations
- **Laura André-Boyet** ESA
  My weightlessness experiences
- **Joseph Dervay** NASA
  227 The Most Unique Ward Round in the Solar System: International Medical Operations for Human Spaceflight

★ **ESAM Space Award Ceremony – Lifetime Achievement in Space Medicine**

COURSE

ESAM AME Refresher Course

03 October 2026 | 13:30 – 16:30 | Ambassador Hall

CHAIRS **Terje Saehle · Declan Maher**

- **Norbert Güttler**
  0215 Practical AME Cardiovascular Risk Assessment

- **Diederik de Rooy**
  0222 Mental Health Assessment / Pilot App for self assessment in Mental Health. The role of Peer Support or escalation to the AME.

- **Rui Pombal**
  0229 Report on the use of the MED.B.055 template as found by the UCS Study completed by Rui.

- **Declan Maher**
  0224 Emphasis on elements of the Aeromedical Examination and Assessment

- **Rui Pombal, Alberto Prata, Cátia Saraiva**
  182 An Aeromedical Centre Health-Trends Analysis

- **Declan Maher**
  0225 The physical examination and referrals from the AME – Focus on an area of Advanced AME assessment, e.g. the 15 point Oncology Report.

- **Anthony Sverre Wagstaff**
  0213 Risk Assessment in Aviation Medicine – Using the Risk Matrix

30 SEPTEMBER 2026 WEDNESDAY

13:30	REGISTRATION DESK OPENS

01 OCTOBER 2026 THURSDAY (1st DAY)

07:30	REGISTRATION DESK OPENS

AMBASSADOR HALL

09:00
OPENING CEREMONY
Opening Speeches

09:45
Medical and Physiological Perspective of Türkiye's First Human Space Mission
Air Force Brig. Gen. Alper GEZERAVCI
The First Astronaut of Türkiye

10:15
The Cat in The Car
Plt. Üner BEKÖZ
Antalya Science University

10:45 11:00	COFFEE BREAK CONNIE 1 HALL

11:00
ANDRÉ ALLARD LECTURE
Chair: Francisco Rios Tejada
Light and Circadian Rhythms: Mechanisms, Health and New Applications for Aerospace Medicine
Prof. Russell G. Foster
Invited Speaker

12:00 13:30	LUNCH BREAK
12:00 13:30	ESAM Executive Committee meeting (12:00 - 13:30) Room: Marlon Hall (In The Main Building)

AMBASSADOR HALL

CLINICAL MEDICINE SESSION (1)

Chairs:
Richard O. Speakman
Elena Cataman

13:30–13:45
(98) A risk matrix approach to aeromedical assessment: 4 years of the USAFSAM AMRAAM
Ryan S. Mayes, **Richard O. Speakman**, Amy G. Hicks, Kristin L. Vogt, Octavio A. Borges, Talib Y. Ali, Kevin F. Heacock

13:45–14:00
(232) Morbidity Patterns and Medical Fitness of Cabin Crew Members: A 10-Year Retrospective Study
Elena Cataman, Lucia Ivanov, Larisa Sicanova, Tatiana Balan, Natalia Netrebciuc, Nina Turculet

14:00–14:15
(149) Photon-Counting CT in Cardiac Imaging—Impact and Potential for Aviation Medical Risk Stratification
Daniel Anton Veit, Hans Juergen Noblé, Kai Nestler, Paul Martin Bannsmann, Josef Ehling

14:15–14:30
(174) The Future of Coronary Artery Disease Assessment in Aircrew
Eddie Davenport

14:30–14:45
(176) Management of Cardiac Implantable Electronic Devices During Air Travel: What Should Clinicians Know?
Tanya Camuz, Zeynep Kolak, Sumeyye Turhan, Isilay Kok, Mustafa Yildiz

14:45–15:00 · Discussion

CONNIE 2 HALL

SPACE MEDICINE SESSION (1)

Chairs:
Kenneth Myers
Krzysztof Kowalczuk

13:30–13:45
(93) Emergency Medical Ground Operations Support for Astronaut Spacesuit Testing at Kennedy Space Center
Kenneth Myers, Abigail Mcdonald

13:45–14:00
(162) Evaluation of Basic Life Support Algorithm Feasibility in a Microgravity Analogue Using the Crew Medical Restraint System Integrated with the Atmed Restraint System
Arkadiusz Trzos, **Krzysztof Kowalczuk**, Karol Łyziński, Mateusz Matt Harasymczuk, Daria Salacińska

14:00–14:15
(237) First Intravenous Fluid Infusion Completed Onboard the International Space Station: A Medical Training Demonstration
Joseph P Dervay, MD, Craig Kutz, MD

14:15–14:30
(143) Post-Landing Orthostatic Intolerance after Spaceflight: Characterization of Intravenous Fluid Resuscitation in NASA Astronauts
Lydia Johnson Kolaparambil Varghese, Josef Pleticha

14:30–14:45
(172) Coming Home, A Critical Phase of Adaptation: The Blind Spot of Preparation for Analogue and Space Environments
Barbara Le Roy, Charles Martin Krumm, Christian Clot, Marion Trousselard

14:45–15:00 · Discussion

CONNIE 3 A HALL

SAFETY, AVIATION ACCIDENTS SESSION (1)

Chairs:
John Stephen Crowley
Alpo Vuorio

13:30–13:45
(186) UAS-related hazards to aircraft and humans
John Stephen Crowley

13:45–14:00
(189) Aircraft accident casualty identification using DNA techniques
Alpo Vuorio, Antti Sajantila, Robert Bor, Bruce Budowle

14:00–14:15 Not Presented
(184) Volcanic Ash and Gas Exposure in Aviation: Operations Lessons from the 2025 Hayli Gubbi Eruption in Ethiopia
Bargo M YOUSIF, Solomon Beka, Alexander Mkwizu

14:15–14:30
(217) Analysis of spinal imaging findings in post ejection cases: A retrospective study
Uday Bansal, Pradeep Lather, M S Nataraja, Yashvir Singh Dahiya, B N Vasudev, Rohit Aggarwal

14:30–14:45
(223) Through Canopy Ejection of a Female Pilot during Spin Recovery: Injury Pattern Analysis and Lessons Learnt
Ashu Chandra

14:45–15:00 · Discussion

CONNIE 3 B HALL

MENTAL HEALTH SESSION (1)

Chairs:
Quay Snyder
Margaret Anne Oakes

13:30–13:45
(59) Mental Health Factors in Aviation Accidents/Incidents - A Tool for International Investigators
Quay Snyder, William Hoffman, Aric Raus

13:45–14:00
(78) Human first, pilot second: working with aviation psychologists
Margaret Anne Oakes

14:00–14:15
(139) Acute mania in a commercial pilot with adulterated e-cigarette: a case report
Dandapithapani Thyagarajan

14:15–14:30
(220) Peer Support in Aviation: What Are We Learning from 1,000 Cases?
Aedrian Bekker, Sarah Gordon, Rob Bor, Ruth Henderson

14:30–14:45 · Discussion

15:00 15:30 — **COFFEE BREAK CONNIE 1 HALL**

AMBASSADOR HALL

EASA PANEL; RESEARCH STUDIES

Chairs:
Claudia STERN
Cristian PANAIT

15:30–16:30
(146) Diabetes in Aviation: Safety, Performance, and Aeromedical Certification Implications for Pilots and Air Traffic Controllers
Pedro CAETANO

(156) Cardiovascular Disease in Pilots and ATCOs: New Treatments and Diagnostic Measures
Mateja KOTNIK KERBEV

Colour vision in aviation safety – EASA VISION study
Alfred ROELEN

Recent regulatory updates in aeromedical certification of pilots and ATCOs in Europe
Cristian Ionut PANAIT

CONNIE 2 HALL

AVIATION PHYSIOLOGY SESSION (1)

Chairs:
Çağla Nur Türken
Yihe Wang

15:30–15:45
(150) Multi-Modal Physiological and Behavioral Fatigue Risk Assessment in Student Pilots: Integrating Resting HRV, In-Flight Autonomic Monitoring,Neurobehavioral Performance, and Subjective Workload
Çağla Nur Türken, Botond Szűcs

15:45–16:00
(6) Study on the mechanism of ZDHHC4-mediated ICAM1 palmitoylation modification in the progression of Atherosclerosis aggravated by repeated +Gz exposure
Yihe Wang, Jianquan Tian, Xinyi Zan, Luwen Zhang

CONNIE 3 A HALL

AIRLINE AND CERTIFICATION SESSION (1)

Chairs:
Kristen L Matulis
Tim Sprott

15:30–15:45
(90) Parkinson's Disease and Deep Brain Stimulation: Aeromedical Certification Considerations for Aviation Medicine Professionals
William R Hoffman, **Kristen L Matulis**

15:45–16:00
(133) The Pilot Medical: More Than a Tick and a Pee
Tim Sprott, Kate Manderson

16:00–16:15
(154) Historical Evolution of Cardiovascular and Diabetes Rulemaking in FAA Aerospace Medicine
Charles Mathers, Samantha King, Susan Northrup

16:15–16:30
(170) Transitioning Aeromedical Responsibility From Public To Private Sector: A Practical Framework And Lessons Learned From Panafricare Clinic
Richard Mussard, Miodrag Todorovic, Leonard-Marin Lupu

16:30–16:45
(182) An Aeromedical Centre Health-Trends Analysis
Rui Pombal, Alberto Prata, Cátia Saraiva

CONNIE 3 B HALL

MENTAL HEALTH SESSION (2)

Chairs:
Faheem Naqvi
Alpo Vuorio

15:30–15:45
(230) Neurodivergence in candidates seeking aviation medical certification: Developing a Specialist Neurodevelopmental Pathway
Faheem Naqvi, Wakil Ahmed, Jasmine Leyland

15:45–16:00
(190) Post-traumatic stress disorder and its practical application in turbulence-triggered trauma
Alpo Vuorio, Robert Bor, Bruce Budowle, Alastair Gray, Anna Stina Suhonen Malm

16:00–16:15
(233) Psychological and occupational consequences of medical and operational certificate limitations in aviators: A Cross-Sectional Analytical Study
Koroush Soleimani, Abolfazl Khamaki, Marzieh Magfoori

16:15–16:30
(191) How to assess suicide risk in pilots with major depression?
Alpo Vuorio, Anna Stina Suhonen Malm, Bruce Budowle, Alastair Gray, Sarah Gordon, Robert Bor

16:30–16:45 · Discussion

17:00 19:30 — **WELCOME RECEPTION - Grace A-B Hall (in the main building)**

02 OCTOBER 2026 FRIDAY (2nd DAY)

08:00 REGISTRATION DESK OPENS

AMBASSADOR HALL

08:30

ERNSTING PANEL

Medications in Aviation

Examine issues and approaches to the approval and use of medications in airmen and air traffic control specialists

Moderator: Dr. John V. Barson
Chair, IAASM Scientific Sub-Committee

Introduction

Dr. Ansa Jordaan, Chief, ICAO Aviation Medicine Section
The ICAO approach regarding the use of medications in Airman and Air Traffic Control Specialists.

Dr. Kate Manderson, Principal Medical Officer at the Australia Civil Aviation Safety Authority (CASA)
The CASA policy regarding the use of medications by Australian Airman and Air Traffic Control Specialists and the development of the process by which Selective Serotonin Reuptake Inhibitors (SSRIs) were approved for use.

Dr. Cristian Panait, Medical Expert, Aircrew & Medical Dept, European Union Aviation Safety Agency (EASA)
The EASA policy regarding the use of medications in the European Union.

Dr. Ewan Hutchison, Lead Consultant, United Kingdom Civil Aviation Authority
The UK policy regarding the use of medications by UK Airman and Air Traffic Control Officers and the development of the process by which Insulin Dependent Diabetics were cleared to perform Airline Transport Pilot duties.

Dr. Susan Northrup, Federal Air Surgeon, Federal Aviation Administration
The FAA policy regarding the use of medications by United States Airman and Air Traffic Controllers.

Dr. Vinh N. Kieu, Pharm. D., FAA Clinical Pharmacologist, Federal Aviation Administration
The FAA Pharmaceutical Database and the process for addition of new medications to the database.

09:45 – 10:00 Discussion

10:00 – 10:30 COFFEE BREAK CONNIE 1 HALL

AMBASSADOR HALL

HUMAN FACTOR SESSION (1)

Chairs:
Roland Ludovic Vermeiren
Benjamin Tan

10:30–10:45
(103) Reasons for incapacity of ATCO's
Roland Ludovic Vermeiren

10:45–11:00
(141) From Pathogenesis to Salutogenesis: Reframing Medical Regulation in Civil Aviation
Benjamin Tan

11:00–11:15
(153) ARTEMIS 4557 - Mitigating Hypoxic Stress and Supporting Early Autonomic Adaptation Through Virtual Reality Mindfulness: An Operational Countermeasure for High-Altitude Deployments
Andrea Mastroilli, Andrea Chirico, Stefano Livi, Gaetano Buonaiuto, Vincenza Iodice, Pietro Perelli

11:15–11:30
(193) Aeromedical Stressors: Hypobaric Hypoxia, Mental Workload – A Digital Signal Processing (DSP) Architecture for ANS Physiological Mapping of Human Performance
Harry Dr. Harper, Harry Dr. Harper

11:30–11:45
(104) High-Altitude Exposure and Hematological Adaptation: A Pilot Study Comparing Real and Simulated Hypoxia
Carmen Nigro, Luigi Nardi, Francesco Piccolo, Marco Lastilla, Pasquale Musolino, Pietro Perelli, Paola Verde

11:45–12:00 · Discussion

CONNIE 2 HALL

TRAVEL MEDICINE SESSION (1)

Chairs:
Emine Elif Vatanoğlu Lutz
Esra Çınar

10:30–10:45
(44) New Perspectives On Global Health and Aviation Through World Medical Association Declarations
Emine Elif Vatanoğlu Lutz, Sina Ercan, Hakan Kiral, Mehtap Kaçar

10:45–11:00
(244) Public Health Management in Civil Aviation During the COVID-19 Pandemic: A Chronological Assessment at Global, National, and Institutional Levels
Esat Rıdvan Dikleli, Dijan Ertemir, **Esra Çınar**, Elif Gündüz Kamberler, Gözde Şen, Mehmet Deniz Aybey

11:00–11:15
(83) Investigation on Microbial Contamination Status of Drinking Water and Object Surfaces Aboard Civil Aircraft
Jinhui Fan, Yinjauan Duan, Junjie Hu, Yanmin Qi

11:15–11:30
(27) Why Aircraft are safer than boats: Comparative R_0 Modeling of Hantavirus Transmission in Aircraft and Expedition Cruise Ships
Sanjay Pooran

11:30–11:45
(10) Innovations in Public Health Event Multi-Layered Risk Reduction Strategy: An Update
Kris Matthew Belland

11:45–12:00 · Discussion

CONNIE 3 A HALL

SPACE MEDICINE SESSION (2)

Chairs:
Tianyu Song
Maria-Vittoria Carminati

10:30–10:45
(5) Evaluating Lunar Dust Simulant Toxicity in Human Pulmonary Alveolar Cells: A Framework For In Vitro Toxicological Studies
Tianyu Song, Julia Laskowska, Joshua Rasera, Terry Tetley

10:45–11:00
(57) Comparative Mammalian Diving Genomics as a Framework for EVA Decompression-Stress Transcriptomics
Maria-Vittoria Carminati

11:00–11:15
(62) Safety of GLP-1RA use for spaceflight, a review of relevant literature
Samuel David Stephenson, David P Reyes, William J Tarver

11:15–11:30
(84) EXPAND: A Standardized Multi-Domain Biomedical Dataset for Quantitative Risk Modeling in Commercial Human Spaceflight
Jimmy Wu, Jackson Brougher, Melia Singh, Dorit Donoviel, **Elizabeth Reynolds**

11:30–11:45
(157) You Star What You Eat: Fueling the Next Generation of Crewed Exploration
Jason-Flor Sisante, Saahil Golia, **Core Young, Ganeev Singh**

11:45–12:00 · Discussion

CONNIE 3 B HALL

CLINICAL MEDICINE SESSION (1)

Chairs:
Norbert Guettler
Krzysztof Kowalczuk

10:30–10:45
(200) Fitness to Fly After Pre-flight Transcatheter Aortic Valve Implantation in a High-Risk Patient with Severe Aortic Stenosis: A Case Report
Tanya Camuz, Zeynep Kolak, Idil Buğday, Mustafa Yıldız

10:45–11:00
(214) Arrhythmia and conduction disorders in aging aircrew
Norbert Guettler

11:00–11:15
(202) Restoring Safe Air Travel After Percutaneous Left Main Coronary Artery Stenting for Extrinsic Compression by a Dilated Pulmonary Artery in Pulmonary Arterial Hypertension: A Case Study
Tanya Camuz, Zeynep Kolak, Kadriye Memic Sancar, Begüm Uygur, Mustafa Yıldız

11:15–11:30
(219) When High Altitude Mimics Myocardial Infarction: Arrhythmogenic Mitral Valve Prolapse in a Professional Mountaineer
Pelinsu Elif Ozkan, Mustafa Yıldız, Aylin Altun

11:30–11:45
(12) Aeromedical Challenges in Fitness-to-Fly Assessment of a Pilot with Elevated Lipoprotein(a)
Daria Sałacińska, Konrad Tkaczewski, **Krzysztof KOWALCZUK**

11:45–12:00 · Discussion

12:00 – 13:30 LUNCH BREAK

IAASM GENERAL ASSEMBLY (12:00–13:30)
Room: Sofia Hall (in the main building)

02 OCTOBER 2026 FRIDAY (2nd DAY) — continued

AMBASSADOR HALL

SPACE MEDICINE SESSION (3)

Chairs:
Abdurrahman Engin Demir
Tatiana Kriukova

13:30–13:45
(88) Glymphatic and Perivascular Clearance Dysfunction as a Potential Candidate Convergent Pathway Linking SANS and Neurocognitive Vulnerability During Long-Duration Spaceflight
Abdurrahman Engin Demir, Duru Berfe Genç, Şükrü Hakan Gunduz

13:45–14:00
(138) Transcranial ultrasonography – a new method for diagnosing hydrocephalus associated with long-term spaceflight (HALS)
Alexander Iova, **Tatiana Kriukova**

14:00–14:15
(276) The Glymphatic System in Space: Effects of Microgravity on Cerebrospinal Fluid Dynamics and Neural Homeostasis
Daniela Romina Tito Tudela

14:15–14:30
(187) Risks of neurovascular aging under lunar gravity: Forecasting progression, recovery, and countermeasures for Artemis missions
Yaritzael Vidal, **Barbara Pastori**

14:30–14:45
(281) The Brain at High Altitude: Neurocognitive Adaptation to Chronic Hypobaric Hypoxia in Andean Populations
Daniela Romina Tito Tudela

14:45–15:00 · Discussion

CONNIE 2 HALL

CLINICAL MEDICINE SESSION (2)

Chairs:
Fabrizio Palumbo
Dominique Luton

13:30–13:45
(91) Aeromedical Unfitness in 2025: From Selection to Surveillance – Patterns of Disqualification Across Class 1, 2 and 3 Aircrew
Fabrizio Palumbo, Marco Lastilla, Pietro Perelli

13:45–14:00
(203) Pregnancy among Civil Flight Attendant and Pilot: criteria for maintaining flight duty and pregnancy prognosis. A retrospective study of 255 pregnancies between 2020 and 2024
Dominique Luton, Francesca Apicella, Michel Klerlein

14:00–14:15
(206) Evaluation of Dentistry Students' Perceived Knowledge and Awareness of Aviation Dentistry
Emin Murat Canger, Berivan Canpolat

14:15–14:30
(163) Obstructive Sleep Apnea Screening in Military Pilots: Performance of the STOP-BANG Questionnaire and Development of a Novel Predictive Model
Claudia Milella, Pasquale Musolino, Federico Piccoli, Andrea Mazzoni, Fabrizio Magnifica

14:30–14:45
(25) Sleep Quality in Flight Personnel: Impact of Operational Workload and Implications for Aviation Safety
Elisa Pozzi, Camilla Sigurtà, **Anna Fachinetti**, Giovanni De Vito

14:45–15:00 · Discussion

CONNIE 3 A HALL

ARTIFICIAL INTELLIGENCE SESSION (1)

Chairs:
Mehtap Kaçar
Yuan Cao

13:30–13:45
(28) Interpretable Machine Learning for Short-term Coronary Heart Disease Risk Estimation in Airline Pilots
Yuan Cao, Hong Su, Siqi Wang, Yanmin Qi

13:45–14:00
(168) A Multidimensional Framework for Fatigue Monitoring in Long-Haul Airline Pilots: A Wearable-Based Proof-of-Concept Study
Riccardo Groppo, Sara Groppo, Massimo Violante, Andrea Romigi, Elisa Pozzi, Anna Fachinetti, Camilla Sigurtà

14:00–14:15
(43) An Overview of the Ethics of Artificial Intelligence and New Technologies in Aviation and Space Medicine
Emine Elif Vatanoğlu Lutz, Sina Ercan, Hakan Kiral, Mehtap Kaçar

14:15–14:30
(164) Predictive neural artificial intelligence for autonomous cognitive, emotional, and operational support during long-duration spaceflight
Dorely Medina Leal, **Alan Emir Medina Delgado**, Erandi Daniela Ruiz Coronado, Isis Avedoy Cortez, Willian Alberto Valdivia González, Jahir Garcia Macias, Lenin Manuel Rosales Ramirez, Consuelo Karely Raya Haro

14:30–14:45
(256) The intertwined future of the aerospace industry and artificial intelligence: inevitable friend, foe, or both? A premortem analysis of the decades ahead
Niveta Ramakrishnan, Paul H. Nelson, Lawrence W. Steinkraus, Jacob Ray Berry

14:45–15:00 · Discussion

CONNIE 3 B HALL

HUMAN FACTOR SESSION (2)

Chairs:
Ryan S. Mayes
Angus Rupert

13:30–13:45
(79) Physiologic episodes in high-performance aviation: the state of the science
Ryan S. Mayes

13:45–14:00
(132) A potential material solution to mitigate vection illusions
Angus Rupert, John Crowley

14:00–14:15
(207) Contrast Sensitivity Vis-A-Vis Visual Acuity as Measures of Visual Adaptation Time
Jeyakarthik Ramar

14:15–14:30
(142) From Fatigue Assessment to Game-Based Training Intervention: A Closed-Loop Fatigue Management Framework for Air Traffic Controllers
Chenxin Pan, **Yanhua Liu**

14:45–15:00 · Discussion

15:00 / 15:30 — **COFFEE BREAK CONNIE 1 HALL**

AMBASSADOR HALL

AVIATION PHYSIOLOGY SESSION (2)

Chairs:
David Powell
Michael-Luke Jones

15:30–15:45
(113) Sealing Properties of Close-Fitting Masks Worn Over Facial Hair - What Do Studies Show?
David Powell, Desmond Connolly, Rebecca Sheppard Hickey, Henry Lupa

15:45–16:00
(1) G-induced alterations of consciousness in UK military aviation: career prevalence, incident characteristics and pilot attitudes
Michael-Luke Jones, Joseph Keith Britton, Nicholas David, Charles Green, Ross Daniel Pollock

16:00–16:15
(221) Comparison of Physiological Parameters and Coriolis Cross-Coupling Effects Following Vestibular Apparatus Stimulation in AirFox® DISO Disorientation Simulator and Dynamic Flight Simulator
Shaleen Pratap Singh

16:15–16:30
(226) Correlation of Computerized Dynamic Posturography (CDP) Parameters with Lean Body Mass in Indian Air Force (IAF) Aircrew
Sourav Gain, Punyashlok Biswal, Biplab Bhowmick, Sudhangshu Sekhar Mohapatra

16:30–16:45 · Discussion

CONNIE 2 HALL

AIRLINE MEDICINE SESSION (1)

AIRLINE HEALTH:
Bring Your Coffee Chat

Chairs:
Sara Souter
Rui Pombal

15:30–15:45
Highlights from the 2026 Aviation Health Conference - Part One
David Powell

15:45–16:00
Highlights from the 2026 Aviation Health Conference - Part Two
Sara Souter

16:00–16:15
Highlights from the 2026 Aviation Health Conference - Part Three
Rui Pombal

16:30–16:45
Who does The Earth Belong to (Show)
Plt. Üner BEKÖZ
Antalya Bilim University

CONNIE 3 A HALL

SPACE MEDICINE SESSION (4)

Chairs:
Christian Clot
Begum Aydogan Mathyk

15:30–15:45
(173) Cave Environments as High-Fidelity Analogues for Future Lunar Surface Missions: Human Factors Insights from the DEEP Time
Christian Clot, Trousselard Marion, Jeremy Roumian, Camille Barbaro, Antoine Roy, **Barbara Le Roy**

15:45–16:00
(147) How to develop an adverse outcome pathway for assessment radiation-induced female infertility: a framework for space health risk
Jessica D'Urbano, Awukuku Asamoah-Mensah, Saadia Khilji, Amy Michelle Simms, Biyanka Hati, Shiven Gupta, Aylin Yaba Ucar, Haley Race, Ruth Farrell, **Begum Aydogan Mathyk**, Edouard Azzam, Vinita Chauhan

16:00–16:15
(161) The gut microbiome under cosmic radiation: implications for astronaut health during long-duration spaceflight
Dorely Medina Leal, Lenin Manuel Rosales Ramirez, Jahir Garcia Macias, Alan Emir Medina Delgado, Consuelo Karely Raya Haro, Willian Alberto Valdivia González, **Isis Avedoy Cortez**, Erandi Daniela Ruiz Coronado

16:15–16:30 · Discussion

CONNIE 3 B HALL

CLINICAL MEDICINE SESSION (3)

Chairs:
Sharavaannan Rajan
Dragana Dragic Ranisavljevic

15:30–15:45
(254) Cardiovascular Implication of Occupational Noise Exposure in the Aviation Industry, A Systematic Review
Sharavaannan Rajan

15:45–16:00
(259) "Papillary Thyroid Carcinoma in a Commercial Aircrew Member: An Occupational and Aeromedical Case Study"
Dragana Dragic Ranisavljevic

16:00–16:15
(198) Atypical presentation of Lyme disease as an isolated case of Erythema Migrans in Aircrew: An Approach to Aeromedical disposition – A case report
Biswajit Nemai Bhowmick, Monie Riju Simon

16:15–16:30 · Discussion

18:30 — **ACADEMICIANS' DINNER**
(for preregistered Academicians and their accompanying person only)
(free evening for other participants)

03 OCTOBER 2026 SATURDAY (3rd DAY)

08:00 — REGISTRATION DESK OPENS

AMBASSADOR HALL

ESAM SPACE MEDICINE PANEL

Chairs:
François Bernard
Joerg Hedtmann

08:30

(197) Spaceflight Associates Neuro-ocular Syndrome Research
Claudia Stern (DLR)

(144) Aero-medical Fitness of Aircrew Members and Passengers Health Standards Related to Higher Airspace Operations
Pedro Caetano (EASA)

My weightlessness experiences
Laura André-Boyet (ESA)

(227) The Most Unique Ward Round in the Solar System: International Medical Operations for Human Spaceflight
Joseph Dervay (NASA)

ESAM Space Award Ceremony - Lifetime Achievement in Space Medicine

09:45–10:00 · Discussion

CONNIE 2 HALL

ORAL PRESENTATION AWARD SESSION (1)

Jury
John Barson, IAASM
Ellis Boudreau, AsMA
Claudia Stern, ESAM
Nazım Ata, TAMA

08:30–08:45

(61) Effects of a 60-Day Bed Rest on Cerebral Perfusion Assessed by Arterial Spin Labeling
Manuel Michno, Henning Weis, Laura De Boni, Claudia Stern, Darius Gerlach, Daniel Aeschbach, David Elmenhorst, Eva Maria Elmenhorst

08:45–09:00

(46) Real-world impact of the transition to CAD-based colour vision assessment in Turkish aeromedical certification: a 10-year experience from a tertiary referral centre
Ayşe Ozpinar

09:15–09:30

(24) Biomechanical characterization of gait patterns under simulated hypogravity conditions using a LBPP treadmill
Duarte Marques Conchinhas, Fausto J. Pinto, Edson Dos Santos Oliveira, Antonio Prieto Veloso, Nelson Alexandre Campos Vinagre, Thais Russomano, Filipa João

09:30–09:45

(97) Healthcare avoidance among air traffic controllers: Barriers to help-seeking
Marco Antonio Méndez-López, William R. Hoffman, Alejandra Valencia-Cruz, Kimberly Perkins

09:45–10:00

(89) Pilot Impairment and Incapacitation in Commercial Aviation: Medical Etiologies and Safety Implications
William R Hoffman, Justin Devlin, Paulo Alves

10:00–10:15

Who does The Earth Belong to (Show)
Pit. Üner BEKÖZ
Antalya Bilim University

CONNIE 3 A HALL

POSTER PRESENTATION AWARD SESSION

ESAM BEST POSTER AWARD JURY
RAPID-FIRE PRESENTATIONS

Chairs:
Rui Pombal
Declan Maher

Jury:
Claudia Stern
Felix Strollo

08:30–10:00

0094 / Chung Yu Lai (multi0912@gmail.com)
0130 / Fabrizio Magnifica (fabrizio.magnifica@aeronautica.difesa.it)
0171 / Shulin Liu (shulinl345:H360iu@smmu.edu.cn)
0196 / Dijan Ertemir (dertemir@thy.com)
0167 / Shienafiel Hussin (shienafiel@moh.gov.my)
0115 / Abilio Tiago Barros Oliveira (abiliotiago@hotmail.com)
0095 / Si Yu Chen (csy331031@gmail.com)
0199 / Gözde Şen (g.sen@thy.com)
0248 / Pedro Tiago Pinto (gomesplnto.pedro@gmail.com)
0108 / Muhannad Moawad Almutairi (muhannad.moawad.m@gmail.com)
0067 / Ignace Hakizimana (ignacehak@gmail.com)
0107 / You Jin Lin (youjinlin7@gmail.com)
0075 / Filip Garmaz (filipgarmaz03@gmail.com)
0128 / Andrea Mazzoni (mazzoniandrea@tiscali.it)

CONNIE 3 B HALL

SPACE MEDICINE SESSION (5)

Chairs:
Carlos Andrés Aguilar Aguilar
Ximena Megchun Vázquez

08:30–08:45

(290) Toward Autonomous Neurocritical Care for Space Exploration: Translating Aeromedical and Austere TBI Evidence into Secondary-Injury Monitoring and Decision Support
Carlos Andrés Aguilar Aguilar, Karen Estephania Garcidueñas Loya, Xóchitl Citlali Aldana Rodríguez, Josué De Jesús Hernández Vázquez

08:45–09:00

(291) Neurospinal Readiness in Aerospace Operators: Integrating Biomechanical Demand, Spinal Vulnerability, and Operational Capacity Across High-G Aviation and Spaceflight
Ximena Megchun Vázquez, Alondra Acero Espinosa, Flor Isamar Vázquez Vázquez, Daniella Jacqueline Monjaraz Castro, Alba Patricia Zenteno Ulloa, Karina González-Morales, Carlos Andrés Aguilar Aguilar

09:15–09:30

(292) Progressive Neurocritical and Neurosurgical Autonomy for Earth-Independent Medical Operations During Lunar and Martian Missions: A Scoping Review and Evidence-Informed Framework
Fernanda Jiménez Cruz, Diego Rodríguez Romero, Jorge Francisco Sarmiento Martínez, Ronaldo Enrique Medrano Ramírez, Carlos Andrés Aguilar Aguilar

09:30–09:45

(293) Toward a Framework of Space Neurohydrodynamics: Integrating Venous, CSF, Cerebral, and Neuro-Ocular Adaptations to Microgravity
Carlos Andrés Aguilar Aguilar, Nubia Aime García Pulido, Nora Socorro Payán González, Hugo Daniel Ramírez Loya, Diego Noé Tovilla Aguilar, Oscar Eduardo Camacho Hernández

09:45–10:00

(294) Toward Autonomous Neurocritical Care in Long-Duration Spaceflight: Mapping Non-Invasive Monitoring and Decision-Support Evidence
Uriel Antonio Guechi Rodríguez, Carlos Andrés Aguilar Aguilar, Issac Elías Aguilar Cantón, César Omar Gonzáles Aguilar Aguirre, Eduardo Jesús Dzul Castañeda, Jhonatan Franklin Jiménez Aguilar

10:00–10:15 · Discussion

10:00 – 10:30 — COFFEE BREAK CONNIE 1 HALL

AMBASSADOR HALL

SPACE MEDICINE SESSION (6)

Chairs:
Nattarit Pongkunakorn
Begum Aydogan Mathyk

10:30–10:45

(245) Blood Flow Restriction and Neuromuscular Electrical Stimulation as Countermeasures to Spaceflight-Induced Musculoskeletal Deconditioning: A Comparative Review
Nattarit Pongkunakorn, Piyapat Jameekornkul, Tipthanan Chotipinit, Panus Choocheepwattana

10:45–11:00

(8) Impact of Simulated Microgravity on Pelvic Blood Flow in Women of Reproductive Age: A Pilot Doppler Study
Ceren Ünal, Işıl Ayhan, Gizem Cural Kula, Satyam Patel, Huseyin C Yalcin, Afak Durur Karakaya, **Begum Aydogan Mathyk**

11:00–11:15

(126) From evidence to operations: a sex-specific medical framework for long-duration human spaceflight
Dorely Medina Leal

11:15–11:30

(257) Weight Matters - Effects of Microgravity on Individual Cells
Paul Rambaut

11:30–12:00 · Discussion

CONNIE 2 HALL

ORAL PRESENTATION AWARD SESSION (2)

Jury
John Barson, IAASM
Ellis Boudreau, AsMA
Claudia Stern, ESAM
Nazım Ata, TAMA

10:30–10:45

(101) Reclassification of Screening Electrocardiograms in Polish Air Force Aircrew Using the Polish Air Force ECG Interpretation Criteria (PAF-ECG Criteria): A Multi-Reader Comparative Study
Michał Andrzej Kurek, Magdalena Rola, Katarzyna Barwińska

10:45–11:00

(205) From Evidence to Checklist: Development of a Mental Health Quick Reference Handbook (QRH) for Pilot Self-Assessment and Help-Seeking
Louise Farrell Doyle

11:15–11:30 · Discussion

CONNIE 3 A HALL

TRAVEL MEDICINE SESSION (2)

Chairs:
Surendra Sodhi
Justin Devlin

10:30–10:45

(80) Inflight Medical Events and Flight Duration: Implications for Risk-Based Remote Medical Support and Medical Kit Optimization
Surendra Sodhi

10:45–11:00

(111) Epidemiology of In-Flight Seizures
Justin Devlin, Paulo Alves, Cody Thorstenson, Leemeshan Moodley, Neil Nerwich

11:00–11:15

(185) Descent-Associated Barodontalgia in a Root Canal–Treated Mandibular Molar with Asymptomatic Apical Periodontitis
Esra Bihter Gürler

11:15–11:30

(106) Awareness, readiness and barriers of healthcare workers in providing in-flight n=medical assistance
Olga Verba

11:30–11:45

(228) In-Flight Medical Events in a High-Volume Carrier: A Descriptive Analysis of 9,837 Passenger Cases and Evidence-Based Emergency Medical Kit Optimization Recommendations
Seçkin Elçin, Buyçe Kaya, Elif Gündüz Kamberler, Gözde Şen

11:45–12:00 · Discussion

CONNIE 3 B HALL

HUMAN FACTOR SESSION (3)

Chairs:
David J Schroeder
Nidhi Kakkar

10:30–10:45

(11) An Initial Exploration of Burnout in Aviation Personnel: Air Traffic Control
David J Schroeder

10:45–11:00

(37) Long COVID and Return-to-Flight Assessment in Aviation Personnel
Nidhi Kakkar

11:00–11:15

(249) Impact of temporal feature engineering on machine learning prediction of cognitive performance during spaceflight-analogue bed rest
Tasneem Rahman, Alistair Mcewan

11:15–11:30

(29) The effectiveness of working memory and relaxation training in improving cognitive functions of jet pilots
Michal Janewicz, Hanna Bednarek, Krzysztof Kowalczuk

11:30–11:45

(175) Redox Preconditioning and Recovery in Aerospace Hypoxia: A Translational Rationale for Controlled Systemic Medical Ozone
Claudio Tavera

11:45–12:00 · Discussion

12:00 – 13:30 — LUNCH BREAK

ESAM GENERAL ASSEMBLY (12:00–13:30)
Room: Marlon Hall (In The Main Building)

03 OCTOBER 2026 SATURDAY (3rd DAY) — continued

AMBASSADOR HALL

ESAM AME REFRESHER COURSE

Chairs:
Terje Saehle
Declan Maher

13:30

(0215) Practical AME Cardiovascular Risk Assessment.
Norbert Güttler

(0222) Mental Health Assessment / Pilot App for self assessment in Mental Health. The role of Peer Support or escalation to the AME.
Diederik de Rooy

(0229) Report on the use of the MED.B.055 template as found by the UCS Study completed by Rui.
Rui Pombal

(0224) Emphasis on elements of the Aeromedical Examination and Assessment
Declan Maher

(182) An Aeromedical Centre Health-Trends Analysis
Rui Pombal, Alberto Prata, Cátia Saraiva

CONNIE 2 HALL

HUMAN FACTOR SESSION (4)

Chairs:
Philip Brady
Franco Di Bonaventura

13:30–13:45

(261) A Proposed Mental Health Risk Stratification Tool for Commercial Human Spaceflight and Civil Aviation
Philip Brady, Charles Dukes

13:45–14:00

(110) From Crew Resource Management to Life Resource Management: Transcendental Meditation as a Tool for Occupational Stress Mitigation in Commercial Aircrews
Franco Di Bonaventura, Enzo Emanuele, Piercarlo Minoretti

14:00–14:15

(201) Crew Resource Management in Cardiology: Great Functional Similarity
Zeynep Kolak, Tanya Camuz, Sumeyye Turhan, Mustafa Yildiz

14:15–14:30

(86) Republic of Singapore Air Force (RSAF) Targeted Training Regimen (TTR) Programme for Aircrew
Edwin Hong Teck Loh, Hui Yi Chia

14:30–14:45

(109) Integrated Ozone Autohemotherapy and PEMF for Operational Recovery in Pilots and Astronauts
Claudio Tavera

14:45–15:00 · Discussion

CONNIE 3 A HALL

TRAVEL MEDICINE SESSION (2)

Chairs:
Joerg Siedenburg
Panus Choocheepwattana

13:30–13:45

(268) Air Transport of Highly Contagious Patients
Joerg Siedenburg

13:45–14:00

(60) Establishing a Fitness-to-Fly Service and Hypoxic Challenge Test at Srinagarind Hospital: A Multidisciplinary Approach
Panus Choocheepwattana, Apiwan Manimmanakorn, Worawat Chumpangern, Dararat Chantha, Poungrat Pakdeechote, Piyapat Jameekornkul

14:00–14:15

(180) Evaluation of Malaria Cases Detected at Turkish Airlines Between the years of 2015 and 2025 and Disease Prevention Activities
Dilek Cemil, Esat Rıdvan Dikleli, Salih Yaşar Marangoz, Gözde Şen, Mehmet Deniz Aybey

14:15–14:30

(192) Prolonged grief disorder following the Malaysia Airlines MH 17 crash in 2014
Alpo Vuorio, Bruce Budowle, Anna Stina Suhonen Malm, Sarah Gordon, Robert Bor

14:30–14:45

(66) Case report of a long haul commercial passenger flight encountering two separate medical diversions in succession
Swee Weng Fan

14:45–15:00 · Discussion

CONNIE 3 B HALL

CLINICAL MEDICINE SESSION (4)

Chairs:
Wiaam Yasser Elkhatib
Harry Dr. Harper

13:30–13:45

(129) Cardiovascular screening for civilian commercial suborbital spaceflight: an operational risk-stratification framework
Wiaam Yasser Elkhatib, Karen Ong, Duncan Hughes

13:45–14:00

(251) Hypobaric Chamber Examinations and Training: The Aeromedical Flight Profile Analysis - Evaluating an Autoregressive Burg Unified Spectral Transformation Program as a Clinical and Stress Management Utility
Harry Dr. Harper

14:00–14:15

(264) Evaluation of Volume Changes in Root Canal Fillings Induced by Repeated Hyperbaric Pressure Exposure: A Pilot Study
Emin Murat Canger, Menduh Savaş İlbasmış, Zeynep Sude Aksu, Hasan Ekeer

14:15–14:30

(145) Toward Space Reproductive Medicine: A Framework for Women's Health During Long-Duration Spaceflight
Olga Tkachenko

14:30–14:45

(204) Incidence of Barotrauma-Related Otologic Episodes in Commercial Airline Pilots: A Retrospective Cohort Study
Buyçe Kaya, Seçkin Elçin, Esat Rıdvan Dikleli, Dijan Ertemir

14:45–15:00 · Discussion

15:00 – 15:30 — **COFFEE BREAK CONNIE 1 HALL**

AMBASSADOR HALL

ESAM AME REFRESHER COURSE

Chairs:
Terje Saehle
Declan Maher

15:30

(0225) The physical examination and referrals from the AME - Focus on an area of Advanced AME assessment, e.g. the 15 point Oncology Report.
Declan Maher

(0213) Risk Assesment in Aviation Medicine -Using the Risk Matrix –
Anthony Sverre Wagstaff

16:00–16:30 · Discussion

CONNIE 2 HALL

HUMAN FACTOR SESSION (5)

Chairs:
Nidhi Kakkar
Zeynep Göker

15:30–15:45

(41) Medical Causes of Pilot Incapacitation: Aeromedical Challenges and Implications for Flight Safety
Nidhi Kakkar

15:45–16:00

(45) Psychosocial factors affecting Turkish flight instructors' and student pilots' perceived stress status
Zeynep Göker

16:00–16:15

(65) Looking At the Ethics of Drone Operations: Did We Really Think About It?
Mehtap Kaçar, Sina Ercan, Hakan Kiral, **Emine Elif Vatanoğlu Lutz**

16:15–16:30

(235) Psychosocial and occupational consequences of geopolitical crises in Iranian civilian flight crews: Implications for human factors and operational safety
Koroush Soleimani, Abolfazl Khamaki, Marzieh Magfoori

16:00–16:30 · Discussion

CONNIE 3 A HALL

NONE

CONNIE 3 B HALL

CLINICAL MEDICINE SESSION (5)

Chairs:
Fatima Zohra Tlemcani
Harry Dr. Harper

15:30–15:45

(148) From arrhythmic risk to operational risk: aeromedical decision-making in a fighter pilot with low-risk ventricular pre-excitation
Fatima Zohra Tlemcani, Houda Echchachoui, Meryem Zerrik, Zakaria Illoughmane, Mouna El Ghazi, Fahd Bennani Smears, Safaa Maktit, Mounya Jaouhar, Mohammed Chems

15:45–16:00

(262) Aeromedical Hypobaric Examinations and Training Realtime Monitoring of ANS Performance Status: Artifact-Resilient Stress and Systemic Fatigue Prediction
Harry Dr. Harper

16:00–16:15

(258) Acceleration Physiology for Clinical Orthostatic Hypotension: Applying 9G techniques to a 1G problem
Geoffrey W McCarthy

16:15–16:30

(234) "Prevalence and Associated Determinants of Metabolic Syndrome Among Commercial Airline Pilots: A Cross-Sectional Study"
Marzieh Maghfori, Koroush Soleimani, Abolfazel Kamaki

16:45 – 17:00 — **ESAM BEST POSTER AWARD CEREMONY**
ICAM 2026 BEST ORAL AWARD CEREMONY
(Ambassador Hall)

17:15 – 17:30 — **CLOSING CEREMONY**
(Ambassador Hall)

19:30 – 20:00 – 23:55 — **COCKTAIL**
GALA DINNER
(Ambassador Hall)



ICAM 2026 · ABSTRACT BOOK

Oral Presentations

1–3 October 2026 · Hilton Istanbul Bosphorus · Istanbul, Türkiye

3rd INTERNATIONAL CONGRESS OF AEROSPACE MEDICINE
İSTANBUL TÜRKİYE

Accepted Oral Presentation

[Abstract:0001]

G-induced alterations of consciousness in UK military aviation: career prevalence, incident characteristics and pilot attitudes

~~Michael-Luke Jones~~[1], Joseph Keith Britton[1], Nicholas David Charles Green[1], Ross Daniel Pollock[2]
[1]Royal Air Force Centre of Aerospace Medicine, RAF Henlow, United Kingdom
[2]Centre for Human and Applied Physiological Sciences, King's College London, United Kingdom

INTRODUCTION: Sustained +Gz acceleration during high-performance maneuvers generates a hydrostatic pressure gradient that can reduce pilot cerebral perfusion. This can precipitate G-induced alterations of consciousness leading to flight-safety risks. A Royal Air Force (RAF) survey from 2012 reported the career prevalence of experiencing these incidents as 37.2%. Despite the introduction of new aircraft with advanced anti-G countermeasures and updates to centrifuge training, incidents continue to be reported. This study assessed whether the prevalence of these incidents had changed following ten years of changes in aircraft systems, operations and training.

METHODS: An anonymous survey was distributed to UK Armed Forces pilots using the REDCap platform. The survey instrument captured demographics, career history of G-induced alterations of consciousness, details of the most recent episode (aircraft type, peak +Gz, risk factors) and self-rated attitudes to risk factors and mitigations. A two-sample z-test was carried out to compare prevalence in RAF respondents with 2012 survey results. Additional exploratory analyses were conducted to investigate incident reporting across aircraft types, associations with risk-factors and pilot attitudes.

RESULTS: Survey responses were received from 403 pilots with a 11.9% response rate. Career prevalence of at least one G-induced alteration of consciousness incident was 21.6% (95% CIs 17.8 - 25.9%; RAF subset 21.9% vs 37.2% in 2012 survey, $z=-4.92$, $p<.001$). The proportion of incidents in frontline jet pilots increased over time (41.7% from 2015 to 2023 versus 4.3% prior to 2015). Eurofighter Typhoon was the most common aircraft platform in recent incidents (29.0% from 2015 to 2023, n = 38). Leading risk factors reported included rapid Gz onset (80.5%), not controlling the aircraft at the time of the incident (46.0%), pre-flight fatigue (32.2%) and the G-layoff effect (32.2%). With respect to pilot attitudes, recency of +Gz exposure was rated as the most important risk factor.

CONCLUSIONS: Whilst this study indicates that career prevalence of G-induced alterations of consciousness has fallen since 2012, over one in five UK military pilots continued to report at least one incident. Therefore, the high G environment remains a relevant flight safety hazard in UK military aviation. Despite aviation medicine training, student pilots and instructors in the non-handling pilot role continue to be at risk from failure to carry out an adequate anti-G straining maneuver. The reported importance of high-G recency also suggests that additional risk assessment for the G-layoff effect may be beneficial, particularly in frontline jet pilots.

Keywords: acceleration, G-induced alteration of consciousness, G-induced loss of consciousness, almost loss of consciousness, survey

[Abstract:0005]

Evaluating Lunar Dust Simulant Toxicity in Human Pulmonary Alveolar Cells: A Framework For In Vitro Toxicological Studies

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BACKGROUND: With renewed international interest in lunar exploration, researchers are conducting ground-based experiments with lunar dust simulants (LDS) in preparation. Understanding LDS toxicity is therefore crucial to protect space agency personnel from potential respiratory risks. However, there is limited LDS toxicological data available and published studies vary in methodology, exposure models and materials. This study aimed to contribute new LDS toxicity data, using appropriate target cells and materials, and proposing a framework to guide future in vitro toxicological studies.

METHOD: Human pulmonary alveolar macrophage (THP-1) and epithelial (TT1) cells were exposed for 24 hours to increasing concentrations (12.5–200µg/ml) of two types of LDS: LMS-1D and LHS-1D. The MTT assay assessed mitochondrial activity to determine cell viability. The LDH assay assessed cellular LDH release and cell membrane integrity as another indicator for cell viability. Cellular oxidative stress was examined using the dihydroethidium (DHE) reaction which stained reactive oxygen species (ROS) and confocal microscopy to visualise fluorescence. Wheat germ agglutinin (WGA) dye was also used to visualise cell membrane glycoproteins.

RESULTS: LDS exposure did not cause any sign of necrotic cell death. The MTT assay showed mitochondrial activity increased in THP-1 cells up to 100µg/ml but began decreasing at 200µg/ml. TT1 cells demonstrated no significant change in mitochondrial activity across all concentrations. LDH release by both cell types remained minimal following particle exposure in both cell types and displayed no difference compared to untreated controls. DHE staining revealed an observed increase in red fluorescence in THP-1 cells, indicating increased ROS generation. WGA staining showed an increase in green fluorescence in both THP-1 and TT1 cells, indicating upregulation of cell membrane glycoproteins or increased folding of the cell membrane. THP-1 cells exhibited increased mitochondrial activity and ROS generation, potentially demonstrating a stress or immune response, whereas TT1 cells appeared more resilient and showed no significant response to LDS exposure.

CONCLUSION: This study indicates that neither LMS-1D nor LHS-1D are overtly cytotoxic following an acute exposure of human alveolar cells in vitro. However, the induction of intracellular ROS and mitochondrial activity in THP-1 cells following LDS exposure suggests that these cells might be susceptible to activation by LDS and induce adverse respiratory responses. Such screening methods will help contribute to our understanding of LDS toxicity and exposure risks for researchers, though more research is required to evaluate long-term effects and in vivo relevance.

Keywords: Lunar dust simulant, Cytotoxicity, Pulmonary alveolar cells

[Abstract:0006]

Study on the mechanism of ZDHHC4-mediated ICAM1 palmitoylation modification in the progression of Atherosclerosis aggravated by repeated +Gz exposure

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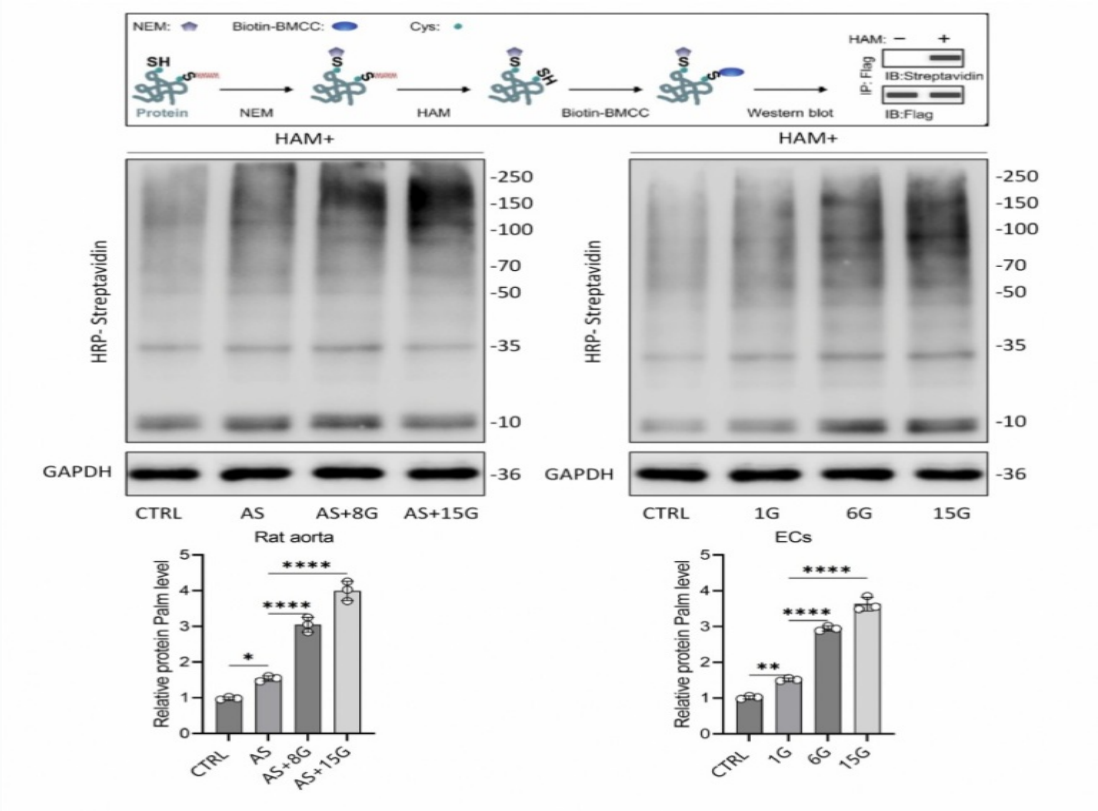
This project addresses a key scientific problem: the molecular mechanisms underlying the increased risk of atherosclerosis (AS) in pilots due to repeated exposure to long-term positive acceleration (+Gz) remain unclear. Our preliminary animal experiments confirmed that +Gz exposure exacerbates AS progression and revealed that it increases protein palmitoylation levels in aortic tissues. Combined with single-cell sequencing, we found that the palmitoyltransferase ZDHHC4 is significantly upregulated in endothelial cells, accompanied by the enrichment of cell adhesion and oxidative stress pathways. Furthermore, immunoprecipitation-mass spectrometry (IP-MS) analysis indicated an interaction between ZDHHC4 and the adhesion molecule ICAM1. Accordingly, we propose the following scientific hypothesis: +Gz exposure upregulates ZDHHC4, which catalyzes the palmitoylation of ICAM1, thereby enhancing its protein stability and membrane localization. This amplifies monocyte adhesion and vascular wall inflammation, subsequently activating MMP1, and ultimately driving plaque instability. By integrating a custom-built cellular hypergravity device, *Apoe*$^{-/-}$ rat models, and *in vitro* experiments, this project will utilize acyl-biotin exchange (ABE) assays, quantitative proteomics, and site-directed mutagenesis to systematically elucidate the cascade mechanism of "mechanical stimulation–palmitoylation modification–inflammation amplification–ECM remodeling." This study aims to provide a novel theoretical basis and potential intervention targets for the prevention and control of cardiovascular risks in the special occupational population of military aviation.

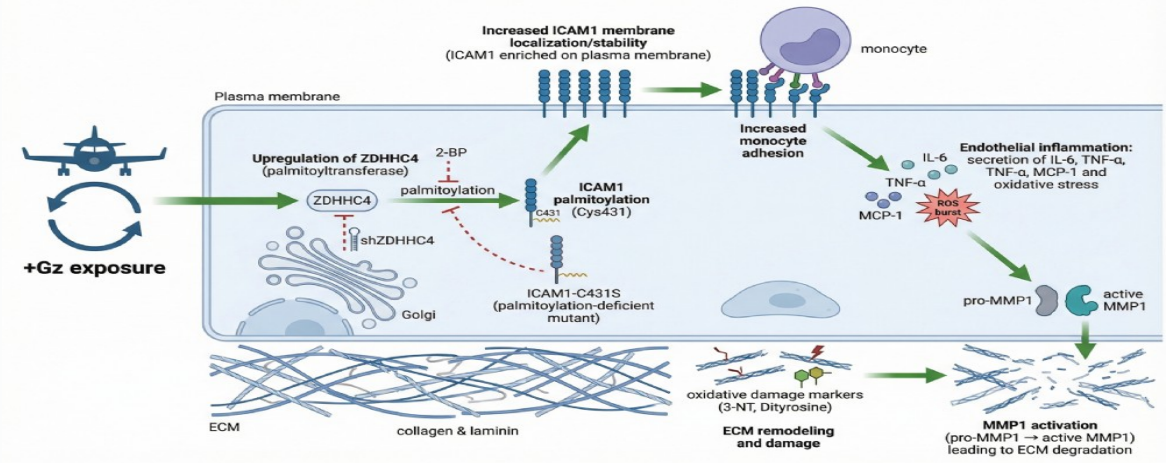
Keywords: +Gz, Atherosclerosis, Palmitoylation, ZDHHC4, ICAM1

Oral Presentations

ABE-Based Palmitoylation Modification Detection

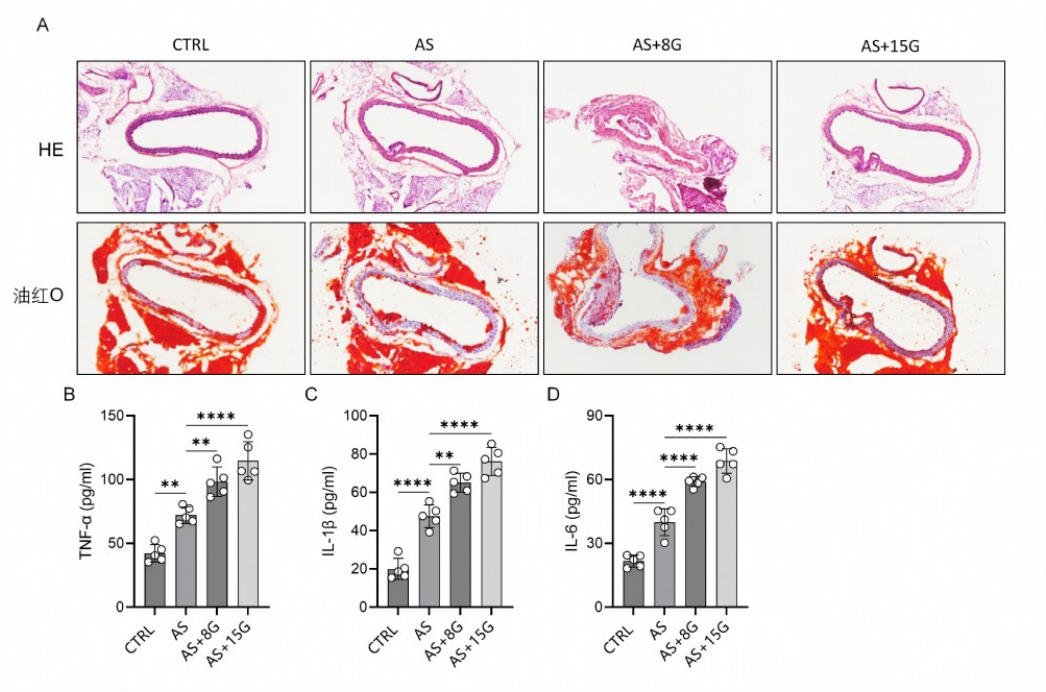


Mechanism of ZDHHC4-Mediated ICAM1 Palmitoylation in +Gz-Exacerbated Atherosclerosis: A Schematic Diagram

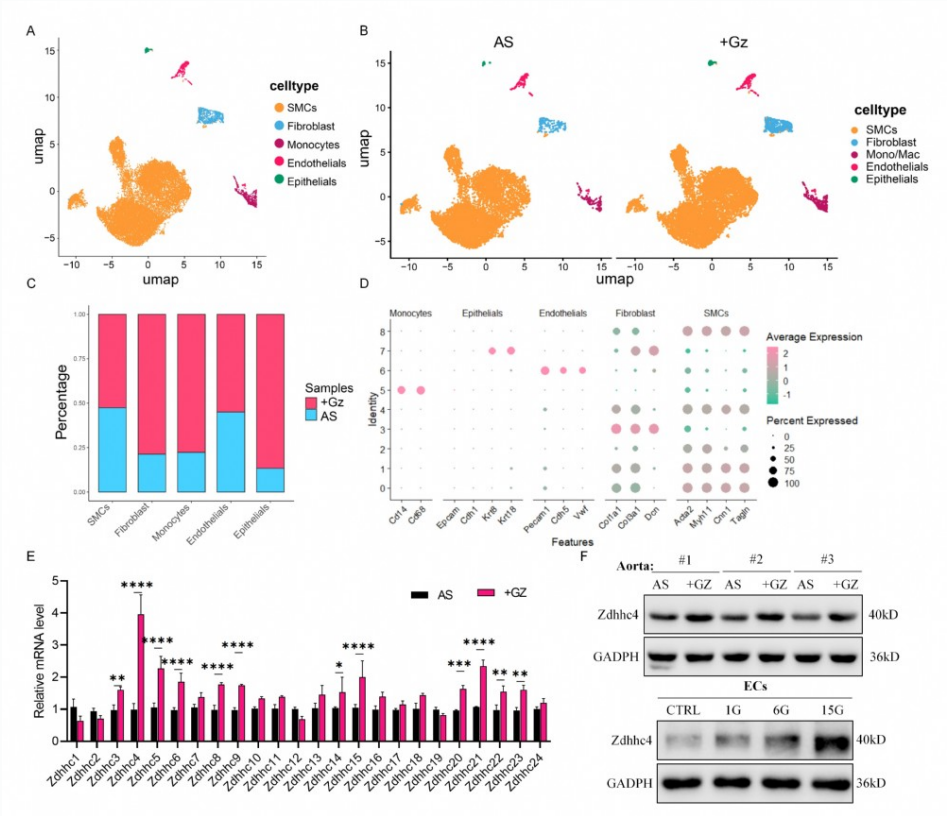


Results of H&E Staining, Oil Red O Staining, and Inflammatory Cytokine Detection in Rat Aorta

Oral Presentations

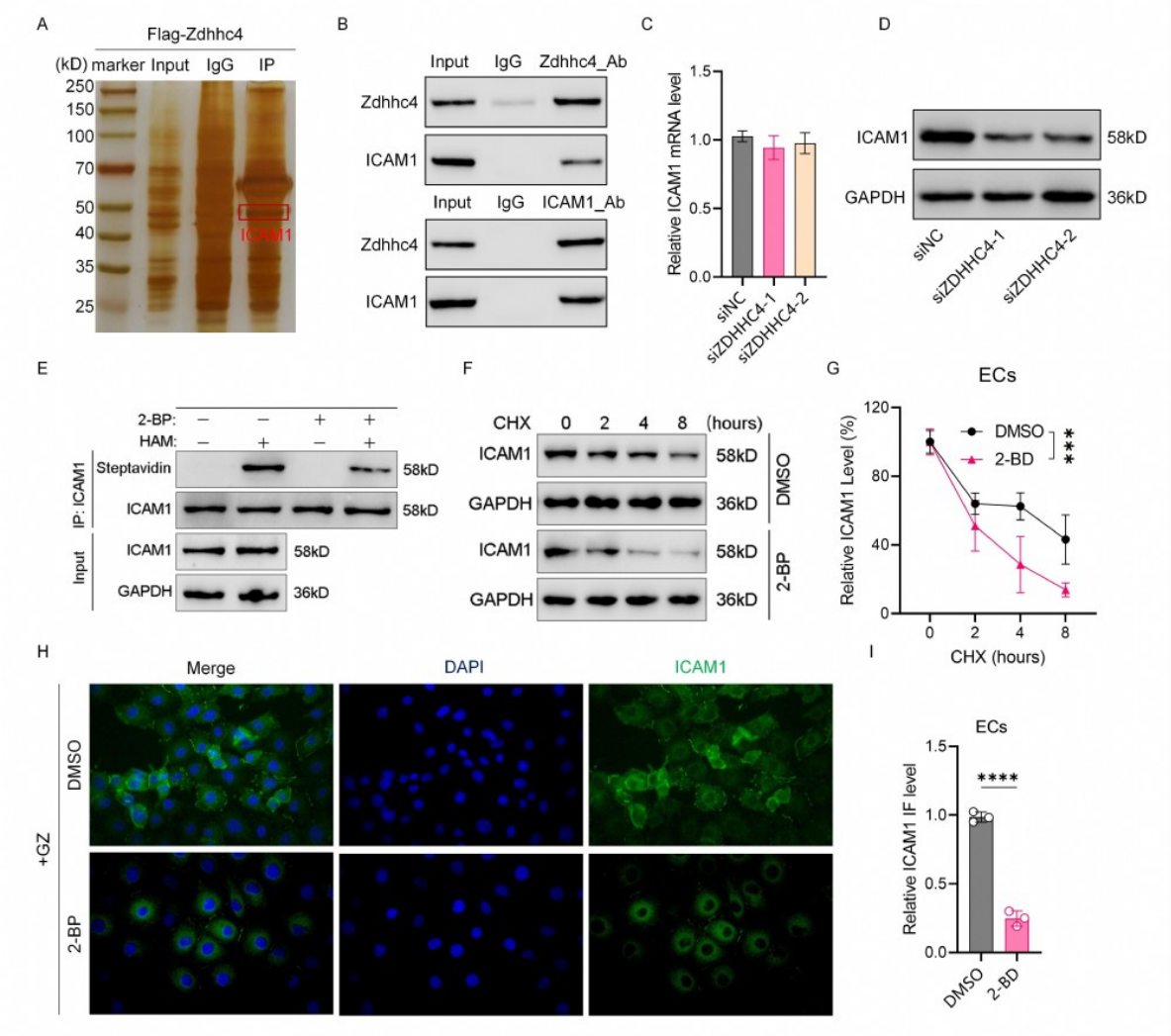


Single-Cell RNA Sequencing of Rat Aorta



Oral Presentations

ZDHHC4 Regulates the Palmitoylation of ICAM1



[Abstract:0008]

Impact of Simulated Microgravity on Pelvic Blood Flow in Women of Reproductive Age: A Pilot Doppler Study

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This pilot study evaluates the acute effects of simulated microgravity on pelvic blood flow in reproductive aged women using Doppler ultrasound to characterize gravitational influences on uterine and ovarian hemodynamics. Exposure to altered gravity induces cardiovascular adaptations, yet its effects on female pelvic circulation and reproductive organ perfusion remain poorly understood, particularly in the context of longer duration spaceflights and Artemis missions. This pilot study evaluated the acute impact of simulated microgravity on pelvic arterial hemodynamics in women of reproductive age using a 15° head-down tilt (HDT) model. All participants underwent Doppler assessment of bilateral common, external, internal iliac, and ovarian arteries in supine and HDT positions. HDT resulted in modest changes in systemic hemodynamics, with slight increases in blood pressures. Doppler findings demonstrated vessel specific responses predominantly in proximal vessels, including increased systolic acceleration in the right common iliac artery and elevated pulsatility index in the left external iliac artery. Ovarian arteries exhibited high variability without consistent directional changes. These findings suggest that acute gravitational unloading preferentially affects proximal pelvic vessels while preserving distal parenchymal circulation, indicating early vascular adaptation to altered gravity.

Keywords: space medicine, microgravity, women, doppler, reproductive organs

[Abstract:0010]

Innovations in Public Health Event Multi-Layered Risk Reduction Strategy: An Update

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Aerospace Medical Association (AsMA)

BACKGROUND: Public health events continue to challenge the aviation system through risks of infectious disease transmission, operational disruption, passenger concern, and cross-border spread. Aviation requires layered, practical, and scalable mitigation approaches that can function in occupied environments without degrading safety or operations. This update reviews innovations relevant to a multi-layered public health event risk reduction strategy, with particular emphasis on continuous ultraviolet-C, ventilation, filtration, administrative controls, and risk communication.

Description: This review summarizes evolving strategies that strengthen aviation resilience against respiratory infectious threats and other public health events. Particular attention is given to the role of ultraviolet-C as an adjunct, not a replacement, to existing protections such as aircraft ventilation, HEPA filtration, cleaning protocols, symptom awareness, and public health response measures. Unlike episodic surface cleaning alone, continuous environmental disinfection technologies may provide an additional layer of protection during active operations. Key considerations include engineering safeguards, exposure control, operational feasibility, regulatory acceptability, and integration into a broader Swiss cheese style risk reduction framework.

DISCUSSION: A multi-layered strategy remains the most practical and defensible approach for aviation public health preparedness. Emerging technologies, including properly engineered UV-C applications, may help reduce transmission risk while supporting passenger confidence and system continuity. Their value is greatest when incorporated into a broader framework that includes surveillance, layered environmental controls, evidence-based policy, and clear public health communication. This update highlights the need to match mitigation tools to operational use cases and to continue evaluating effectiveness, safety, and implementation pathways. The aviation sector should remain forward-leaning in adopting scalable innovations that strengthen preparedness for future public health events.

Keywords: Aviation medicine, infectious disease, risk reduction, layered mitigation, UV-C, pandemic preparedness

[Abstract:0011]

An Initial Exploration of Burnout in Aviation Personnel: Air Traffic Control

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INTRODUCTION: Since identification of a "burnout syndrome" and development of the most widely used Maslach-Jackson burnout inventory (MBI-HS & GS) additional measures have been introduced. In 2019 WHO included burnout in the ICD-11framework as a phenomenon that occurs in an occupational context because of chronic workplace stress. It is not a medical condition. International interest has expanded to identifying the extent and nature of burnout in most occupations (1,120,000 Google Scholar results 1976 to 20026). Estimates of US and international workers experiencing heightened levels of burnout range from 45-55%. This investigation was designed to identify studies where authors used a burnout scale to assess burnout in aviation personnel.

METHODS: Using key words of burnout in pilots, cabin crew, flight attendants, air traffic controllers, maintenance, security and other personnel, searches of Google Scholar, Pub Med, and Psych Info literature were made. Additional articles were added following review of the identified articles. Number of English language studies included in the review is 132. This presentation will be focused on the 18 studies of air traffic controllers.

RESULTS: The ATC studies were from the US and 11 other countries. Burnout measures included: MBI-GS (8 studies), Polish version of the Link BO inventory (3 studies), a Bounceback-Burnout measure (3 studies), Rome Burnout Inventory, and the BAT. Another two studies were focused on emotional exhaustion and/or fatigue. A study from Iran described results from use of intensive short-term psychotherapy with controllers who had high burnout scores. The first assessment of burnout in aviation personnel involved US ATCSs (Rose, Jenkins, and Hurst, 1978). A systematic three-year review of controller health and well-being with a four item bounceback-burnout measure, lower scores on a work satisfaction measure, competency ratings from colleagues, and evidence of work pathology during psychiatric interviews. ATCSs who were not burned out (97), partial burnout (115), or burned out (35/346). A revised scoring procedure for the bounceback-burnout questionnaire was subsequently used to assess striking and non-striking ATCSs in 1982 as well as ATCSs who responded to the nationwide FAA Employee attitude surveys in 1984 and 1986. Evidence for age-related changes and other demographic factors was identified, support was also found for the impact of the job demands and job resources (JDR) model. While most studies associated burnout with various occupational and family stressors, a recent meta-analytic analysis has questioned that approach. Issues associated with weakness in application and use of burnout measures will be identified.

Keywords: Burnout, stress, job demands, resources, performance

[Abstract:0012]

Aeromedical Challenges in Fitness-to-Fly Assessment of a Pilot with Elevated Lipoprotein(a)

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BACKGROUND: Coronary heart disease (CHD) is a significant problem in both civil and military aviation. Cardiovascular disease (CVD) remains one of the leading causes of in-flight incapacitation, which makes cardiovascular risk assessment particularly important in pilots. As a professional group, pilots are exposed to various factors that may increase the risk of heart disease. Lipid disorders are still one of the least controlled risk factor for CVD. In this context, lipoprotein (a) recognized as an independent and strong cardiovascular risk factor is becoming increasingly important in the diagnosis and treatment of pilots.

CASE: We present the case of a 33-year-old civilian pilot after an acute coronary syndrome (ACS), with hyperlipoproteinemia (a) that was unresponsive to standard lipid-lowering therapy. Laboratory tests during ACS have shown hypertriglyceridemia (589 mg/dl) and hyperlipoproteinemia (a) (80mg/dl) with normal LDL and HDL cholesterol levels. Antiplatelet therapy, statin, fenofibrate and beta-blocker were initiated. The patient demonstrated good compliance to the prescribed therapy and lifestyle recommendations. However, despite this, follow-up laboratory tests were shown: Lp(a) 158 mg/gl, TG 63 mg/dl, LDL-C 66 mg/dl, HDL-C 33 mg/dl, TC 112 mg/dl. For hyperlipoproteinemia (a) (HLPa), he was qualified for lipoprotein apheresis (LA). To date, the patient continues to undergo regular LA procedures, showing a very good response to treatment, with approximately 70% reduction in Lp(a) levels, reaching minimum values of 49 mg/dl.

DISCUSSION: The case is characterized by a high degree of complexity in terms of medical assessment due to the use of lipoprotein apheresis. The application of the apheresis has not yet been described in relation to flight personnel in the available literature. Aviation medicine examiner (AME) has to take an individual approach to each medical case and, at the same time, strictly complying with the applicable medical certification regulations. The pilot's state of health remains inextricably linked to flight safety, which the AME is required to take into account each time when assessing the pilot's fitness to fly.

Keywords: lipoprotein, aviation, coronary artery disease, pilot

[Abstract:0024]

Biomechanical characterization of gait patterns under simulated hypogravity conditions using a LBPP treadmill

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[2]CIPER,Universidade de Lisboa Faculdade de Motricidade Humana, Estr. da costa, 1495-751 Cruz Quebrada,

INTRODUCTION: Human space exploration exposes astronauts to reduced gravitational loading, leading to musculoskeletal deconditioning, altered neuromotor control, and increased injury risk during extravehicular and surface operations. While microgravity effects are well documented, gait mechanics in partial-gravity environments such as the Moon (0.20 g) and Mars (0.38 g) remain insufficiently characterized. Understanding these adaptations is essential for designing effective countermeasures, spacesuits, and mission protocols. This study aimed to quantify spatiotemporal and kinematic changes in human gait under simulated hypogravity to identify biomechanical risks and targets for intervention.

METHODS: Thirteen healthy adults (aged 18–35 yr; both sexes) performed consecutive 3-min walking trials at 3.2 km·h⁻¹ under four gravity conditions using the AlterG® lower-body positive-pressure treadmill: Earth (1 g), Mars (0.38 g), Moon (0.20 g), and return-to-Earth, each performed with and without a 5% incline. Three-dimensional kinematics were obtained via Xsens wearable motion sensors positioned on the pelvis and lower limbs. Spatiotemporal parameters (step length, cadence, stance and swing duration) and joint angles (hip, knee, ankle) were extracted for each condition. Nonparametric Friedman tests with Wilcoxon post-hoc comparisons and Bonferroni correction assessed differences across gravity levels. Ethics approval was granted by the Faculty of Human Kinetics, University of Lisbon (CEIFMH No. 3/2023), and informed consent was obtained from all participants.

RESULTS: Hypogravity produced significant gait alterations relative to 1 g. Lunar simulation increased step length by 8.5% and swing duration by 15.9%, while step frequency decreased by 7.7%. Hip and knee range of motion increased by 19.7%, ankle dorsiflexion decreased, and knee adduction rose by 33.4%. Martian gravity elicited similar but attenuated changes. Gait mechanics upon return to 1 g were not significantly different from baseline.

DISCUSSION: Decreasing gravitational load drives a shift toward slower, stability-focused gait patterns, characterized by increased frontal-plane control demands. These biomechanical adaptations highlight critical considerations for spacesuit joint design, in-mission exercise countermeasures, and habitat task planning. The findings also inform terrestrial rehabilitation and training programs using body-weight support systems.

LEARNING OBJECTIVES: 1. Describe how partial-gravity environments (Moon and Mars) alter human spatiotemporal and joint-level gait mechanics. 2. Identify biomechanical parameters essential for designing effective hypogravity exercise and suit-mobility countermeasures with implications for terrestrial rehabilitation and athletic training.

Keywords: Hypogravity, gait, biomechanics, moon, mars, lbpp treadmill

[Abstract:0025]

Sleep Quality in Flight Personnel: Impact of Operational Workload and Implications for Aviation Safety

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[2]Occupational Medicine Department - University of Insubria - Varese - Italy

INTRODUCTION: Sleep is a fundamental physiological process essential for maintaining psychophysical balance and ensuring operational safety in aviation. Flight crew members are routinely exposed to circadian misalignment and irregular duty schedules, conditions known to impair cognitive performance and increase the risk of operational errors. This study aims to assess sleep quality and the prevalence of excessive daytime sleepiness (EDS) among flight personnel, with a focus on the impact of different operational workloads.

METHODS: In this cross-sectional observational study, 549 pilots undergoing aeromedical evaluation at the Cavok Medical Center between February and May 2025 were assessed using validated instruments, including subjective sleep quality measures and the Epworth Sleepiness Scale (ESS). Lifestyle factors and psychosocial stressors were also collected to identify determinants of sleep impairment. Comparative analyses were conducted between Long-Haul (LH) and Short-/Medium-Haul (SH) operations to evaluate workload-specific effects.

RESULTS: A total of 549 pilots were included in the analysis. Preliminary findings indicate a high prevalence of sleep disturbances among flight crew members. Significant differences emerged according to operational type: Long-Haul crews reported higher levels of chronic fatigue and circadian misalignment, whereas Short-/Medium-Haul operations were more frequently associated with acute workload-related fatigue. Regular physical activity appeared to be a protective factor, while smoking, alcohol consumption, elevated body mass index (BMI), and snoring were associated with poorer sleep quality.

DİSCUSSİON and CONCLUSIONS: These findings identify pilots as a high-risk population for sleep disorders. Adequate sleep is critical for maintaining situational awareness, while fatigue acts as a multiplier of human error. Targeted preventive strategies, including objective sleep monitoring, multidisciplinary interventions, and longitudinal research, are warranted. Furthermore, continued development and implementation of Fatigue Risk Management Systems (FRMS) are essential to mitigate safety risks.

Keywords: Sleep Disorders, Circadian, Rhythm Fatigue

correlation between regular physical activity and sleep quality

Physical activity	N	Mean SQ	SD	t-statistic	p-value
Yes (≥2x/week)	421	8.22	1.13	-3.628	<0.001
No	128	7.80	1.14	—	—

Table 4. Correlation between regular physical activity and sleep quality (N=549).

correlation between sleep quality and subjective insomnia indicatorrs

Variable	N	Mean SQ	SD	t-statistic	p-value
Sleep duration 5-7 hours	311	7.78	1.18	-9.196	<0.001
Sleep duration ≥8 hours	235	8.61	0.84	—	—
Difficulty falling asleep (No)	535	8.18	1.08	6.799	<0.001
Difficulty falling asleep (Yes)	14	6.14	1.83	—	—

Table 2. Correlation between sleep quality (SQ) and subjective insomnia indicators.

self-rated sleep quality by operational category

Operational category	N	Mean SQ	SD	F (ANOVA)	p-value
Short/Medium-Haul	—	8.13	1.15	42.7	<0.001
Long-Haul	—	7.83	0.98	—	—
Difference (Δ%)	—	-0.30 (-5%)	—	η^2=0.078	—

Table 3. Self-rated sleep quality by operational category (N=549).

[Abstract:0027]

Why Aircraft are safer than boats: Comparative R_0 Modeling of Hantavirus Transmission in Aircraft and Expedition Cruise Ships

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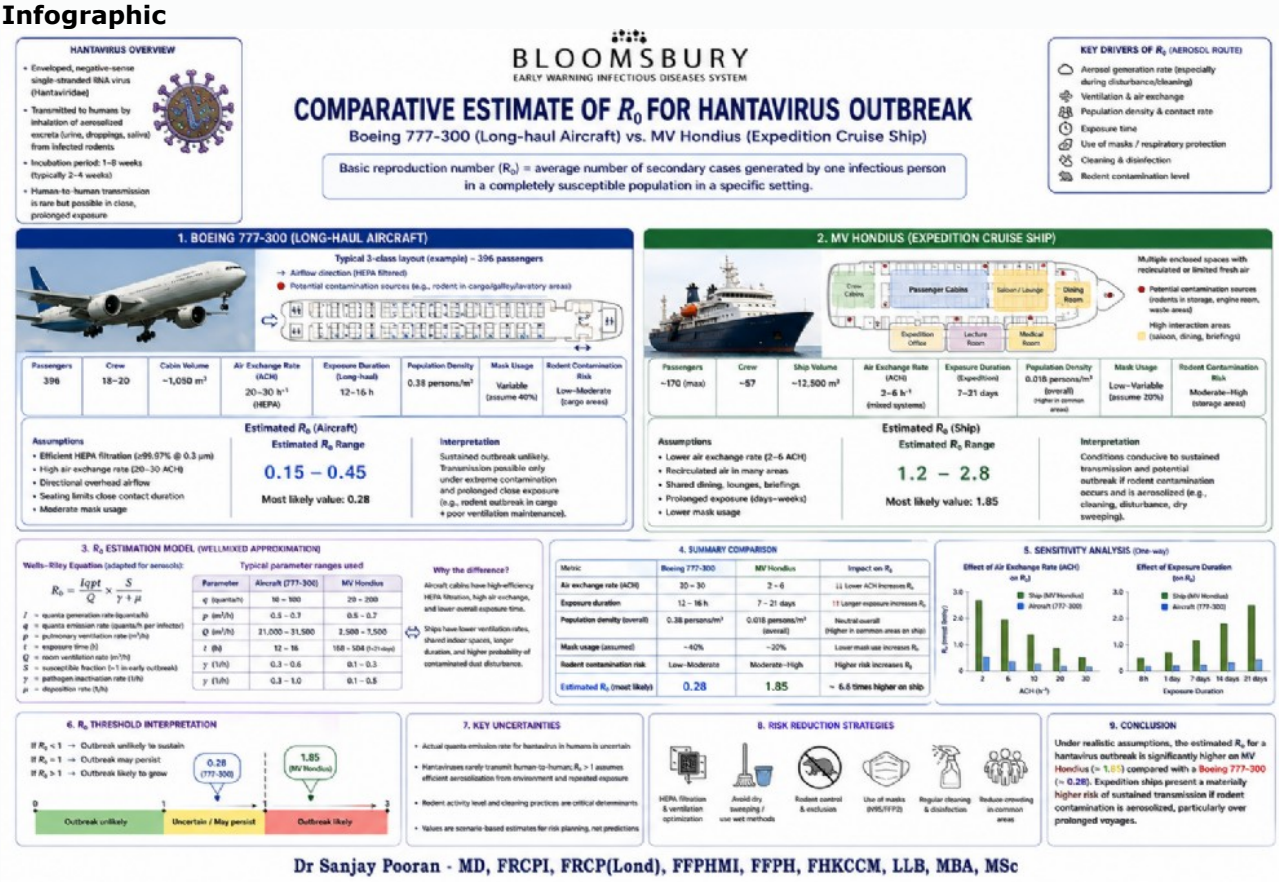
Hantavirus transmission within enclosed transportation systems remains an underexplored but increasingly important public health concern, particularly in environments where aerosolized rodent excreta may accumulate and where prolonged human exposure occurs in confined indoor spaces. While modern commercial aviation is often perceived as high risk for infectious disease spread because of passenger density and extended travel duration, aircraft environmental control systems may substantially reduce airborne transmission potential compared with maritime travel environments. This study presents a comparative estimation of the basic reproduction number (R_0) for a hypothetical hantavirus outbreak in two distinct travel settings: a Boeing 777-300 long-haul commercial aircraft and the expedition cruise ship MV Hondius. A Wells–Riley aerosol transmission model was applied using environmental and operational assumptions derived from ventilation characteristics, exposure duration, occupancy density, mask utilization, and probability of rodent contamination. The aircraft scenario incorporated HEPA-filtered air circulation, high air exchange rates ranging from 20–30 air changes per hour, predominantly unidirectional airflow, and average exposure durations of 12–16 hours involving approximately 396 passengers. In contrast, the expedition vessel scenario considered lower ventilation efficiency of 2–6 air changes per hour, recirculated air in multiple shared indoor environments, prolonged exposure durations of 7–21 days, and increased likelihood of environmental contamination in storage and service areas. Estimated R_0 values for the Boeing 777-300 ranged from 0.15 to 0.45, with a most likely value of 0.28, indicating that sustained transmission would be unlikely under normal operating conditions. By comparison, estimated R_0 values aboard MV Hondius ranged from 1.2 to 2.8, with a most likely value of 1.85, suggesting significantly greater potential for sustained outbreak propagation if aerosolized contamination were introduced. Sensitivity analyses demonstrated that exposure duration and ventilation efficiency were the dominant variables influencing transmission risk. Lower mask utilization and prolonged occupancy of common indoor areas further amplified outbreak potential aboard the vessel. These findings suggest that modern aircraft may offer substantially greater protection against aerosol-transmitted hantavirus infection than expedition cruise ships because of superior ventilation engineering, HEPA filtration, directional airflow systems, and shorter exposure periods. The findings also reinforce the need for integrated infection prevention policies in maritime expedition travel, including environmental surveillance, rodent control programs, wet-cleaning protocols, passenger density management, and enhanced ventilation standards during prolonged voyages in remote regions where medical evacuation and outbreak containment may be challenging.

Keywords: hantavirus, aerosol transmission, aviation medicine, expedition cruise ships, Wells–Riley model, airborne infection

Oral Presentations

Infographic



Dr Sanjay Pooran · MD, FRCPI, FRCP(Lond), FFPHMI, FFPH, FHKCCM, LLB, MBA, MSc

This infographic compares the estimated basic reproduction number (R_0) for a hypothetical hantavirus outbreak in two very different environments: a British Airways 777-300 long-haul aircraft and the MV Hondius expedition cruise ship. R_0 represents the average number of secondary infections caused by one infected person in a fully susceptible population. If R_0 is below 1, sustained transmission is unlikely. If it exceeds 1, an outbreak may continue to grow. The aircraft scenario produced an estimated R_0 range of 0.15 to 0.45, with a most likely value of 0.28. This suggests that a hantavirus outbreak on a modern long-haul aircraft would probably remain limited. Several factors contribute to this lower risk: high-efficiency HEPA filtration, rapid air exchange rates (20 to 30 air changes per hour), directional airflow, relatively short exposure duration (12 to 16 hours), and high assumed mask usage. Although contamination could occur in cargo or galley areas, the cabin environment overall is designed to reduce airborne transmission. In contrast, the MV Hondius cruise ship showed an estimated R_0 range of 1.2 to 2.8, with a most likely value of 1.85. This indicates conditions that could support sustained transmission and potential outbreaks. Cruise ships have lower ventilation rates, more recirculated air, prolonged exposure over days or weeks, shared dining and lounge spaces, and lower assumed mask use. Rodent contamination risks in storage or waste areas may also increase aerosol exposure if infectious material becomes disturbed. The comparison highlights how environmental and operational conditions strongly influence infectious disease spread. The infographic concludes that ventilation quality, exposure duration, crowd density, and contamination control are major drivers of transmission risk. It also emphasizes that these estimates are scenario-based models intended for planning and risk assessment rather than precise outbreak predictions.

[Abstract:0028]

Interpretable Machine Learning for Short-term Coronary Heart Disease Risk Estimation in Airline Pilots

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INTRODUCTION: Traditional aeromedical risk assessment relies on static linear models that may struggle to capture high-dimensional, non-linear interactions within healthy professional cohorts. This study aimed to develop and validate an interpretable machine learning (ML) framework to estimate short-term(within 12 months) coronary heart disease (CHD) risk.

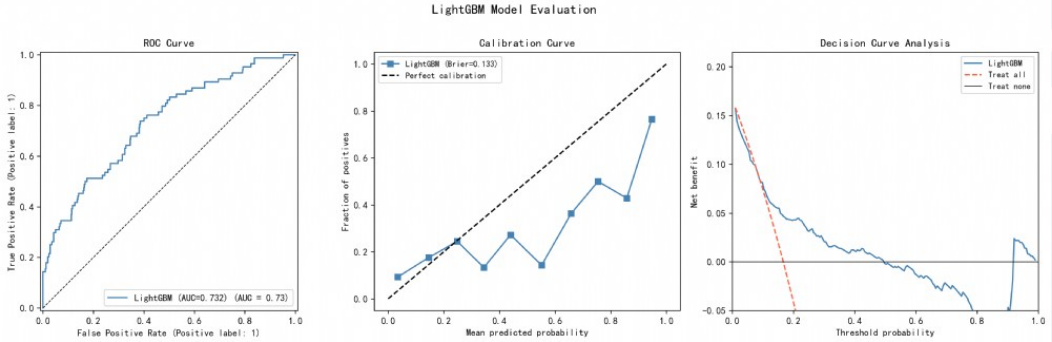
METHODS: A LightGBM architecture was implemented for its ability to model non-linear interactions and heterogeneous feature patterns based on a well-characterized physical examination dataset consisting of CHD cases and age-matched controls. To ensure robustness, hyperparameters were optimized via stratified 5-fold cross-validation. Algorithm transparency was achieved through SHAP (SHapley Additive exPlanations) for feature-level attribution, while model reliability was quantified using the Brier Score to evaluate probabilistic performance.

RESULTS: The ML framework achieved an AUC of 0.73 and a Brier Score of 0.133, indicating favorable predictive reliability within a difficult-to-predict cohort. SHAP analysis identified "Recent Flight Hours" as a primary predictive vector; specifically, abrupt changes in recent flight workload were associated with elevated predicted CHD risk—a non-linear pattern undetected by traditional Cox regression ($P>0.05$). While Cox analysis confirmed structural markers like carotid ultrasound ($P<0.05$), the ML model successfully extracted subtle metabolic stress signals (BUN, LDL, DBP) typically attenuated by the "healthy worker effect" in this population. Decision curve analysis demonstrated that the LightGBM model provided positive net benefit across a clinically meaningful threshold range of 1% to 49%, outperforming both treat-all and treat-none strategies.

CONCLUSION: The combination of an AUC of 0.73 and a Brier Score of 0.133 is particularly meaningful in this population, where rigorous medical screening compresses physiological variance and often attenuates conventional diagnostic signals. This study validates the feasibility of an interpretable ML framework for pilot health surveillance. By integrating occupational telematics with clinical biomarkers, the model supports a transition toward proactive, evidence-based health management. Although further prospective external validation is warranted before operational deployment, implementing this algorithmic stratification into routine aeromedical operations may enhance long-term aviation safety.

Keywords: Explainable AI, LightGBM, Coronary Heart Disease, Aviation Medicine,Occupational Health

Performance metrics of the LightGBM CHD risk prediction model



[Abstract:0029]

The effectiveness of working memory and relaxation training in improving cognitive functions of jet pilots

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INTRODUCTION: Jet pilots, often operate under conditions of extreme cognitive demands and intense pressure. The aim of the study was to examine the effect of two types of interventions, cognitive training (working memory, WM) and relaxation training (using Schultz's autogenic method) on attention and memory performance in military pilots.

METHOD: Forty-one male and female pilots (age: M = 34.55, SD = 7.16; flight time: M = 513.36 h) participated in the study. Participants were assigned to three groups: WM training (n = 13), relaxation training (n = 15), and an inactive control group (n = 13). The interventions consisted of 20 sessions conducted over 5 weeks. Determination Test (DT), Corsi visuospatial test and Cognitrone (COG) task were used to assess the efficiency of attention and working memory.

RESULTS: 1. DT: The relaxation training group showed no significant improvement in reactive attention to rapidly changing stimuli, $F(2, 37) = 2,192$; $p < 0,126$; eta2 = 0,106.
2. Corsi Test: No significant effect of training on memory capacity was found, $F(2, 38) = 0,09$; $p = 0,914$; eta2 = 0,005.
3. COG: No significant effect of training on visual attention was found $F(2, 38) = 2,951$; $p < 0,064$; eta2 = 0,134

CONCLUSIONS: The study did not show any method as a more effective method than the other. The lack of significant changes may be due to the pilots' very high baseline performance, significantly exceeding population norms. The results suggest that we should prepare more demanding tasks and maybe training methods should be tailored specifically for jet pilot needs.

Keywords: relaxation training, working memory training, military pilots, attention

[Abstract:0037]

Long COVID and Return-to-Flight Assessment in Aviation Personnel

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Background

Long COVID has emerged as a significant clinical and occupational health concern following the COVID-19 pandemic. Persistent symptoms including fatigue, cognitive dysfunction, dyspnea, autonomic instability, sleep disturbance, and psychological stress may adversely affect operational performance and flight safety in aviation personnel. The multisystem nature and variable presentation of Long COVID create unique challenges for aeromedical assessment and return-to-flight decision-making. As aviation operations normalize globally, aerospace medicine practitioners increasingly encounter aircrew requiring individualized evaluation following prolonged post-viral symptoms.

OBJECTIVE:
To review the aeromedical implications of Long COVID in aviation personnel and to evaluate challenges associated with return-to-flight assessment and operational readiness.

METHODS: A narrative review of aerospace medicine, occupational medicine, pulmonary medicine, neurology, and rehabilitation literature was conducted. Published evidence regarding persistent post-COVID symptoms affecting cognition, fatigue, cardiopulmonary function, autonomic regulation, sleep quality, and psychological wellbeing was reviewed. Existing aeromedical approaches and operational considerations related to return-to-flight assessment were also examined.

RESULTS: Long COVID symptoms may impair attention, executive function, reaction time, exercise tolerance, and fatigue resilience, all of which are essential for safe aviation operations. Persistent cognitive symptoms (“brain fog”), sleep disruption, autonomic dysfunction, and reduced physical endurance may adversely affect operational performance even after apparent recovery from acute infection. Variability in symptom severity and recovery trajectories complicates standardized aeromedical evaluation. Emerging evidence supports multidisciplinary assessment approaches incorporating cardiopulmonary evaluation, neurocognitive assessment, fatigue screening, and individualized operational risk stratification. Current aeromedical guidance remains heterogeneous across regulatory systems, highlighting the need for more standardized evidence-based frameworks.

CONCLUSION: Long COVID presents complex challenges for aerospace medicine and aviation safety due to its multisystem effects and variable clinical course. Comprehensive multidisciplinary evaluation and individualized return-to-flight assessment are essential to ensure operational readiness and protect flight safety. Continued research is required to better define long-term aeromedical implications and optimize return-to-duty strategies for aviation personnel.

Keywords: Long COVID, Aerospace Medicine, Aeromedical Certification

[Abstract:0041]

Medical Causes of Pilot Incapacitation: Aeromedical Challenges and Implications for Flight Safety

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Background

Pilot incapacitation, whether sudden or subtle, represents a significant concern in aviation safety and aerospace medicine. Although catastrophic in-flight incapacitation events are relatively uncommon, even mild or transient impairment may adversely affect situational awareness, decision-making, communication, and operational performance. Medical causes of incapacitation may include cardiovascular disease, neurological disorders, hypoxia, fatigue, metabolic disturbances, medication effects, psychological conditions, and acute illness. As commercial aviation operations become increasingly complex and the pilot workforce continues to age, early recognition and risk stratification of medically related performance impairment remain essential components of aeromedical practice.

OBJECTIVE:
To review common medical causes of pilot incapacitation and to evaluate associated aeromedical and operational implications relevant to aviation safety.

METHODS: A narrative review of aerospace medicine, cardiology, neurology, occupational medicine, and aviation safety literature was conducted. Published evidence regarding acute and chronic medical conditions associated with pilot incapacitation, subtle cognitive impairment, fatigue-related performance degradation, and medication-associated operational risk was reviewed. Relevant aeromedical certification principles and risk mitigation strategies were also examined.

RESULTS: Cardiovascular events, neurological disorders, metabolic abnormalities, fatigue, and medication side effects remain among the most significant contributors to pilot incapacitation risk. While sudden incapacitation events are often emphasized in aeromedical screening, more subtle forms of impairment including fatigue, cognitive slowing, dizziness, and reduced situational awareness may be more difficult to detect yet operationally significant. Aging, polypharmacy, sleep disorders, and chronic occupational stress may further increase vulnerability to performance impairment. Current aeromedical approaches incorporate medical screening, cardiovascular risk assessment, neurocognitive evaluation, and operational risk stratification; however, evolving operational demands continue to challenge traditional assessment models.

CONCLUSION: Medical incapacitation remains a critical concern in aerospace medicine due to its potential impact on flight safety and operational performance. Greater emphasis on early identification of subtle impairment, multidisciplinary risk assessment, and individualized aeromedical evaluation may enhance safety outcomes and support operational readiness in modern aviation environments.

Keywords: Pilot Incapacitation, Aerospace Medicine, Aviation Safety

[Abstract:0043]

An Overview of the Ethics of Artificial Intelligence and New Technologies in Aviation and Space Medicine

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By 2026, the integration of Artificial Intelligence (AI) and new technologies in aviation and space medicine is shifting from conceptualization to operational implementation, bringing critical ethical challenges to the forefront. Key ethical issues center on ensuring safety, maintaining human oversight, managing data privacy, and mitigating algorithmic bias, especially as AI takes on more autonomous roles in safety-critical environments.

The primary concern is that AI systems must be certifiable and highly reliable, with the goal of excluding risk in flight operations. Professionals emphasize that humans must remain in control of decision-making, overseeing systems, and maintaining the power to intervene to avoid deskilling and ensure responsibility. AI systems must be understandable and not act as "black boxes." Explainable AI is crucial for establishing trust and allowing operators to understand AI-driven recommendations. Establishing clear liability for AI-driven decisions is complex, particularly when AI acts autonomously in space medicine or during emergency situations. The use of large datasets for training AI introduces risks of bias, demanding that algorithms be fair and protect user privacy. Over-reliance on automated systems risks eroding pilot and technician skills and increasing dependency in times when AI is absent. Excessive reliance may reduce operator alertness, leading to automation bias and potential errors. Furthermore, professionals are expressing concerns about psychological distress and perceived threats to job security stemming from autonomous AI. Due to communication delays, AI in deep space must act with high autonomy in diagnosing and treating conditions like radiation sickness or surgical emergencies, raising questions about autonomous consent. Ensuring that AI for medical care during missions adheres to, and respects, ethical guidelines set on Earth. On the other hand, Ethics permits the definition of limits that must not be exceeded, but politics sometimes does not take account of ethical considerations. The implications of politics in space involve the issue of sharing data obtained from space. Benefits include the victory represented by successful manned space flights, the enlargement of our field of knowledge, the use of space technologies for meteorological observation purposes and the development of satellite communication. However, those benefits do not diminish the importance of the risk factor. In this regard, the importance of defining a forward-looking strategy founded on objective explanation and identification of risks is evident. This explanation can only be made through ethical principles. In this presentation, we will describe an overview of Ethics of Artificial Intelligence and New Technologies in Aviation and Space Medicine.

Keywords: medical ethics, artificial intelligence, space medicine, ethics, aviation medicine,

[Abstract:0044]

New Perspectives On Global Health and Aviation Through World Medical Association Declarations

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The World Medical Association (WMA) governs global health ethics primarily through the Declaration of Helsinki (ethical research) and the Declaration of Geneva (physician commitment). These, alongside declarations on social determinants and pandemic response, emphasize prioritizing patient well-being, the human right to health, and upholding ethical standards during health emergencies. WMA also asserts that public health is inseparable from individual medical care, demanding that physicians and health systems prioritize disease prevention, health promotion, and the social determinants of health. The intersection of global health and aviation focuses on preventing the international spread of diseases while ensuring safe, efficient air travel. Key organizations like the ICAO (International Civil Aviation Organization) and WHO (World Health Organization) cooperate to manage risks through preparedness, surveillance, and health regulations. Air travel can transport vectors like mosquitoes over long distances, facilitating the spread of diseases like Zika or Hantavirus. The ethics of global health and aviation involves balancing the benefits of rapid international connectivity with the risks of disease transmission, environmental damage, and inequities in access to care. Key ethical considerations include the responsibility of airlines to protect public health during pandemics, the climate justice implications of high-carbon travel, and the safety, security, and privacy of both passengers and crew. Air travel is a primary driver of the rapid international spread of infectious diseases. Ethical frameworks often struggle to balance necessary quarantine or travel restrictions with human rights, such as freedom of movement. The aviation industry faces pressure to prioritize safety over profit (e.g., maintaining airworthiness, ensuring proper maintenance). International law for public health in aviation is not fully harmonized. Enforceable laws are primarily the responsibility of national authorities, leading to inconsistent, sometimes conflicting policies. The WMA insists that global health should not be seen in isolation, as it is intrinsically linked to individual health, health care and medical care. The WMA advocates for the development of integrated health care systems in which both global health and individual health can be addressed. Public health is heavily influenced by a number of social factors and should therefore be approached from a broad perspective. A comprehensive public health approach should take into consideration all social determinants of health, non-communicable disease and lifestyle, in addition to the traditional elements of communicable diseases and sanitation. We will present innovative global health and aviation perspectives via WMA Declarations.

Keywords: Global Health, Aviation Law, WMA Declarations, Healthcare Integration, public health

[Abstract:0045]

Psychosocial factors affecting Turkish flight instructors' and student pilots' perceived stress status

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This study investigated the psychosocial factors affecting the perceived stress levels of 55 flight personnel, including flight students (n = 40) and flight instructors (n = 15) working at a flight school. The study examined participants' perceived quality of life, biorhythm patterns, personality traits, burnout levels, perceived stress levels and coping mechanisms, flight instructors' job satisfaction levels and attitudes towards flight instruction, and flight-related stress factors experienced by flight students and effects of stressors on the students flight performance.

The median age was 47.5 years for flight instructors, and 23 years for student pilots. Of 78.2% (n = 43) was male and 41.8% (n = 23) of the subjects were smokers. The most common flight-related stressors for flight trainees were flight/schedule planning (35%), checkride (35%), flight instructor personality (35%), flight instructor capability (32.5%), and flight instructor availability (30%). The impact of flight-related stressors on flight performance was perceived as a positive factor by 32.5% of the students, while 25% (n = 10) reported it as a negative.

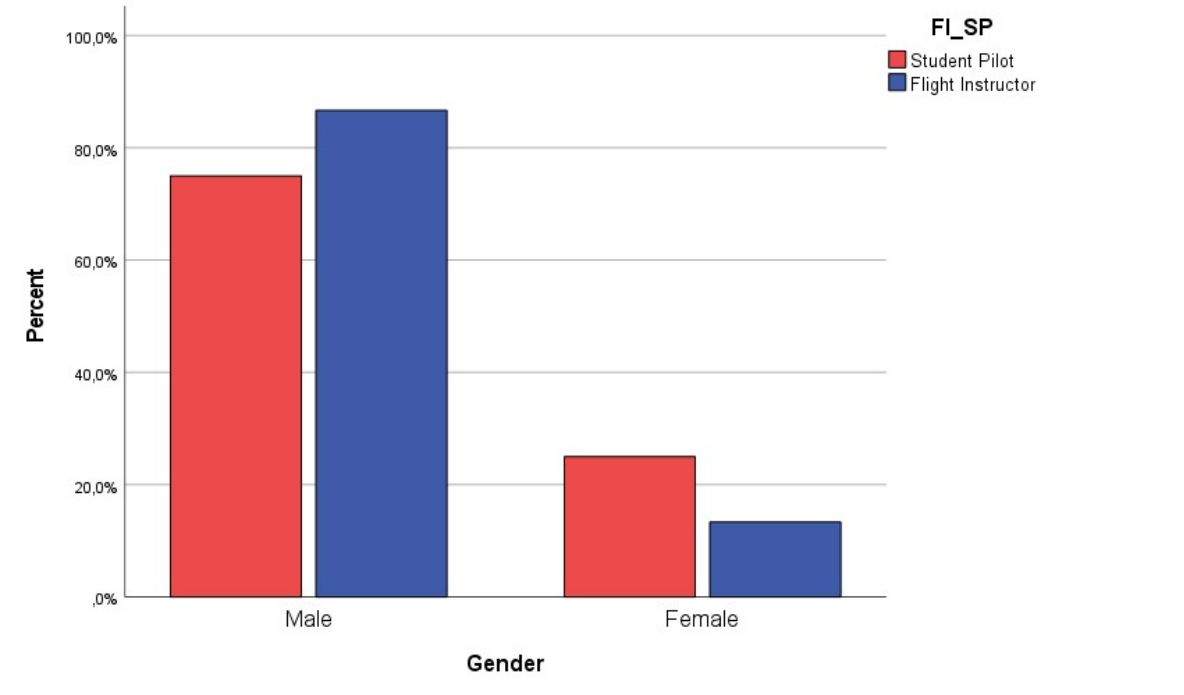
A negative correlation was found between perceived stress of student pilots and their all QoL domains ($p<.001$ for all), and a positive correlation with sleep, activity, social, eating, and total levels of biorhythm ($p<.001$ for all). There was similar findings for flight instructors; a negative correlation between perceived stress and QoL parameters [physical (<.001); social ($p =.045$); environmental ($p =.007$); national ($p<.001$)] and a positive correlation with their sleep ($p<.001$), eating ($p =.031$), and total ($p<.001$) levels of biorhythm scores were found. There was another positive correlation between perceived burnout level of flight personnel and their perceived stress ($p<.001$), and a negative correlation ($p =.002$) between their perceived stress of flight instructors and the level of attitude towards the flight instructor profession.

The logistic regression analysis of factors predicting the level of perceived stress revealed that the only parameter predicting moderate stress perception was the total BRIAN, which indicates irregularity in the biorhythm ($\chi2(5) = 28.58$, $p<.001$; $B =.220$, $OR = 1.245$ [95% CI: 1.054 – 1.472].

The perception of stress, which has the potential to have both positive and negative effects on flight performance, appears to have the potential to contribute to flight safety when considered in the context of biorhythm parameters including sleep, eating, activity and social domains. This study is important since it is the very first study conducting psychosocial factors in this issue in Türkiye.

Keywords: Perceived stress, QoL, BRIAN, burnout, job satisfaction, flight instructor

Gender distribution of student pilots and flight instructors



The predictors of level of perceived stress (binary logistic regression analysis)

						95% C.I.for EXP(B)	95% C.I.for EXP(B)
	B	S.E.	Wald	P value	Exp(B)	Lower	Upper
Psychological QoL	-,248	,270	,843	,359	,780	,459	1,325
BRIAN-Total	,220	,085	6,636	,010	1,245	1,054	1,472
Burnout	,275	,815	,114	,736	1,316	,266	6,506
Job satisfaction	,062	,918	,005	,946	1,064	,176	6,424
ASTP	-,010	,051	,039	,843	,990	,895	1,094

Exp(B): Odds ratio QoL: Quality of Life BRIAN: Biological Rhythm Interview of Assessment in Neuropsychiatry Scale ASTP: An Attitude Scale of Teaching Profession (ASTP) for Flight Instructors

[Abstract:0046]

Real-world impact of the transition to CAD-based colour vision assessment in Turkish aeromedical certification: a 10-year experience from a tertiary referral centre

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Purpose
Conventional colour vision assessment in aviation has relied on Ishihara plates, anomaloscopy, lantern tests and other supplementary examinations. Following implementation of EASA regulations and the introduction of Colour Assessment and Diagnosis (CAD) testing in Türkiye, new applicants and previously certified aircrew were assessed under updated standards. This study examined the impact of CAD implementation on aeromedical certification pathways and outcomes.

METHODS: This retrospective study included Class 1 and Class 2 pilots and cabin crew members referred to a tertiary aeromedical referral centre between 2017 and 2026 following failed Ishihara testing. Applicants underwent CAD testing and additional assessments when indicated. Initial certification decisions were made according to EASA regulations. Renewal assessments were performed according to updated regulations and included medical flight testing (MFT), mock-up evaluations, and the application of operational restrictions (OML, MCL, SSL, and VCL) when required. Applicants diagnosed with dichromacy were considered ineligible for Class 1-2 certification and were therefore not referred for alternative assessment pathways. Operational assessment was restricted to applicants without previous colour vision-related incidents.

RESULTS: Of 827 individuals, 97 had normal colour vision and 730 had confirmed congenital colour vision deficiency; 502 underwent initial assessment and 228 underwent renewal assessment. The initial group comprised 225 Class 1 pilots, 235 cabin crew members, and 42 Class 2 applicants. In the combined Class 1 and cabin crew groups, 237 met certification criteria and 223 did not. Among Class 2 applicants, 9 met criteria directly; of the 33 who failed initial evaluation, 19 subsequently obtained Class 2 certification with VCL restrictions.

During renewal assessment, 56 pilots, 5 Class 2 applicants, and 167 cabin crew members were evaluated. 26 pilots met the criteria directly, 5 were unsuitable because of dichromacy, and 25 underwent MFT. Following MFT, 19 received certification with OML and SSL restrictions, 2 were reclassified as Class 2 with VCL restrictions, 2 failed and had their certificate revoked, and 2 remained under evaluation. Among cabin crew, 60 met the criteria directly; 34 received MCL restrictions, and 73 underwent mock-up assessment. Subsequently, 66 received certification with MCL and SSL restrictions, and 7 failed.

CONCLUSIONS: The introduction of CAD testing substantially changed aeromedical certification pathways in Türkiye for both newly evaluated applicants and previously certified aircrew. Certification decisions incorporated colour vision thresholds together with occupational requirements, previous certification status, and the outcomes of operational assessments when indicated. Our findings may inform future practice in aviation medicine.

Keywords: Colour vision deficiency, Colour Assessment and Diagnosis (CAD), aeromedical certification, aviation medicine, anomaloscopy, occupational vision

[[Abstract:0057]]

Comparative Mammalian Diving Genomics as a Framework for EVA Decompression-Stress Transcriptomics

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C2Space Tech LLC

INTRODUCTION: Decompression sickness remains a mission-relevant risk during extravehicular activity, lunar surface operations, and transitions between spacecraft, suit, and habitat pressure environments. Current countermeasures focus primarily on operational reduction of inert gas burden, but they do not fully explain individual susceptibility or the molecular mechanisms that mediate decompression-stress injury. Diving mammals repeatedly tolerate hypoxia, pressure exposure, vascular redistribution, oxidative stress, and reperfusion during routine dives. This study uses mammalian diving evolution as a comparative framework for identifying hypoxia-inducible factor/decompression stress pathway genes that may inform future transcriptomic models of aerospace decompression risk.

METHODS: We analyzed coding-sequence conservation across 42 candidate genes in the hypoxia-inducible factor/decompression stress pathway across 55 mammalian species, including terrestrial, semi-aquatic, and aquatic taxa. Percent identity values were evaluated using beta generalized linear mixed models and complementary nonparametric analyses. Models tested whether conservation patterns were associated with ecological niche, categorical diving thresholds, or continuous maximum dive depth. Candidate genes included pathways involved in oxygen sensing, vascular regulation, metabolic switching, inflammation, endothelial function, oxidative-stress control, and reperfusion injury.

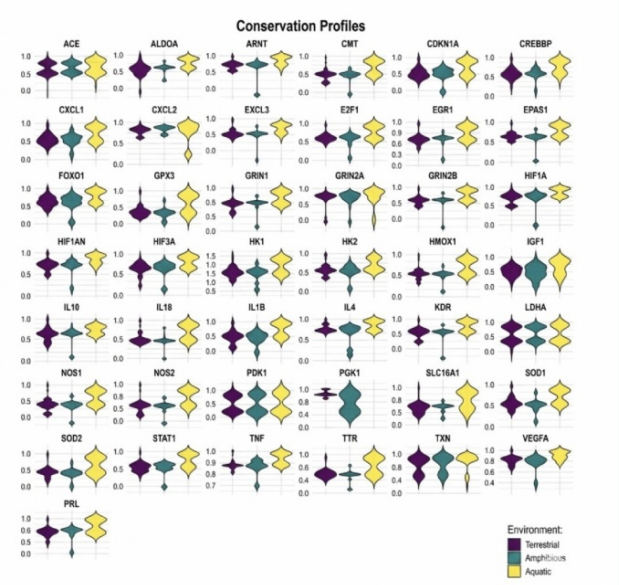
RESULTS: Aquatic taxa showed a broad, cutoff-independent conservation signal across the HIF/DCS pathway, consistent with an aquatic foundation of elevated conservation in oxygen sensing, vascular regulation, and hypoxia-response control. In the global ecological model, aquatic taxa showed higher PID-based conservation than the reference group, $\beta = 0.719$, 95% CI [0.527, 0.912], $p = 2.52 \times 10-13$. Most genes showed categorical conservation shifts across ecological or diving-threshold classes rather than uniform linear scaling with maximum dive depth. HK2 showed the strongest continuous maximum-depth effect, $\beta = 2.146$, 95% CI [0.542, 3.750], p-adj. = 0.014, and NOS2 also showed a supported positive depth-associated slope, $\beta = 0.303$, 95% CI [0.047, 0.559], p-adj. = 0.031. Strong categorical signals included NOS3, TNF, and VHL.

CONCLUSIONS:
These findings support a layered model of decompression-stress adaptation: an aquatic baseline, threshold-associated deep-diving gatekeepers, and rare continuously scaling depth optimizers. For aerospace medicine, these genes provide candidate targets for future experiments exposing human or mammalian cells to decompression-relevant stressors followed by transcriptomic analysis. This approach may help identify pathways involved in endothelial stability, inflammatory activation, nitric oxide signaling, oxidative-stress control, and hypoxia-response regulation relevant to astronaut DCS susceptibility and EVA risk mitigation.

Keywords: decompression sickness, EVA, genetics, prebreathe

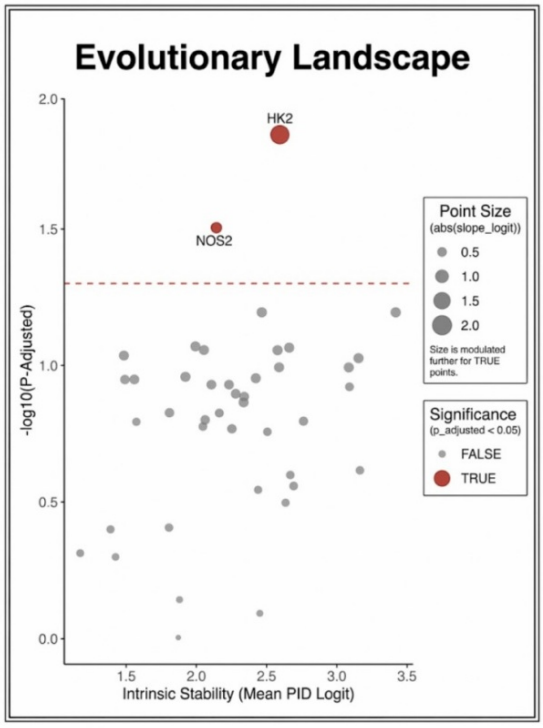
Oral Presentations

Figure 1 — Conservation Profiles



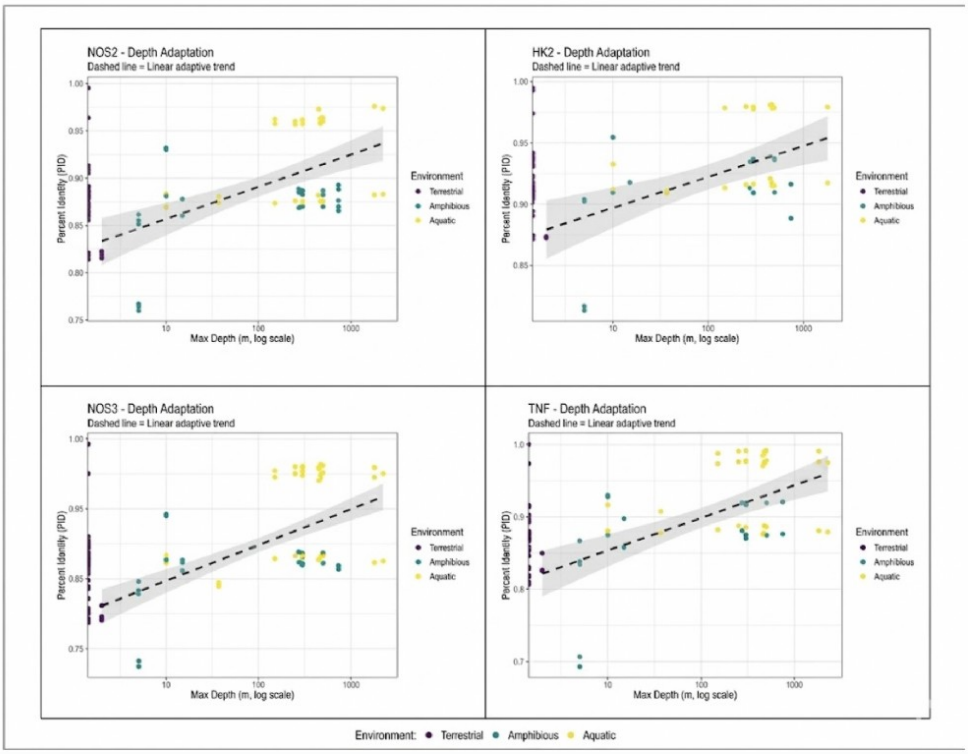
Conservation profiles of candidate HIF/DCS genes across terrestrial, amphibious, and aquatic mammals. Violin plots show percent identity distributions by ecological group, demonstrating broad conservation structure across genes involved in hypoxia response, vascular regulation, oxidative stress, inflammation, and decompression-stress physiology.

Figure 2 — Evolutionary Landscape



Evolutionary landscape of HIF/DCS conservation and maximum diving depth. HK2 and NOS2 exceed the FDR-adjusted significance threshold, identifying them as candidate depth-associated optimizers whose conservation increases with maximum diving capacity.

Figure 3 — Representative Depth-Associated Genes



Representative HIF/DCS genes showing continuous and threshold-associated conservation patterns. HK2 and NOS2 show supported continuous depth-associated conservation, while NOS3 and TNF illustrate strong decompression-relevant pathways tied to vascular tone, nitric oxide signaling, inflammation, and endothelial stress.

[Abstract:0059]

Mental Health Factors in Aviation Accidents/Incidents - A Tool for International Investigators

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Aviation mental health has received increased scrutiny in recent years, reflecting both emerging research on healthcare-seeking behaviors among aviation professionals and heightened awareness following notable mental health–related aviation events, However, most accident investigators currently lack training and standardized methods to assess whether mental health (MH) contributed to aviation incidents and may be uncomfortable addressing this factor without specialized training. The absence of a common approach and data-collection method limits hazard identification and the development of effective safety recommendations. To address these issues, the Accident Investigators' Mental Health Job Aid (AIMHJA) was developed by an international team of researchers. This presentation provides the background and current approach to investigating mental health considerations in aviation incidents. It identifies the expressed need for additional tools for accident investigators to fully consider the possible role of MH. The key goals in providing a tool and the development process are outlined. The presentation will provide a brief overview of the two-tier tool, the Accident Investigators Mental Health Job Aid with the first tier designed for investigators without MH training and the second tier applicable for those with MH and/or human factors experience. Finally, possibilities for incorporation of the AIMHJA into aviation Safety Management Systems internationally will be discussed.

Keywords: accident investigation, mental health, aviation, safety management systems, investigator job aid

[Abstract:0060]

Establishing a Fitness-to-Fly Service and Hypoxic Challenge Test at Srinagarind Hospital: A Multidisciplinary Approach

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Background

Patients with respiratory diseases, cardiovascular conditions, or obesity frequently require assessment of fitness for commercial air travel due to the reduced oxygen partial pressure during flight. With passenger flight volumes increasing at Khon Kaen, a structured fitness-to-fly service has become clinically necessary. Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, therefore developed a formalised, multidisciplinary protocol to address this need.

Overview

Three protocols were developed collaboratively by a team of aerospace medicine physicians and physiologists from the Department of Physiology, together with pulmonologists and respiratory nurses from the Department of Internal Medicine. The first establishes a referral pathway directing patients with respiratory conditions to aviation medicine assessment. Secondly, a hypoxic challenge test (HCT) protocol was designed to be aligned with the British Thoracic Society Clinical Statement on Air Travel. A custom connector between the hypoxicator and patient mask was fabricated using 3D-printing technology to suit equipment configuration. The third forms a professional scope of practice between aerospace medicine and pulmonology: patients who passed the HCT without the history of hypercapnia are evaluated and fill the MEDIF by an aerospace physician, while those requiring respiratory management are co-managed with, or referred to pulmonology.

Discussion

This presentation describes the development and early implementation of a fitness-to-fly service at a university hospital, focusing on protocol design, interdepartmental collaboration, and management of complex respiratory cases. Findings from the initial operational period are discussed as a practical model for institutions seeking to establish a comparable service.

Keywords: Passenger Health, Pre-flight Assessment, Aerospace Medicine Clinic

[Abstract:0061]

Effects of a 60-Day Bed Rest on Cerebral Perfusion Assessed by Arterial Spin Labeling

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INTRODUCTION: Head-down tilt bed rest (HDT bed rest, −6° tilt) is an established model for simulating the physiological effects of microgravity. This positioning leads to a headward fluid shift and induces cardiovascular, muscular, and neurological changes similar to those observed during long-duration spaceflight. While structural and cognitive alterations of the brain in the context of HDT bed rest are well documented, little is currently known about the effects on cerebral perfusion. Pseudo-continuous arterial spin labeling (ASL), a non-invasive MRI technique, enables the quantitative measurement of cerebral blood flow (CBF) and thus provides new insights into the brain's vascular adaptability under simulated microgravity conditions.

METHODS: Within a 60-day HDT bed rest study conducted in the:envihab facility of the German Aerospace Center in Cologne, 23 healthy participants (12 m, 11 f) were examined using ASL at six measurement time points: 6 days before the start of bed rest (baseline); on days 2, 30, and 57 of the bed rest phase; as well as 2 and 12 days after its end (recovery). Cerebral perfusion was analyzed in seven predefined regions of interest (ROIs). In this way, the main hypothesis was tested that a 60-day HDT bed rest period results in reduced cerebral perfusion.

RESULTS: The results show a significant decrease in cerebral perfusion in all 7 examined regions during HDT bed rest compared to baseline. This reduction in cerebral perfusion ranges from 12.4% in central brain structures to 15.5% in the frontal lobe. The most pronounced decline was already observed on day 2, followed by gradual partial recovery up to day 57. Two days after the end of bed rest, an "overshoot" effect was observed, in which perfusion values rose above baseline. Twelve days after remobilization, values had largely normalized. The temporal pattern was consistent across all regions, although interindividual differences were present.

DISCUSSION:
HDT bed rest induces a reversible reduction in cerebral perfusion, followed by a temporary overcompensation after remobilization. These findings underscore the high vascular plasticity of the brain under altered gravitational and positioning conditions. The results are relevant for the preparation of astronaut long-duration missions in space as well as for clinical scenarios involving prolonged immobilization. Further analyses will investigate the relationship between perfusion changes, cognitive function, and neurovascular regulation over time.

Keywords: Bedrest, Head-Down-Tilt Bedrest, Arterial-Spin-Labeling

[Abstract:0062]

Safety of GLP-1RA use for spaceflight, a review of relevant literature

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BACKGROUND: Glucagon-like peptide-1 receptor agonists (GLP-1's) are used for type 2 diabetes mellitus, weight loss, and other emerging indications. These medications work by mimicking the effect of incretin, a peptide hormone secreted by the intestines, which has receptors in multiple organs responsible for its different therapeutic effects. Weight loss is associated with increased insulin sensitivity, reduced hypertension, improved cholesterol levels, and enhanced quality of life which may benefit future commercial spaceflight participants and professional astronauts. Understanding the aeromedical implications of these medications is important.

METHODS: We conducted a focused literature review incorporating position statements and medical certification guidelines from numerous aviation, military, and dive organizations, including but not limited to: National Aeronautics and Space Administration (NASA), United States Air Force (USAF), Federal Aviation Administration (FAA), Diver Alert Network (DAN), Undersea and Hyperbaric Medical Society (UHMS), and Association of Diving Contractors International (ADCI). We also conducted a focused literature review on associated adverse events and the safety of GLP-1 use.

RESULTS: GLP-1's are currently allowed for use by commercial pilots under FAA medical certification standards and would be waiver-able for flight by the USAF, United States Army, and United States Coast Guard. Multiple organizations, including ADCI, do not mention or provide recommendations for GLP-1 use. DAN and UHMS do not specifically mention GLP-1's but provide guidelines outlining safety protocols for recreational divers taking insulin or hypoglycemic agents. Data from ground based meta-analyses and clinical practice guidelines for GLP-1 adverse event management demonstrate most side effects are gastrointestinal and resolve within 12 weeks from reaching the highest dose. Meta-analyses incorporating non-diabetic patients demonstrate rates of approximately 1% for any level of hypoglycemic symptoms with GLP-1 use.

DISCUSSION: While GLP-1's have not yet been used in spaceflight, they are permitted or waiver-able for flight by the FAA and multiple aeromedical branches of the military. These medications demonstrate manageable side-effects after reaching the highest dose. Moreover, the risk of medical incapacitation from serious adverse events, particularly hypoglycemia, falls below the 1% risk threshold commonly applied in aeromedical decision-making. Thus, available evidence supports the conditional safety of GLP-1 use in spaceflight once the highest maintenance dose is reached and the patients have been monitored to ensure side effects are under control or resolved.

Keywords: GLP-1, GLP-1RA, Spaceflight, Safety, Hypoglycemia

[Abstract:0065]

Looking At the Ethics of Drone Operations: Did We Really Think About It?

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Drone operations raise critical ethical questions regarding privacy, surveillance, accountability, and the dehumanization of violence. Key ethical pillars include adhering to international humanitarian law (distinction, proportionality, precautions), ensuring privacy and data protection maintaining human oversight over lethal weapons, and minimizing physical harm to individuals. Drones can violate privacy by enabling constant monitoring and collecting personal data, turning citizens into data points. In military contexts, drone use can lead to targeting errors and civilian "collateral damage" while removing the risks to the user, creating a "risk-free" mode of killing. The use of drones can reduce the enemy to a digital target, potentially lowering the threshold for the use of force. Operators must manage personal data ethically. The use of surveillance drones by police raises questions about civil liberties, warrant requirements, and potential abuse of power. In humanitarian settings, drones must be used responsibly, with care for local communities. Operators should be transparent about their operations and respect the privacy of people on the ground. Operators are expected to keep their skills sharp and their equipment in good repair. Personal data collected should be handled in accordance with privacy laws. In lethal operations, human oversight is considered critical for accountability. Using drones to avoid putting people at risk, such as in rescue missions. Avoiding flying over private property and avoiding recording people without their permission. In the modern world, warfare has undergone a profound transformation, both in form and in concept. In particular, drone technology has deeply shaken the ethical and political dimensions of classical warfare. Traditional understandings of war, state-centered, symmetrical, and defined by borders, have been seriously questioned since the second half of the 20th century. Identifiable actors have increasingly been replaced by anonymous armed structures, technology-based methods of killing, and progressively more lawless practices of violence. Today, rather than defined borders, frontlines, or declared enemies, there exists a constant state of violence across dispersed geographies. Drones, originally mean “male bees that do not produce honey”. They also denote a monotonous, buzzing sound. These devices have triggered profound transformations in the spatial, temporal, and ethical dimensions of warfare. In this paper,we will present an overview on the ethics of drone operations.

Keywords: drone operations, ethics, humanitarian law, drone technology

[Abstract:0066]

Case report of a long haul commercial passenger flight encountering two separate medical diversions in succession

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This is a case report based on my personal experience as a passenger, of an unusual incident where two separate medical diversions were encountered in a long haul commercial passenger flight from Doha, Qatar to Philadelphia, USA. The first diversion resulted from a medical emergency occurring soon after departure from Doha. The aircraft landed at Rome, Italy and all passengers and aircrew had to disembark for an overnight stay because crew duty hours would be exceeded. The same aircrew and most of the passengers boarded the same aircraft next morning to continue the flight to Philadelphia. The second diversion resulted from a medical emergency occurring soon after departure from Rome. The aircraft landed at London, UK where the aircraft was on ground for a few hours while the passenger was transported off the aircraft. The flight subsequently arrived at Philadelphia with a total travel time of 49 hours, instead of the originally planned 15 hours. The first medical diversion involved an elderly passenger with chronic illnesses, who missed medication and was not eating well. The second medical diversion involved an elderly passenger who seemed to have suffered an aggravation of chronic illnesses due to lack of adequate rest and sleep from the overnight stay caused by the first medical diversion. This presentation discusses not only the challenges posed on the passengers and staff during a medical diversion but the possible impact of one medical diversion on the occurrence of another. While the airline and airport staff worked diligently, medical diversion resulting in an overnight is a difficult situation to manage, posing heavy stress on passengers and staff. The patient involved in the second diversion spent the night at the airport and did not have regular meals. This seems to have contributed to the manifestation of symptoms requiring immediate in-flight medical management. Because the flight was delayed by a day, a new flight number was assigned. This masked the fact that the same aircraft, aircrew and passenger cohort were involved in two medical diversions within the same journey. While a double medical diversion is a rare event, with the aging population and the ease of travel by population of diverse demographics, recurrence may be a possibility in the future. However, they may appear as separate, independent incidents because of the way data may be captured.

Keywords: Medical Diversion, Commercial Flight, Long Haul

[Abstract:0078]

Human first, pilot second: working with aviation psychologists

Margaret Anne Oakes
Oaktree Psychology Referrals

Led by an airline pilot and UK HCPC Registered Counselling Psychologist, Dr Margret Oakes, this tutorial will provide an introduction to the clinical work of psychologists working with pilots who report mental health and other psychological challenges during their career. It is designed to support the work of AMEs in particular but will also be relevant to pilots, regulators and pilot managers. Starting with an overview of the regulatory environment and epidemiology, the tutorial will use a fictional case study to illustrate a typical pathway through classification as unfit, psychological therapy, reclassification as fit and return to work. It will also examine the way in which appropriately qualified psychologists can support both AMEs and airline managers. The fictional case study will be used to illustrate the assessment of a pilot applicant who reports significant psychological challenges and consider regulatory acceptable means of compliance (AMCs) for assessment and treatment. It will describe assessments at the start of careers, when presenting as unfit and when requesting recertification as fit. Time permitting, it will also consider the psychological assessment of cabin crew and applicants who report a diagnosis of neuro-diverse presentations such as autism or ADHD. Providing an overview of treatment, the tutorial will review evidence based and NHS approved options illustrated by the fictional case study. Finally, it will discuss the return to work process. Throughout the tutorial, the fictional case study will provide an engaging illustration of both how an aviation psychologist might work with a pilot and the interaction between pilot, AME, regulator and psychologist.

Keywords: Pilot Mental health, aviation psychology, psychological assessment, psychological treatment

[Abstract:0079]

Physiologic episodes in high-performance aviation: the state of the science

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BACKGROUND: In-flight physiologic episodes (PhysEps) among high-performance aircraft pilots have classically been attributed primarily to hypoxia or g-induced loss of consciousness (GLOC). Accordingly, training, pilot selection, and incident response investigations have been centered around this paradigm. However, multiple PEs among 4th- and 5th-generation fighter pilots have been noted that do not appear to be due to hypoxia or GLOC. A broader understanding of physiologic episodes is needed.

DESCRIPTION: In 2018, a North American Treaty Organization (NATO) working group was formed to create a consensus understanding of PhysEps, building on a similar U.S. working group. The focus of the group was to create PhysEp classification criteria (including a case definition), to create a matrix of the relevant exposures present in the tactical aviation environment along with the potential outcomes of those exposures, and to report on the current state of science for PhysEps.

DISCUSSION: PhysEps often represent a normal physiologic response to an abnormal environment, with variable symptom presentation and multifactorial and/or variable causes. However, not all relevant exposures and outcomes are well-understood. This uncertainty and the multifactorial nature of PhysEps suggest that a comprehensive, systematic, and methodical assessment by a specialist is needed to understand the complex interactions between exposures and physiologic responses. Critically, a current understanding of the rapidly evolving state of the science is necessary for assessment of PhysEps. Ultimately, the goal is to design a system that is tolerant of PhysEps while maintaining operations at the edge of the performance envelope.

Keywords: Physiologic Events, Physiologic Episodes, Fighters, High-Performance Aviation, Physiology

[Abstract:0080]

Inflight Medical Events and Flight Duration: Implications for Risk-Based Remote Medical Support and Medical Kit Optimization

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Inflight Medical Events (IMEs) remain among the most frequent operational and clinical challenges faced by airlines. While the overall incidence of IMEs has been extensively studied, less attention has been given to the influence of flight duration on the nature, severity, and management requirements of these events. This paper examines the relationship between short-, medium-, and long-haul operations and the spectrum of medical conditions encountered onboard. Our study from May 2025 to May 2026 has shown an incidence of 41.77% IMEs in Long/ultra Long haul flights, 36.71% in medium haul flights and 21.52% in short haul flights. There are some significant differences in the nature of IMEs too in the three categories, which can have impact on contents of medical kits that we need to carry and themedical equipment needed on board.The study explores how risk profiles vary by route structure and how medical kit contents,onboard medical equipment, and telemedicine capabilities can be optimized accordingly, toimprove clinical outcomes.

Keywords: IMEs, Flight Duration, Clinical profiles, Medical Kits, Medical Equipments, Telemedicine

[Abstract:0083]

Investigation on Microbial Contamination Status of Drinking Water and Object Surfaces Aboard Civil Aircraft

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To investigate the status and distribution pattern of microbial contamination in drinking water and on high-touch object surfaces onboard civil aircraft, so as to provide a reference for formulating microbial monitoring, disinfection and prevention strategies for aircraft.

METHODS: Samples of drinking water and frequently-touched object surfaces were collected from aircraft with different flight ranges operated by multiple airlines, followed by bacterial culture and pathogenic bacteria identification.

RESULTS: In this survey, a total of 22 water samples and 997 object surface specimens were collected. The overall qualification rate of drinking water onboard civil aircraft was 85%, and the main contamination issue was the total bacterial count exceeding the standard. For drinking water, the median (P_{50}) of total bacterial count at different sampling points in the cabin was 11 cfu/ml, and no statistically significant difference was observed in the total bacterial count between the forward galley and the aft galley. For object surfaces, the median(P_{50}) of total bacterial counts on tray tables, seat armrests, toilet rings, toilet seats, toilet handrails and washbasin buttons were 1.0 cfu/cm², 1.4 cfu/cm², 20 cfu/item, 30 cfu/ item, 10 cfu /item and 10 cfu /item, respectively. A Statistically significant differences in microbial contamination status were detected across different flight ranges (Z=-1.989, P=0.047). A total of 55 species of pathogenic bacteria and opportunistic pathogenic bacteria were isolated in this survey, and the detection rate of pathogenic bacteria on toilet seats reached 93.8%. The detection rates of pathogenic bacteria for long-haul and short-haul flights were 70.6% and 65.2%, respectively.

CONCLUSION: Certain safety hazards exist in the hygienic status of drinking water and object surfaces onboard aircraft. The contamination status and pathogenic bacteria detection rate on object surfaces vary among aircraft with different flight ranges. Long-haul flights and lavatory facilities exhibit higher levels of contamination and higher risk of disease transmission. It is recommended that routine microbial monitoring on object surfaces and standardized disinfection should be implemented for civil aircraft.

Keywords: Drinking water,porous surface,microorganism

[Abstract:0084]

EXPAND: A Standardized Multi-Domain Biomedical Dataset for Quantitative Risk Modeling in Commercial Human Spaceflight

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Exploration-class missions require medical systems that can detect physiological change, forecast risk, and recommend countermeasures under constrained, partially autonomous conditions. AI-enabled, on-demand pharmaceutical production depends on models linking environmental exposure, molecular state, clinical phenotype, and operational performance. These models are limited by small, inconsistent astronaut datasets. This program addresses that gap by collecting standardized biomedical, behavioral, environmental, and biospecimen data from commercial spaceflight participants before, during, and after flight. EXPAND is a centralized database/biorepository designed to expand research access and establish industry standards.

EXPAND Essential Measures adapts NASA's Standard Measures framework for commercial human spaceflight through a low-burden, cross-mission protocol. The current dataset includes 50 participants, 24 orbital and 26 suborbital, from 20 countries and four commercial providers. EXPAND deploys a consistent, low-burden protocol across missions that captures sensorimotor/neurovestibular assessments (vertical and torsional alignment nulling), cognitive performance (NASA Cognition battery), continuous wearable biometrics (activity, heart rate, SpO_2, sleep actigraphy), ocular health surveillance aligned with SANS protocols, standardized behavioral questionnaires, and comprehensive Space Omics profiling (whole genome sequencing, bulk and single-cell RNA-seq, proteomics via the Olink 5,400-protein platform, 16S rRNA microbiome sequencing, and metabolomics). To date, 17 completed the Space Omics biospecimen and assay pipeline.

EXPAND provides a structured human spaceflight dataset for developing state-aware models of physiological adaptation rather than relying on population averages or isolated endpoints. It aligns physiology, cognitive and behavioral performance, ocular surveillance, and molecular assays across mission phases. This structure can support biomarker discovery, individual risk stratification, and models that infer when a countermeasure may be needed and what therapeutic approach may be appropriate. Rapid post-flight sampling, often within hours of landing, captures transient immune, metabolic, neurovestibular, and fluid-shift responses that may otherwise be missed. These data can inform digital twin models and closed-loop decision systems, although prospective validation will be required before operational use. EXPAND is not only as a commercial astronaut research repository, but translational infrastructure for computational space medicine. By combining standardized phenotyping, longitudinal biospecimens, environmental context, and multi-omic measurements across a diverse commercial participant population, EXPAND creates the data substrate needed to train/test predictive models for exploration health risks. The EXPAND dataset can be used to observe phenotypic and molecular changes to NASA HRR risk categories including SANS, immune system dysfunction, sensorimotor impairment, and behavioral health. Further, this growing dataset can serve as a foundation for individual risk stratification, biomarker discovery, and integrated computational modeling of human health risks during exploration-class missions.

Keywords: Commercial Spaceflight, Computational Space Medicine, Multi-omics, Biomarker Discovery, Risk Stratification, Digital Twins

[Abstract:0086]

Republic of Singapore Air Force (RSAF) Targeted Training Regimen (TTR) Programme for Aircrew

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BACKGROUND:
High-G environments pose significant physiological and psychological challenges for aircrew, with occupationally related musculoskeletal (MSK) injuries and G-induced loss of consciousness (G-LOC) remaining critical safety concerns. To provide elite athlete-level support for aircrew, reduce injury risk, and promote long-term G-readiness, RSAF introduced the TTR Programme as part of its Human Performance Maximisation (HPM) Initiatives for aircrew.

DESCRİPTİON:
The envisaged TTR Programme comprises: a. G-readiness Programme: Holistic G-tolerance training for ab-initio trainees by a multidisciplinary team of Aviation Medicine specialists, sports trainers, and performance psychologists over a course of fourteen weeks in Basic Aviation Ground School (BAGS). This approach equips trainees with essential knowledge, skills, and confidence to meet high-G demands, with a primary focus on achieving success in attaining 8G in their first Human Training Centrifuge (HTC) Initial Qualification.b. Remedial Programme: Personalised 1:1 training by professional sports trainers for aircrew with G-related issues (e.g., failure of five G-habituation sessions during BAGS). These are conducted two to three times weekly for up to ten weeks. A total of three trainees successfully passed their HTC requirements post-intervention. Objective improvements in skeletal muscle mass and strength performance were observed, indicating enhanced muscular development relevant to G-tolerance.c. Advanced Programme: Rigorous physical and cognitive training for fighter and helicopter aircrew focused on enhancing capacity to meet platform-specific operational demands. A list of eight cognitive training exercises was designed to target domains such as psychomotor skills, cognitive flexibility, short-term working memory, and attention. These sessions are conducted two to three times weekly over ten weeks, aiming to enhance cognitive resilience under fatigue to improve executive functioning.

DISCUSSION:
The TTR Programme represents a strategic shift from reactive to proactive training. Introducing targeted and comprehensive G-tolerance training at the ab-initio stage fosters sustainable habits, cultivates high-performance mindset in aircrew, and promotes an enduring culture of readiness. Long-term positive health outcomes will translate into career longevity for aircrew across platforms.Measures of effectiveness include (1) improving HTC performance, (2) reducing flying restrictions due to MSK injuries, and (3) tracking of health indices and in-flight performance data. Early data will be analysed and presented.Future efforts will focus on scalability and long-term outcome monitoring. This model offers a replicable framework for other air forces seeking to optimise human performance in high-G environments.

Keywords: Targeted Training Tegime, Human Performance Maximisation, G-Training

[Abstract:0088]

Glymphatic and Perivascular Clearance Dysfunction as a Potential Candidate Convergent Pathway Linking SANS and Neurocognitive Vulnerability During Long-Duration Spaceflight

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Introduction: Glymphatic and perivascular transport contribute to cerebrospinal fluid–interstitial fluid exchange and solute clearance. Their disruption has been proposed as a common pathway linking spaceflight-associated neuro-ocular syndrome (SANS) and neurocognitive vulnerability during long-duration missions. We assessed how directly spaceflight and analogue evidence supports this hypothesis.

Methods: A rapid scoping review was structured with reference to PRISMA-ScR. PubMed was the sole database searched on 1 July 2026, covering publications from 1 January 2010 to that date; supplementary identification used incidental retrieval and targeted citation checks. Eligible human and animal reports assessed tracer kinetics, perivascular morphology, diffusion, contrast enhancement, or aquaporin-4 (AQP4) in relation to spaceflight, bed rest, hindlimb unloading, elevated carbon dioxide, or radiation exposure. Descriptive synthesis distinguished transport measurements from imaging and molecular surrogates. Broader sleep and radiation studies provided mechanistic context.

Results: Screening 106 PubMed records and three supplementary candidates yielded 13 reports: five human and eight animals. Human imaging findings were inconsistent. In one astronaut cohort, eight of 24 participants developed SANS and had larger baseline and postflight perivascular volumes, but proportional increases were comparable between groups. Another astronaut report found no significant SANS association. Bed-rest studies reported either reversible perivascular expansion or no overall change, with exploratory differences by ocular findings. In 12 healthy adults, 1–2% carbon dioxide altered selected brain and ocular contrast-enhancement measures without directly quantifying clearance. Two rat studies showed shorter hippocampal tracer half-life after three days of unloading and longer half-life after seven days but disagreed on diffusion changes. AQP4 responses varied by tissue and exposure. Two reports identified unloading–radiation interactions in AQP4 staining without demonstrating clearance interactions. Two reports detected no water-maze deficits. Regional tracer loss, perivascular morphology, and AQP4 abundance could not establish whole-brain solute clearance. Small samples, overlapping cohorts, and heterogeneous methods limited clinical interpretation.

Conclusions: Current data supports glymphatic and broader perivascular-clearance dysfunction as a plausible and mission-related converging vulnerability pathway during long-duration spaceflight, although direct evidence of impaired in-flight glymphatic solute clearance remains lacking. Longitudinal studies should combine validated transport measurements with standardized ocular and neurocognitive assessments, accounting for sleep, carbon dioxide, radiation, and previous flight experience.

Keywords: Glymphatic system; Perivascular clearance; Spaceflight-Associated Neuro-ocular Syndrome (SANS); Long-duration spaceflight; Cerebrospinal fluid; Neurocognition

Oral Presentations

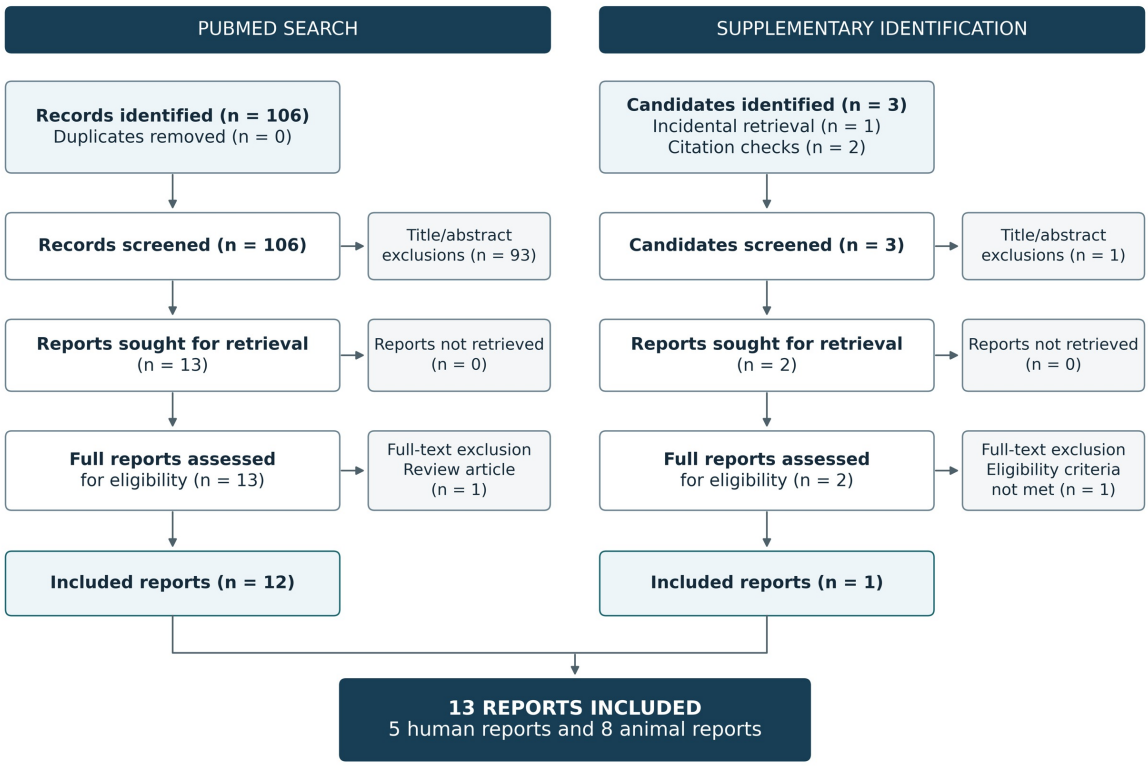

Figure 1. Report selection for the rapid scoping review. The PubMed search was performed on 1 July 2026 and covered publications from 1 January 2010 to 1 July 2026. Supplementary candidates arose through incidental article retrieval and targeted citation checks. All 15 reports sought were retrieved; 13 reports were included, comprising five human and eight animal reports. Counts represent reports and may include overlapping participants or missions.

[Abstract:0089]

Pilot Impairment and Incapacitation in Commercial Aviation: Medical Etiologies and Safety Implications

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INTRODUCTION: Pilot impairment and incapacitation (PII) represent a potentially significant threat to aviation safety. However, contemporary operational data describing the medical etiologies and frequency of in-flight incapacitation events remain limited. Existing aeromedical risk assessment frameworks rely heavily on medical certification processes and self-disclosure, despite growing concerns regarding healthcare avoidance and underreporting behaviors among pilots. We analyzed a large international operational database of in-flight medical events affecting pilots while flying commercial aircraft to characterize the associated medical causes and operational outcomes

METHODS: Retrospective analysis of all pilot-related in-flight medical events reported between January 2022 and May 2026 to a commercial medical support service providing real-time consultation for approximately 95% of U.S. commercial airline traffic and 40% of global commercial airline operations. The database consisted of de-identified operational event logs generated during in-flight medical consultations. Available variables included event date, illness category, diversion status, country of origin, and age and gender of the affected individual type. Flight segments flown were obtained from BTS for the US carriers passenger flights in the study period. Descriptive analyses were performed to characterize event frequency, medical etiologies, and operational outcomes.

RESULTS: 454 events were identified resulting in 80 flight diversions. The most frequently identified medical etiologies included gastrointestinal (194 / 43%), neurological (64 / 14%) and cardiovascular (33 / 7%). All other categories contributed 4% or less. The mean age of the pilots was 45 (21-65). The overall estimated rate of PII was 6.21 events per million flight segments for US carriers. Diversions were more common for gastrointestinal (21 / 26%), cardiovascular (18 / 23%) and neurological (17 / 21%) categories. Cardiovascular events carried the highest diversion rate (54.6%) among the most frequent events. No accidents or major safety events were identified in association with the reported incapacitation events.

DISCUSSION: In this large operational analysis of commercial aviation medical events, PII events were uncommon but operationally significant occurrences associated with diverse medical etiologies and frequent flight diversion. Despite the occurrence of in-flight pilot medical impairment, no associated accidents were identified, suggesting that additional operational safety barriers may substantially mitigate downstream operational risk. These findings highlight the potential value of large-scale operational medical event surveillance as a new data source for informing aeromedical risk assessment, certification policy, and aviation safety management strategies.

Keywords: Aeromedical certification, aviation medicine, incapacitation

[Abstract:0090]

Parkinson's Disease and Deep Brain Stimulation: Aeromedical Certification Considerations for Aviation Medicine Professionals

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BACKGROUND: Parkinson's disease (PD) is a progressive neurodegenerative disorder that may affect motor function, cognition, mood, sleep, and other domains relevant to aviation safety. Deep brain stimulation (DBS) has become an established treatment for appropriately selected patients with PD and is increasingly utilized worldwide. As individuals with PD remain active in the workforce longer and treatment options continue to advance, aeromedical examiners, flight surgeons, and regulatory authorities may encounter certification questions involving applicants with DBS. However, many aviation medicine professionals have limited familiarity with the disease process, indications for DBS, expected treatment outcomes, and emerging technologies such as adaptive DBS (aDBS).

Description: This tutorial provides a practical review of Parkinson's disease and the role of DBS within contemporary neurological care. Topics include the pathophysiology and natural history of PD, clinical manifestations relevant to aviation duties, indications for DBS, patient selection considerations, and an overview of DBS system components and function. The tutorial will review symptoms commonly improved by DBS as well as symptoms that may persist or progress despite treatment. Current evidence regarding cognitive and neuropsychiatric outcomes following DBS implantation will be discussed, with emphasis on factors relevant to aeromedical assessment. Finally, participants will receive a brief introduction to emerging technologies, including adaptive DBS (aDBS), and their potential future implications for aviation medicine.

DISCUSSION: The presence of a DBS device alone does not provide sufficient information to determine aeromedical fitness. Effective certification decisions require an understanding of the underlying disease, treatment goals, and potential outcomes. This tutorial is designed to provide aviation medicine professionals with a foundational understanding of Parkinson's disease and DBS, enabling informed consideration of aeromedical certification questions involving applicants with Parkinson's disease.

Keywords: Parkinsons Disease, Certification, Aerospace Medicine

[Abstract:0091]

Aeromedical Unfitness in 2025: From Selection to Surveillance – Patterns of Disqualification Across Class 1, 2 and 3 Aircrew

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BACKGROUND:
Aeromedical certification represents a unique intersection between clinical medicine, operational safety and regulatory decision-making. While initial certification is primarily focused on selection and risk identification, periodic revalidation increasingly reflects the long-term management of chronic disease in an aging aviation population. Understanding the medical causes of aeromedical unfitness may provide valuable insights into evolving health trends among aircrew and aviation personnel.

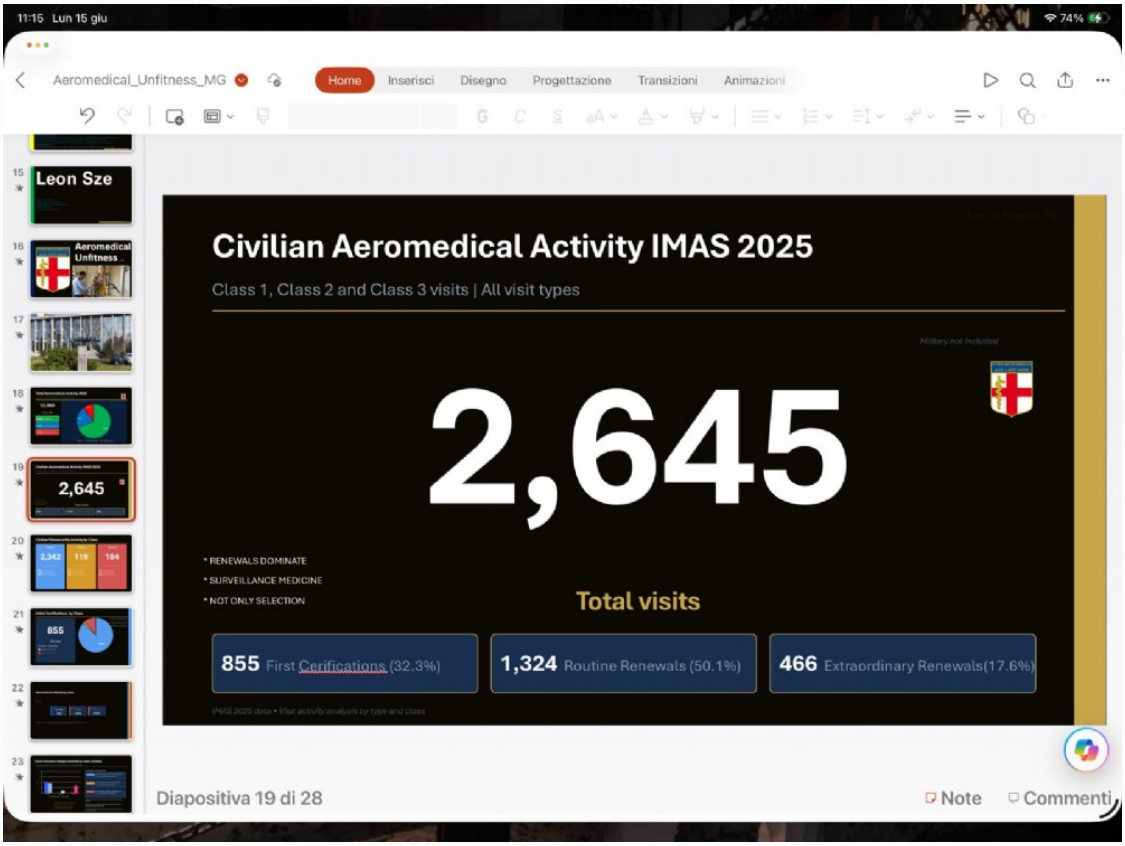
METHODS: A retrospective analysis was conducted on all cases of aeromedical unfitness identified during medical evaluations performed at the Specialist Aeromedical Center of the Italian Air Force Institute of Aerospace Medicine "Angelo Mosso" during 2025. Cases were stratified according to certification class (Class 1, Class 2 and Class 3) and further analyzed by separating initial certifications from subsequent revalidation assessments. Diagnoses were grouped into major clinical categories including ophthalmologic, cardiovascular, metabolic, otorhinolaryngologic, neurological and psychobehavioral conditions.

RESULTS: A total of 2,645 aeromedical evaluations were performed during the study period. Initial certification assessments were predominantly characterized by psychobehavioral and ophthalmologic causes of unfitness, particularly among Class 1 applicants. In contrast, follow-up evaluations demonstrated a substantial shift toward chronic disease surveillance, with increasing contributions from cardiovascular, metabolic and age-related conditions. Ophthalmologic disorders remained a leading cause of unfitness across all certification classes. Among Class 2 and Class 3 populations, cardiovascular disease, cerebrovascular history, metabolic disorders and sensory impairment represented a significant proportion of adverse certification outcomes. The analysis demonstrated that identical datasets may reveal markedly different epidemiological patterns when initial certification and recurrent assessments are examined separately.

CONCLUSIONS:
Aeromedical unfitness is not a static phenomenon but reflects two distinct operational realities: selection of suitable candidates and longitudinal surveillance of certified personnel. While initial certification predominantly identifies psychobehavioral and sensory limitations, recurrent evaluations increasingly address chronic cardiovascular and metabolic disease. These findings highlight the growing importance of preventive medicine, advanced diagnostic strategies and individualized risk assessment within modern aerospace medicine. Operational aeromedical databases may therefore represent a valuable source of real-world evidence to support future regulatory evolution and enhance flight safety through earlier identification of emerging health risks.

Keywords: Aerospace Medicine, Aeromedical Certification, Aeromedical Unfitness, Cardiovascular Risk, Chronic Disease Surveillance,Flight Safety

Oral Presentations



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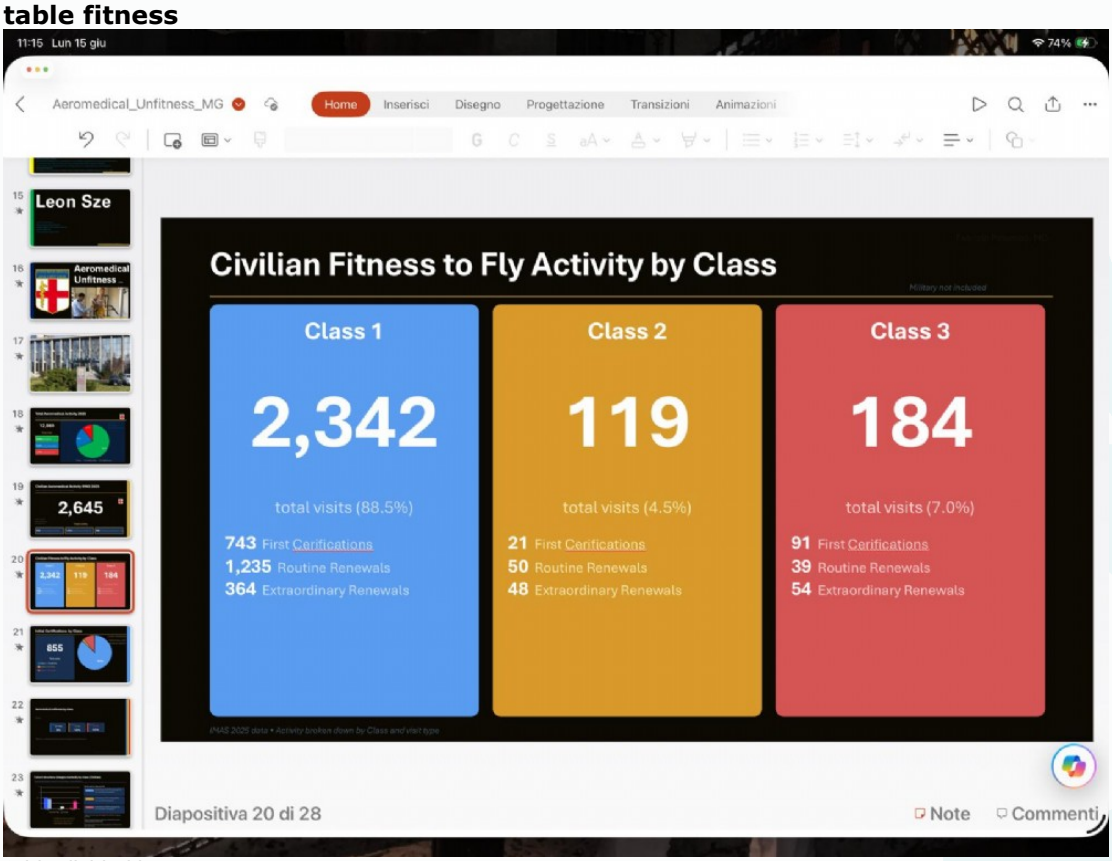

table divided by category

[Abstract:0093]

Emergency Medical Ground Operations Support for Astronaut Spacesuit Testing at Kennedy Space Center

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INTRODUCTION:
The exploration of Space requires protective measures such as an encapsulated pressure suit in the event of loss in cabin atmosphere and exposure to the Space environment. The NASA and Commercial Spaceflight program suits undergo a validation and testing process at Johnson and Kennedy Space Centers as well as through their respective commercial space companies to certify this capability prior to Spaceflight

Method/ Process:

The Spacesuits undergo a 3 level/3 phase testing process –

1. Individual valve and other component functional testing.
2. Integrated suit testing without subjects to confirm that the components and software are operating within the specified parameters.
3. Testing with Live human subjects in the spacesuit as a final safety, comfort, and functionality validation.

The Medical support coverage for the phase 3 human testing is provided at 2 levels

1. Les serious conditions/injuries such as Barotrauma to sinus, middle ear, including tympanic membrane perforation, claustrophobic reactions, eye/skin irritation from fluid leaks, and heat stress reactions.
2. Such situations are covered by an on-site/ on-call Flight Surgeon.
3. Potential medical emergencies such as Air Embolism, Val Salva complications (interruption of venous flow due to strain maneuver with presyncope/syncope), Aspiration of suit fluids, Asphyxia/ Hypoxia, Heat exhaustion, and unrelated cardiovascular and other medical events. Such medical emergencies are initially managed by the on-scene medical personnel with BLS/first aid and other basic life support measures until the Emergency Medical Support (EMS) / Medevac team arrives with full ACLS/PHTLS (Advanced Cardiac Life Support-Prehospital Trauma Life Support) measures for stabilization and transport to an area hospital Emergency Department.

DISCUSSION:
Complications such as Air Embolism in this setting are rare (none recently reported - mainly theoretical) and should be prevented by valve overpressure safety mechanisms, software controls, and safety protocols. Likewise asphyxia and hypoxia are unlikely due to close monitoring and safety protocol checks to confirm proper suit connections and the composition of the supplied air,
Val Salva complications are again expected to be rare under these conditions and with trained subjects). The incidence of cardiac and other medical emergencies are also anticipated to be low due to subject medical screening and selection of fit subjects.
Aspiration is more likely in the weightless environment but could still occur

CONCLUSION:
Although serious medical complications are rare with Spacesuit testing involving human subjects, the provision of EMS and Medical support are still advised.

Keywords: Spacesuit Testing, Barotrauma, Medical Support

[Abstract:0097]

Healthcare avoidance among air traffic controllers: Barriers to help-seeking

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INTRODUCTION: Healthcare avoidance refers to patient disengagement that prevents or delays seeking medical help, compromising personal wellbeing. In aviation, this could be manifested when personnel choose to skip medical attention due to concerns such as the fear of losing their license or career. This behavior may impede the early identification and treatment of otherwise manageable conditions, thereby creating latent risks for both individual wellbeing and operational safety. Research shows that 56% of pilots and 66% of flight attendants exhibit avoidance behaviors. Additionally, 27% of pilots have withheld information on questionaries to protect their professional status. In one study of mostly general aviation, it was estimated that 5% of fatal accidents are linked to health issues never reported to medical authorities. Whether similar healthcare avoidance behaviors occur among air traffic controllers remains largely unknown, representing an important gap in the aviation safety literature.

METHOD: In 2025, IFATCA and the University of Washington conducted a global, anonymous, non-probabilistic convenience survey on ATCO's help-seeking barriers. Statistical analysis using JMP and StataSE yielded prevalence ratios (PRa) adjusted by age, gender and region, considering statistical significance at $p \leq 0.05$ and a 95% confidence interval.

RESULTS: The study included 1,167 ATCOs worldwide: Europe (37%), Americas (24%), Africa (16%), Australia/New Zealand (13%) and Asia (10%). Overall, 61% avoid seeking mental health support and 29% have withheld information. Analysis shows that fear of negative career impact more than doubles the probability of avoidance (PRa=2.28, p=0.000) and non-disclosure (PRa=2.09, p=0.000). Personal discomfort discussing mental health is the strongest trigger for misrepresentation (PRa=1.84, p=0.000). Social stigma, specifically worrying about colleagues' opinions, raises avoidance prevalence by 68% (PRa=1.68, p=0.000). Regarding systematic barriers like privacy concerns increase avoidance by 54% (PRa=1.54, p=0.000). Finally, interpersonal stigma, also related to colleagues' opinions, increases this risk by 42% (PRa=1.42, p=0.000).

CONCLUSION: This study is one of the first to characterize healthcare behavior among air traffic controllers in an international sample. The findings suggest that healthcare avoidance exists within this population, with distinct subgroups demonstrating unique characteristics. Future research should examine the factors contributing to healthcare avoidance and evaluate strategies that could reduce this behavior while supporting both controller health and aviation safety.

Keywords: healthcare avoidance, air traffic controller, mental health, aviation safety, aerospace Medicine

[Abstract:0098]

A risk matrix approach to aeromedical assessment: 4 years of the USAFSAM AMRAAM

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BACKGROUND: The U.S. Air Force (USAF) School of Aerospace Medicine (USAFSAM) Aeromedical Consultation Service (ACS) is responsible for evaluating complex medical waiver requests for aviators and other operational personnel. Historically, the ACS has utilized the 1% rule for medical evaluations, where the maximum acceptable risk for an incapacitating medical event is given as 1% per year. In 2020-21, USAFSAM developed the developed the ACS Medical Risk Analysis and Assessment Matrix (AMRAAM)

DESCRIPTION: The AMRAAM assess 5 levels of likelihood and 4 levels of severity, with categories based on existing USAF standards for assessing and accepting risk. The AMRAAM was designed as a tool to provide a more transparent assessment of aeromedical risk and was adopted as part of USAF policy in 2022. In four years of use, the ACS has learned several valuable lessons regarding the use and implementation of this approach.

DISCUSSION: Lessons learned will focus on four areas. First, the AMRAAM has been well-received by senior leaders, both medical and non-medical. Second, clinicians using the AMRAAM may tend toward bypassing some of the procedural steps, especially for familiar diagnoses. Third, the severity ratings can be further developed; this is particularly true for ground-based operators and other special operations duty personnel. Finally, based on interest from multiple U.S. and international partners, the ACS has generated several recommendations for translating the AMRAAM into other aeromedical systems.

Keywords: Aeromedical, waivers, risk, assessment, matrix, standards

[Abstract:0101]

Reclassification of Screening Electrocardiograms in Polish Air Force Aircrew Using the Polish Air Force ECG Interpretation Criteria (PAF-ECG Criteria): A Multi-Reader Comparative Study

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INTRODUCTION: Resting electrocardiography is routinely performed during periodic aeromedical examinations; however, interpretation of ECG findings in military aircrew remains challenging because existing standards are derived either from the general population or from competitive athletes. Consequently, identical ECG patterns may be classified differently depending on the applied interpretation framework. To address this issue, the Polish Air Force ECG Interpretation Criteria (PAF-ECG Criteria) were developed by integrating contemporary athlete ECG standards with aerospace medicine recommendations and adapting them to the specific characteristics of military aircrew. This study compared ECG classification using routine interpretation and the PAF-ECG Criteria and evaluated interobserver reproducibility.

METHODS: One hundred resting ECGs from routine periodic examinations of Polish Air Force aircrew were independently interpreted by three physicians representing different levels of ECG interpretation experience (resident, internist and cardiologist). Each ECG was independently interpreted according to routine clinical practice and reinterpreted using the PAF-ECG Criteria. The primary endpoint was the paired proportion of ECGs classified as abnormal according to majority consensus (2 of 3 readers). Secondary endpoints included interobserver agreement and identification of ECG patterns responsible for reclassification.

RESULTS: According to majority consensus, routine ECG interpretation classified 45% of recordings as abnormal, whereas the PAF-ECG Criteria classified 18% as abnormal, corresponding to an approximately 60% reduction in ECGs classified as abnormal. In paired analysis, 29 ECGs were reclassified from abnormal to normal and only 2 from normal to abnormal (McNemar $p<0.001$). Pairwise interobserver agreement remained moderate to good (Cohen's κ approximately 0.456–0.714). Residual observer variability was concentrated within a limited number of ECG patterns, with QRS interpretation accounting for the largest proportion of discordant classifications.

CONCLUSIONS:
PAF-ECG Criteria, derived from contemporary athlete ECG standards and aerospace medicine recommendations, systematically reclassify screening ECGs in Polish Air Force aircrew compared with routine clinical interpretation. This comparative evaluation demonstrates the value of a population-specific ECG interpretation framework while identifying ECG patterns responsible for residual observer variability and potential targets for further refinement. These findings provide a foundation for prospective clinical validation and future standardization of aeromedical ECG interpretation in military aeromedical practice.

Keywords: Electrocardiography, Aerospace Medicine, Military Aircrew, ECG Interpretation, Interobserver Agreement, Screening

[Abstract:0103]

reasons for incapacity of ATCO's

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ESAM executive committee and advisory Board

As head of the EUROCONTROL medical service I contacted in 2015 the medical assessors of the EU member states to ask for the reasons of longterm incapacity of air traffic controllers and got several responses. In 2025 I contacted again the medical assessors of the EU member states and got also several responses to compare the evolution of reasons over 10 years. The responses came not always from the same countries. The first conclusion is there is absolutely no standardised way of compelling these data, and some countries have none. The second conclusion is that the main reasons were comparable in the 2 sets of answers, and that new medical risks seem to appear. A more systematic and generalised data gathering is necessary for deeper analysis. For AME's class 3 the access to these main risk area's is important to sharpen their awareness.

Keywords: air traffic controllers, longterm incapacity, data collection

[Abstract:0104]

High-Altitude Exposure and Hematological Adaptation: A Pilot Study Comparing Real and Simulated Hypoxia

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High-altitude hypoxia represents not only a respiratory stressor but also a trigger for hematological remodeling, particularly regarding circulating leukocytes. This study focused not only on leukocyte behavior but also on that of red blood cells and platelets, examining their potential role as indicators of adaptation to hypobaric hypoxia.
We enrolled 16 healthy volunteers, including both military and civilian participants of both sexes, matched for age, body mass index, lifestyle, and smoking status.All participants provided informed consent and underwent an initial clinical evaluation.The protocol incorporated standardized blood sampling, dietary monitoring, sleep diaries, and actigraphy.The experimental design comprised two phases: a simulated hypoxia phase conducted at Pratica di Mare (39 ft above sea level), including four blood sampling points (baseline and post-exercise at sea level; baseline and post-exercise in a hypobaric chamber simulating 15000 ft);and a high-altitude phase on Monte Rosa, with assessments at Capanna Gnifetti(11965 ft)and Capanna Margherita (14940 ft),enabling direct comparison between simulated and real hypoxic exposure.Hematological analyses included lymphocyte counts, lymphocyte subsets, platelet counts, and erythrocyte parameters. Ascent to Capanna Gnifetti followed a one-day acclimatization period in Alagna (3907 ft),with blood samples collected at the facility between 12 and 16 hours after arrival.

Preliminary results from the broader project indicate that high-altitude exposure is associated with measurable biological changes and hematological adaptation. The protocol revealed an increase in leukocyte count following actual high-altitude exposure combined with physical activity, suggesting that the combination of high altitude and physical exertion may modulate circulating immune cells. Indeed, physical exertion significantly altered the absolute white blood cell count across all three stress conditions.To analyze the effects of hypoxia alone, we compared values from samples taken at Pratica di Mare with those collected at the Capanna Gnifetti, finding significant differences ($P = 0.025$ for red blood cells and $P = 0.026$ for white blood cells, respectively).Conversely, exposure to acute hypobaric hypoxia did not affect blood components, showing no significant differences between samples taken at sea level and those collected in the hypobaric chamber.These data support the hypothesis that lymphocytes may help distinguish adaptive immune remodeling from non-specific stress responses.Acute high-altitude exposure appears to induce a complex immune adaptation in which lymphocytes may serve as useful biomarkers of physiological stress and acclimatization.The comparison between simulated and real altitude is particularly important because it clarifies how much of the lymphocyte response is driven by hypoxia itself versus the combined effects of exercise, environment, and operational stress.

Keywords: High-Altitude, Hematological-Adaptation, hypobaric chamber

[Abstract:0106]

Awareness, readiness and barriers of healthcare workers in providing in-flight n=medical assistance

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INTRODUCTION: When in-flight medical emergencies occur, flight attendants are often forced to rely on volunteer physicians among passengers. However, the actual readiness of healthcare workers to provide assistance in flight remains unclear. This research assessed awareness, motivation, and key barriers and fears among physicians and nurses as potential in-flight volunteers.

METHODS: An anonymous survey of 389 physicians and nurses (aged 21–84 years, 5 professional segments) was conducted. Content analysis of open-ended questions regarding personal experience, fears, and training expectations was performed.
RESULTS: 64% of respondents had experience in providing in-flight assistance (syncope, hypertensive crises, cardiac arrest, seizures, allergies, childbirth). Main barriers identified include: fear of legal liability (48%), unfamiliarity with the onboard medical kit contents and lack of necessary medications/equipment (44%), lack of experience, knowledge and fear of errors (44%), absence of clear algorithms (25%), and bystander pressure and video recording (14.5%). The primary motivation for training was "to be ready for anything" (82%). Five target audience segments were identified: emergency specialists (25%), general practitioners (40%), nursing staff (20%), specialists (10%), and experienced experts (5%), each with unique educational needs. From a training course, 88% of respondents expect clear algorithms, 75% expect increased confidence, and 60% expect legal knowledge.
CONCLUSIONS: Healthcare workers are highly motivated to provide in-flight emergency care but face significant deficits in clear algorithms, knowledge of legalities, and information about onboard equipment. A specialized training course with segmented modules for different medical specialties and a legal block reflecting both Russian and international law is needed. These findings provide a foundation for the development of a targeted educational program for medical professionals providing in-flight emergency care.

Keywords (for online submission form): in-flight medical emergency, aviation medicine, healthcare workers, survey, training barriers, volunteer physicians, flight safety

Keywords: in-flight medical emergency, aviation medicine, flight safety

[Abstract:0109]

Integrated Ozone Autohemotherapy and PEMF for Operational Recovery in Pilots and Astronauts

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BACKGROUND:
Pilots and astronauts are exposed to cumulative fatigue, circadian disruption, hypobaric or hypoxic stress, high cognitive load, and delayed psychophysical recovery. Non-sedating, physiology-based recovery countermeasures are needed. This study synthesized the translational rationale for combining systemic oxygen–ozone major autohemotherapy with pulsed electromagnetic fields (PEMF) as a single recovery session aimed at improving operational readiness through convergent effects on redox signaling, nitric oxide pathways, and tissue oxygen handling.
METHODS:
A structured scoping review of primary studies published from 2015 to 2026 was performed to identify human and mechanistic evidence on systemic ozone therapy and PEMF relevant to fatigue, cognitive recovery, endothelial nitric oxide synthase activity, nitric-oxide-dependent microcirculation, oxygen transport and peripheral utilization, and redox hormesis. Findings were organized into molecular, physiological, and operational domains to build a translational framework for aerospace medicine.
RESULTS:
The reviewed evidence suggests partially complementary mechanisms. Ozone-related studies support adaptive redox signaling, including Nrf2/HO-1 activation, endothelial modulation, and clinical signals of benefit in post-viral fatigue and fibromyalgia-like symptom clusters. PEMF studies more consistently support nitric-oxide-linked vasodilation, improved microvascular perfusion and tissue oxygenation, enhanced endothelial function, favorable muscle oxygen kinetics, and faster recovery from exercise-induced soreness. Across both modalities, the most plausible shared pathway is improved oxygen delivery-utilization matching through redox-controlled endothelial responsiveness and peripheral metabolic recovery. Mechanistic claims regarding 2,3-diphosphoglycerate-mediated rightward shifting of the hemoglobin oxygen dissociation curve remain biologically plausible but insufficiently confirmed in modern controlled human studies. No direct studies were identified in pilots, astronauts, or combined ozone-plus-PEMF protocols.
CONCLUSIONS:
Integrated systemic ozone autohemotherapy and PEMF appears to be a biologically plausible investigational countermeasure for psychophysical operational recovery. For aerospace application, the concept should be framed as readiness restoration rather than performance enhancement. Prospective controlled pilot studies in aircrew and space-analogue populations should test safety, feasibility, psychomotor vigilance, executive function, fatigue burden, heart-rate-variability recovery, and muscle oxygenation before operational adoption. The mechanistic and clinical language in this draft is grounded in the ozone and PEMF evidence summarized above, particularly the studies on post-viral fatigue, NO-linked vascular responses, microcirculation, and muscle oxygen kinetics.

Keywords: Aerospace medicine, Human performance, Operational recovery, Fatigue management, Major ozonated autohemotherapy, Pulsed electromagnetic fields.

[Abstract:0110]

From Crew Resource Management to Life Resource Management: Transcendental Meditation as a Tool for Occupational Stress Mitigation in Commercial Aircrews

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BACKGROUND: Crew Resource Management (CRM) has evolved through three generations, from Cockpit Resource Management (NACA, 1940s to 1960s) to Crew Resource Management (NASA, 1970s to 1990s) and Company Resource Management with Non-Technical Skills (1990s to 2000s). The third generation has reached its maximum expression while preserving a strongly materialistic cause-effect framework. In parallel, occupational intensities have increased significantly. Low-cost short and medium-haul operations expose flight crews to daily duty periods of 10 to 12 hours, 2 to 4 sectors, and 7 to 9 flight hours, often within Flight Time Limitations that do not adequately protect aircrew well-being. A recent cross-sectional study on 120 commercial airline pilots showed that inter-flight rest periods shorter than one hour were independently associated with elevated serum cortisol and reduced DHEAS levels, identifying two neuroendocrine markers of cumulative occupational load and targets for mitigation.

DESCRIPTION: This work proposes a fourth-generation CRM (Life Resource Management, LRM) as the conceptual centrepiece of a broader Next Generation Airline model. The holistic transition from CRM to LRM is the defining axis of the proposal, placing the operator at the centre rather than the periphery of the safety strategy. The operational tool selected is Transcendental Meditation – a standardised technique introduced in the West by Maharishi Mahesh Yogi and supported by more than 700 peer-reviewed studies – including controlled trials documenting reductions in serum cortisol and increases or normalisation of DHEAS. These are the same biomarkers altered in pilots with short inter-flight rest, providing a direct biological link between aircrew occupational load and the countermeasure. The technique elicits alpha brainwave activity (8 to 10 Hz) and restful alertness compatible with duty rosters. Dedicated sessions and sites are embedded into airline routines, with about 1% of company staff trained as meditators.

DISCUSSION: LRM addresses a gap in current aviation human factors strategies, where the regulatory and managerial response has remained largely material and procedural. Embedding a measurable, low-cost, culturally neutral stress-mitigation tool into airline safety frameworks may improve aircrew well-being, reduce fatigue-related performance decrements, and support a sustainable safety culture. A field validation study is proposed, designed in collaboration with the Italian centre for Transcendental Meditation, with longitudinal monitoring of serum cortisol and DHEAS in volunteer aircrews before and after a structured TM programme, as a feasible step within the broader Next Generation Airline framework.

Keywords: Crew Resource Management, Life Resource Management, Transcendental Meditation, Pilot Stress, Next Generation Airline

[Abstract:0111]

Epidemiology of In-Flight Seizures

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INTRODUCTION: Prevalence of epilepsy varies according to age group, as well as geographic and economic regions. In the US around 1.2% of the population is affected. Seizure events are not infrequent in air travel.

OBJECTIVE: This study aims to discuss the epidemiology of in-flight seizures in commercial aviation.

METHODS: A de-identified retrospective dataset from a major US-based GBMS provider was analyzed for the period of January 2024 to December 2025. Age and gender were collected along with flight operational variables. Also captured if the affected airline carries an anti-convulsant drug (ACD) in their EMK and if an ACD was recommended to be administered. Epi-Info 7.2.7.0 was used for statistical analysis.

RESULTS: 120,157 cases from 101 global airlines from 5 regions were analyzed. 3,543 cases seizures were retrieved representing 2.95% of all cases and 10.22% of diversions. 56% of the cases were identified as male. Mean age was 36.6 ± 18.9 (4 months to 92 years). The mean time-into-flight was 200 minutes with 57% of covered flight time. Airlines carrying ACDs diverted less for seizures, but with no statistical significance (OR: 1.21, 0.91-1.19). Seizure cases receiving ACDs diverted 3.04% more often, again not reaching significance (OR: 0.67, 0.42-1.00). 82.6% of diverted cases were transported to hospital. Diversion rates followed a bimodal pattern regarding age, higher in younger than 20 and over 60 years. In this sample, ACDs were more commonly present in European carriers (97.4%), followed by Middle-East (96.7%), Asia-Pacific (86.8%, Latin America (73.7%) and uncommon in North America (17.5%).

DISCUSSION: In-flight seizures are a relatively frequent event and cause for diversions. Most cases leading to diversions were considered serious, hence the association with the recommendation for administration and subsequent transportation to hospital upon arrival. Nonetheless, 18% of the diverted cases declined medical attention, or were released upon arrival suggesting that there are opportunities to better assess and stabilize those cases before deciding to divert.

Keywords: In-flight medical events, Seizures, Airline

[Abstract:0112]

When a Clinician on Board Is Not Enough: An In-Flight Behavioural Emergency and the Case for Aeromedical Transport Medicine as a Defined Subspecialty

Ina Schmidt
ICARUS e.V.

Background. Aeromedical transport routinely moves acutely unwell and psychiatrically vulnerable individuals over long distances and across borders. Pilot fitness assessment and aeromedical certification are today mature, well-regulated domains. By contrast, the clinical care of the patient being transported is not: aeromedical transport medicine is not recognised as a distinct medical subspecialty, and no binding, internationally harmonised standard governs the competencies, equipment, or medication that should accompany a patient in flight. In civil-aviation regulation such a person is classified only as a passenger — and what is not defined cannot be reliably regulated.

Clinical scenario. We present an anonymised, composite scenario representative of long-haul medical escort transport. A passenger with a pre-existing psychiatric condition deteriorated in flight into an acute, initially aggressive behavioural crisis perceived by the escorting team as a safety threat. A physician was present. The crisis was controlled in the air with intramuscular diazepam — the only suitable agent available on board — and the patient transitioned to a calm, cooperative state with stable vital signs, and was handed to ground medical care on arrival for definitive follow-up.

Discussion. The outcome was favourable, but it depended on individual clinical competence rather than on a defined standard. Diazepam was used because it was available, not because it was the optimal first-line, titratable agent for acute agitation; an appropriate behavioural-emergency medication set was not standardised. The presence of "a clinician on board" masked the absence of a system: no mandated competency framework, no standardised pharmacological toolkit, and no agreed in-flight protocol. The same structural gap underlies other foreseeable in-flight emergencies, where the decision to treat or to divert is left to improvisation.

CONCLUSION: This scenario illustrates a structural gap, not an isolated lapse. Recognising aeromedical transport medicine as a defined subspecialty — with certified competencies, standardised equipment and medication, and harmonised protocols — would convert patientsafety in transport from a question of who happens to be rostered into a matter of deliberate design. ICARUS proposes this as a shared agenda for the aerospace medicine community.

Keywords: aeromedical transport, in-flight emergency, behavioural crisis, medical subspecialty, standardisation, patient safety.

[Abstract:0113]

Sealing Properties of Close-Fitting Masks Worn Over Facial Hair - What Do Studies Show?

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INTRODUCTION: Recent studies of quick-don aviator masks have challenged the traditional view that beards promote unacceptable leaks in close-fitting masks, suggesting instead that adequate respiratory protection remains. This review aims to provide an updated analysis of all available studies of close-fitting masks in bearded users, to allow better assessment of the risks of allowing facial hair in aircrew who may require such masks in an emergency.

METHODS: Systematic searches identified eligible studies that evaluated the seal of close-fitting masks, intended to achieve optimalrespiratory protection, in the presence of facial hair. Study quality was graded against five criteria: 1) study design(controls); 2) mask testing schedule; 3) bearded cohort size; 4) leak measurement method; and 5) representative testing(increased ventilatory demand, movements, and speech). Consideration was given to data meta-analysis.

RESULTS: Of 21 discrete studies, 5 are rated high quality, 8 medium, and 8 low quality. Overwhelmingly, they indicate that facial hair can seriously degrade the performance of close-fitting masks, with relevant factors including beard age, hair length,and density. Early hair growth (days, possibly hours) can compromise seals at ambient gas supply pressure, with positive(safety) pressure supplies vulnerable to established beards, particularly at lower flow rates and increased ventilatory demands. Mask protection factors may degrade with facial hair by two or more orders of magnitude.

DISCUSSION AND CONCLUSIONS: Safety-critical close-fitting masks require a skin-tight seal for optimal function. Mask seal integrity with facial hair is highly variable between individuals, between masks, and from one wear to the next. Quick-don close-fitting oxygen masks, required in aviation emergencies, will not function reliably unless the user is clean-shaven where the mask seal contacts the skin. Risk assessment of whether to allow aircrew to have facial hair should be informed by understanding the likelihood of oxygen mask leakage in an emergency.

Keywords: mask seal, mask leak, beard, facial hair, quick-don, oxygen mask

[Abstract:0114]

An Undefined Patient in an Unregulated Market: The Case for International Standards in Aeromedical Transport Medicine

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Background. Aeromedical transport of critically ill and vulnerable patients has been practised for decades and is now a global, commercially significant activity. Yet the clinical side of this practice has matured far less than its aviation side. While pilot fitness and aeromedical certification are well-developed regulatory domains, the care of the patient in transit rests on a fragmented patchwork of voluntary accreditation schemes and individual operator policies, with no binding, internationally harmonised standard.The regulatory gap. In international civil-aviation regulation, a person on board is defined only as a passenger; there is no agreed definition of a patient in flight, nor of the medical crew required to care for one. International bodies such as ICAO address facilitation and aircraft operations rather than the clinical competencies, equipment, and medication standards a transported patient requires. Voluntary frameworks (e.g. accreditation bodies and the IATA medical-clearance process) provide partial guidance, but adherence is optional and uneven. Aeromedical transport medicine is, accordingly, not recognised as a defined medical subspecialty. What is not defined cannot be reliably regulated.Market opacity and risk. In the absence of a binding standard and a defined patient category, the market is largely opaque: staffing qualifications, equipment, medication sets, and clinical governance vary widely between providers and are difficult for patients, payers, and referrers to verify. Where commercial incentives operate without a regulatory floor, there is a structural risk that service configuration is shaped more by cost and competition than by patient-safety requirements. The patient — frequently unconscious, sedated, or otherwise unable to advocate for themselves — bears the consequences of this variability, often without the means to assess the quality of care purchased on their behalf.Proposal. We argue that aeromedical transport medicine should be established as a defined subspecialty, underpinned by an internationally harmonised standard: an agreed definition of the in-flight patient and the medical crew, minimum competency and certification requirements, standardised equipment and medication, and transparent, auditable clinical governance. ICARUS proposes this as a shared, non-commercial agenda and invites the aerospace medicine community, certifying authorities, and international bodies to develop it collaboratively

CONCLUSION: Decades of practice have produced capability without a common standard. Defining the patient, the crew, and the required level of care would convert patient safety in aeromedical transport from a function of market choice into a matter of regulated design.

Keywords: aeromedical transport, international regulation, patient safety, medical subspecialty, standardisation, market transparency.

[Abstract:0126]

From evidence to operations: a sex-specific medical framework for long-duration human spaceflight

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As human spaceflight transitions toward sustained lunar operations and future Mars expeditions, medical support systems must evolve beyond standards primarily derived from male astronaut populations. Increasing evidence demonstrates that biological sex significantly influences physiological adaptation to microgravity, space radiation, isolation, and prolonged confinement. Nevertheless, sex-specific evidence remains inconsistently integrated into aerospace medical protocols, resulting in operational gaps that may affect risk assessment, clinical monitoring, countermeasure implementation, and mission readiness.This process review synthesizes current evidence on sex-related physiological adaptations relevant to long-duration human spaceflight and translates these findings into a structured operational framework for aerospace medicine. The review critically examines peer-reviewed literature from aerospace medicine, space physiology, human performance, endocrinology, cardiovascular medicine, musculoskeletal physiology, neurovestibular sciences, immunology, and radiation biology, emphasizing clinically actionable findings with direct operational implications.The proposed framework is organized across the continuum of mission medical support, including pre-flight medical evaluation, individualized risk stratification, in-flight physiological monitoring, preventive countermeasures, autonomous clinical decision-making, and post-flight rehabilitation. Key domains include cardiovascular adaptation, bone and skeletal muscle loss, neurovestibular dysfunction, immune dysregulation, endocrine and reproductive physiology, pharmacological considerations, and sex-dependent responses to ionizing radiation. Particular attention is given to integrating individualized medical surveillance strategies within the operational constraints of deep-space exploration, where communication delays, limited medical resources, and restricted evacuation capabilities require greater crew medical autonomy.Rather than advocating separate medical standards for female astronauts, this review proposes a precision medicine approach in which sex constitutes one component of a multidimensional operational risk model alongside age, mission duration, environmental exposure, and individual physiological variability. By translating fragmented scientific evidence into an operationally oriented framework, this work provides a practical methodology for incorporating sex-specific considerations into aerospace medical planning, crew health surveillance, and future clinical guideline development.As international exploration programs increasingly pursue prolonged missions beyond low Earth orbit, integrating biological sex into evidence-based aerospace medicine represents not only an issue of scientific completeness but also an essential component of operational safety, medical preparedness, and mission success.

Keywords: Aerospace Medicine, Space Medicine, Human Spaceflight, Precision Medicine, Sex Differences, Long-Duration Spaceflight

[Abstract:0129]

Cardiovascular screening for civilian commercial suborbital spaceflight: an operational risk-stratification framework

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BACKGROUND:

Commercial suborbital spaceflights (SOS) expose a growing number of civilian participants to physiologically strenuous environments characterized by variable acceleration profiles, intravascular fluid shifts, vibration, and sympathetic activation. Existing cardiovascular disease screening models are incompletely suited to this cohort. General population risk assessment tools estimate adverse event probabilities over a span of years to decades, while those for professional astronauts are oriented towards heavily screened individuals undertaking longer-duration missions. Current evidence-based screening standards and the available literature remain limited. We sought to develop a practical unified framework for short-duration suborbital spaceflight participants (SFPs) accounting for brief mission duration, non-traditional operational constraints, and the broader underlying comorbid diseases of the general population.

Description:

This process review describes an evidence-based, risk-oriented approach for stepwise cardiovascular disease screening of civilian SFPs participating in short-duration SOS. The framework proposal begins with a structured assessment of cardiovascular history, symptoms, risk factors, prior cardiovascular diagnoses, medications, and functional capacity as well as a comprehensive physical examination. Flight-relevant physiologic stressors are factored to identify cardiac conditions with potential operational significance, such as coronary artery disease, valvopathy, arrhythmia, heart failure, aortopathy, orthostatic disorders, and implanted devices. A likelihood-consequence risk matrix then stratifies cardiovascular findings according to both major adverse cardiovascular event risk and potential mission impact. The pragmatic decision pathway integrates existing terrestrial and aerospace screening approaches, including preventive cardiovascular disease risk models, aviation medical standards, and sports cardiology recommendations. Advanced diagnostic testing is reserved for SFPs whose baseline evaluation suggests significantly elevated cardiovascular risk as opposed to a recommendation for routine, universal testing.

DISCUSSION:

The proposed cardiovascular screening framework for SFPs undergoing SOS emphasizes pragmatic risk mitigation rather than risk elimination. Short duration missions generally entail a lack of safety critical roles for most participants with emergency abort capabilities and immediate post-flight medical access. Routine advanced testing for asymptomatic SFPs likely carries minimal incremental benefit to justify cost, logistics, and potential harms. Informed consent, autonomy, and communication regarding residual risk remain paramount. As commercial human spaceflight evolves, the development of shared registries, multidisciplinary collaboration, and international consensus standards become critical to refining screening practices for this emerging population.

Keywords: Screening, Cardiac, Cardiovascular, Suborbital, Medical Risk

[Abstract:0132]

A potential material solution to mitigate vection illusions

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INTRODUCTION: Visual vection illusions occur when a pilot experiences a false perception of motion due to apparent motion of elements in the visual field. Vection can be mild leading to incorrect control inputs by the pilot or overwhelming leading to total incapacitation. Two case studies of pilot visual vection illusions will be presented: in the first case the pilot was totally incapacitated and the second in which the astronaut makes incorrect inputs as a result of whole field of view apparent motion.

Case Descriptions:
CASE 1: An F-18 pilot in trail position was experiencing the leans during IFR formation flight. On breakout from the clouds, when suddenly exposed to a whole field-of-view vection experience, the pilot developed a total override of the vestibular system leading to complete incapacitation resulting in an inability to focus on instruments secondary to nystagmus and an inability to find the ejection handle due to aberrant vestibulospinal inputs.

Case 2: An astronaut applied sporadic incorrect inputs due to the illusory experience of vection produced by wide field-of-view lunar surface particle motion. Lateral velocity exceeded vertical velocity on impact The vestibular system is often described as a "system of systems" since it provides stabilization and coordination for other sensory systems during dynamic conditions of motion and acceleration via vestibular-ocular, vestibular-auricular and vestibular-spinal pathway reflexes. All major orientation sensory systems provide significant input to the vestibular nuclei in the brainstem. Other than the vestibular end organs (canals and otoliths) the largest sensory input to the vestibular nuclei of the brainstem is the somatosensory input from the skin, muscle and joint system. The angular and linear acceleration information from the end organs only has meaning for body orientation when the organism knows how the head is oriented with respect to the body so the input from the neck to the vestibular nuclei is the largest and most important. Similarly, as we progress down to the feet there are significant skin-muscle-joint inputs to provide awareness of how we are oriented in space. Given the large input from touch it is logical that we can use tactile cueing to "anchor" the body providing veridical information as to our orientation in space. We developed arrays of tactile stimulators (tactors) placed on the torso of the body to provide orientation and velocity cues for pilots. Our prior experiments demonstrated that torso tactile cueing arrays to affected nystagmus responses and altered motion perceptions.

Keywords: Illusion, Spatial Disorientation, Spatial Orientation, Mishap, Vection, Vestibular

[Abstract:0133]

The Pilot Medical: More Than a Tick and a Pee

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CASA and CAA NZ have co-developed a health promotion medical examination and assessment process as part of routine pilot and controller medical certification.Traditional aviation medicals are primarily designed to determine whether a pilot or controller meets minimum medical certification standards and is based on individual disease case detection. The new medical focusses on preventing future disease that may affect likelihood of future medical incapacitation, affect pilot performance and flight safety, as well as extending operational careers. This approach is consistent with ICAO Annex 1 standard 1.2.4.3.It reflects a fundamental shift from "fitness assessment" to "health optimisation".The new medical meets ICAO core certification requirements as well as focussing key aviation related risks on mental health wellbeing, alcohol and substance use, cardiovascular and metabolic disease risk factors, and public health recommended NZ and Australian cancer screening. The approach encourages pilot and controller agency for personal responsibility for health. Other potential outcomes include improved workforce resilience, regulatory outcomes and reduced long term healthcare costs.

Keywords: Health optimisation, Improved pilot performance, greater aviation safety

[Abstract:0138]

Transcranial ultrasonography — a new method for diagnosing hydrocephalus associated with long-term spaceflight (HALS)

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INTRODUCTION: Long-term spaceflight may cause hydrocephalus – a condition known as HALS (Hydrocephalus Associated with Long-Term Spaceflight). The direct sign of HALS is enlargement of the cerebral ventricles, while the indirect sign is intracranial hypertension accompanied by widening of the optic nerve sheath diameter (ONSD). ONSD measurement is possible using portable ultrasound (US) systems. Under the NASA programme aboard the International Space Station, ONSD assessment is being investigated for early diagnosis and monitoring of HALS. However, the value of this test remains debatable, as the method does not visualize the cerebral ventricles themselves – it detects only an indirect, not a direct, sign of the condition.

METHODS: A transcranial ultrasonography (TUS) method for direct brain visualization through the skull bones has been developed and patented in Russia (Iova A.S., Garmashov Yu.A., RF Patent No. 2125401, 1998). Experience with phased-array transducers at 1–4 MHz has demonstrated that visualization of the third and lateral ventricles is achievable in 90% of adults. Two TUS protocols were developed: a full protocol (with remote expert participation for diagnosing hydrocephalus, clarifying its cause, type, and need for treatment or evacuation) and a brief protocol (for crew self- and mutual examination for HALS screening and monitoring). Both use three standard scanning planes through bilateral temporal acoustic windows with ventricular width measurement. Feasibility was verified under simulated spaceflight conditions (hypobaric chamber, 1,500 m altitude; 26 participants aged 22–70 years; 6 underwent 3-hour training; Lumify S4-1, 550 g; images streamed to a remote expert)

Results and CONCLUSIONS: A total of 132 TUS examinations were performed in self- and mutual-examination modes (mean duration: 1.2 min). In all cases, third and lateral ventricular width measurements were successfully obtained. Unlike ONSD measurement, TUS provides direct visualization of the cerebral ventricles – the primary morphological substrate of HALS – and represents the only method currently available under spaceflight conditions capable of detecting the direct sign of hydrocephalus. The brief protocol enables HALS screening and monitoring by crew members after minimal training, without medical specialist involvement. TUS may serve as a valuable addition to existing in-flight monitoring methods aboard the ISS and represents a promising tool for long-duration spaceflight medical research.

Keywords: transcranial ultrasonography, hydrocephalus, spaceflight, HALS, intracranial pressure, portable ultrasound

[Abstract:0139]

Acute mania in a commercial pilot with adulterated e-cigarette: a case report

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BACKGROUND:
Acute mania among flight crew represents a significant aeromedical event with immediate implications for aviation safety. A study conducted in the US in 2015 revealed 6.8% of airlines crew were using e-cigarette prior to flight. Distinguishing a primary psychiatric disorder from substance-induced disorder is critical, as the diagnosis directly influences treatment, prognosis, and aeromedical certification. The increasing availability of adulterated vaping products containing novel psychoactive substances presents an emerging challenge for aviation medicine and safety.

CASE:
A 43-year-old male commercial cargo pilot with over a decade of uneventful flying experience and no previous psychiatric or medical history developed an acute behavioural disturbance shortly after using a newly purchased e-cigarette cartridge during an international layover following a long-haul flight. He presented with severe agitation, grandiosity, markedly reduced need for sleep, persecutory delusions, hallucinations, and disorganised behaviour, culminating in a breach of airport security. Comprehensive investigations, including neuroimaging, cerebrospinal fluid analysis, routine toxicology screening, and laboratory studies, were unremarkable. The initial working diagnosis was a first episode of Bipolar I Disorder with Psychotic Features. However, fluctuating orientation, poor response to standard pharmacological treatment, and rapid spontaneous recovery prompted reconsideration of the diagnosis. Subsequent analysis of the vaping fluid identified multiple unexpected psychoactive substances, supporting a diagnosis of probable Substance-Induced Mood Disorder.

DISCUSSION:
This case illustrates the unexpected consequence of vaping and diagnostic complexity of evaluating acute psychiatric illness in safety-critical aviation personnel. Routine toxicology testing may fail to detect many emerging psychoactive compounds, increasing the risk of diagnostic error. This case also highlights the importance of obtaining a detailed history of vaping and novel substance exposure and considering specialised toxicological analysis when clinical findings are atypical.

CONCLUSION: As e-cigarette use becomes increasingly prevalent among aviation personnel, adulterated vaping products represent an under-recognised aeromedical hazard. This case underscores the need for heightened awareness among Aviation Medical Examiners and regulators, while reinforcing the importance of comprehensive psychiatric assessment and targeted toxicological investigations in pilots presenting with acute behavioural disturbance.

Keywords: Aviation Psychiatry, Aeromedical Certification, Pilot Mental Health, Substance-Induced Mood Disorder, Psychosis, Vaping

[Abstract:0141]

From Pathogenesis to Salutogenesis: Reframing Medical Regulation in Civil Aviation

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BACKGROUND: The concept of salutogenesis by Dr Aaron Antonovsky sees health as a dynamic continuum between total ease and disease. Aeromedical regulation has historically been grounded in pathogenic paradigm, emphasizing the identification of disease, quantification of medical incapacitation risk and establishing fitness to fly via dichotomization. While this approach remains fundamental to aviation safety, contemporary challenges—including those affecting the ageing pilot, increasing chronic disease burden, and evolving perspectives on mental health—highlight the need for complementary models that promote health and functional capacity for the aviation professionals as a key tenet to better manage aviation safety risks.

AIM: To examine the relevance of salutogenesis to civil aviation medical regulation and explore its potential integration to advancing aeromedical decision making and enhancing aviation safety.

METHODS: This review analyses the concept of salutogenesis, with particular emphasis on its 3 key pillars of sense of coherence (SOC), and considers their application within existing aeromedical regulatory frameworks. Potential intersections with health promotion, risk-based certification and return-to-flying assessments are explored.

RESULTS: Salutogenesis provides a useful framework that focuses on health promotion, mental resilience and adaptability, and the capacity to maintain safe performance despite medical challenges. Within aeromedical practice, this perspective supports a more holistic approach and improved assessment of pilots and air traffic controllers, encouraging early intervention, improved health engagement, and individualized risk management. A salutogenic approach does not diminish regulatory standards but complements traditional disease-focused assessments by recognizing factors that enhance operational fitness and long-term wellbeing.

CONCLUSION: Integrating salutogenic principles into the processes involving aeromedical examinations and regulation represents an opportunity to evolve towards a balanced framework that incorporates both risk mitigation and health promotion. Underpinning its success would be the depth of trust between aviation professionals, the aeromedical examiners and the regulator. Integrating a salutogenic approach would potentially enhance aeromedical risk identification and assessment leading to better aviation safety outcomes.

Keywords: civil aviation medical regulation, salutogenesis, sense of coherence, heath promotion in civil aviation

[Abstract:0142]

From Fatigue Assessment to Game-Based Training Intervention: A Closed-Loop Fatigue Management Framework for Air Traffic Controllers

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Background

Fatigue and circadian rhythm disruption are key factors affecting vigilance, cognitive stability, and occupational effectiveness in air traffic controllers (ATCOs). To improve the continuity and specificity of fatigue management, this project developed a closed-loop framework for frontline ATCOs that integrates multidimensional state assessment, risk identification, game-based training, and repeated evaluation into a continuous process for dynamic monitoring and targeted support.

Description

The framework comprises four core assessment domains: short-term cognitive control capacity, fatigue intensity warning, sleep homeostasis warning, and long-term occupational effectiveness. In the initial implementation, 233 valid questionnaires were collected from frontline ATCOs. Structured self-report scales were used to quantify attentional focus, perceived fatigue, sleep health, and overall occupational functioning. Preliminary results showed 74.25% of controllers reported a relatively fatigued state; 62.23% reported circadian rhythm disturbance or insufficient sleep quality. Long-term occupational-effectiveness assessment indicated that participants generally responded proactively to work demands and maintained stable overall occupational functioning, while optimization was still needed in energy management, emotional maintenance, and sustained self-regulation. Association analysis further suggested that controllers requiring improvement in long-term occupational effectiveness had more prominent short-term fatigue and sleep problems.In the intervention phase, assessment results are used to match controllers with corresponding training pathways. When fatigue-intensity or sleep-homeostasis indicators trigger predefined risk signals, controllers are directed to brief game-based modules targeting recovery, relaxation, attentional control, and cognitive activation.When weaknesses are identified in long-term occupational-effectiveness dimensions, specialized training content is assigned for emotional regulation, coping style, self-management, and occupational adaptability. Training effects are evaluated through repeated assessment and process data, including changes in fatigue intensity, sleep homeostasis, short-term cognitive control capacity, training completion, and occupational-effectiveness subdomains.

Discussion

This closed-loop framework connects fatigue-state identification with individualized training pathways and may provide a sustainable and traceable implementation model for fatigue risk management in ATCOs. Future studies should incorporate comparisons across risk groups and objective behavioral or physiological indicators to verify its effects on fatigue reduction, sleep improvement, and occupational effectiveness.

Keywords: Air traffic controllers, Fatigue management, Sleep homeostasis, Game-based training, Human performance, Occupational effectiveness

[Abstract:0143]

Post-Landing Orthostatic Intolerance after Spaceflight: characterization of Intravenous Fluid Resuscitation in NASA Astronauts

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INTRODUCTION: Post-landing orthostatic intolerance (OI) is a prevalent consequence of spaceflight and is often empirically treated with intravenous fluids (IVF) post-landing. Yet IVF administration lacks evidence-based guidelines. As future exploration missions will involve constrained medical resources and delayed support, understanding current post-landing IVF practices is operationally important.

METHODS: We conducted a retrospective review of de-identified flight surgeon documentation for 79 astronauts returning from International Space Station missions between 2001 and 2023. Clinical documentation from landing through post-landing day 3 was reviewed for symptoms consistent with OI, neurovestibular findings, vital sign abnormalities, antiemetic use, and IVF administration. IVF practices were characterized by receipt of fluids, timing, initial bolus volume, repeat boluses, and total administered volume. Associations between demographic and clinical variables were evaluated using chi-square or Fisher's exact testing, as appropriate, and logistic regression was used to assess clinical features associated with IVF receipt.

RESULTS: Nausea was documented in 39.2%, vomiting in 27.8%, dizziness or vertigo in 25.3%, and neurovestibular symptoms in 79.7%. IVF were administered to 41.8%, with marked variability in bolus volume (500-4000 mL). Female sex was associated with higher rates of nausea (p=0.014) and lightheadedness (p=0.033); older age with vomiting (p=0.037). No individual symptom significantly predicted IVF receipt. Haemodynamic triggers and post-infusion reassessment were inconsistently documented.

CONCLUSION: Post-landing management varied substantially, with heterogeneous IVF practices and limited protocolized documentation, underscoring the need for standardized, physiology-informed operational guidelines, particularly for future deep-space missions with constrained medical resources.

Keywords: orthostatic intolerance, spaceflight, microgravity, fluid resuscitation, post-landing recovery, astronaut health

[Abstract:0144]

Aero-medical Fitness of Aircrew Members and Passenger Health Standards Related to Higher Airspace Operations

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In the context of ongoing developments in Higher Airspace Operations (HAO) and growing interest in civil and commercial flights within this domain, EASA has been tasked by the European Commission to prepare a draft regulatory framework for HAO in the European Union. Within that framework, EASA commissioned the Royal Netherlands Aerospace Centre (NLR) to study the aero-medical fitness of aircrew and passenger health in order to develop medical standards and guidelines for HAO. We present the results of an assessment of existing literature and knowledge related to HAO.For this project, HAO was defined as operations above 55,000 ft involving vehicles with the aerodynamic or (sub-)orbital flight characteristics of an aircraft or balloon.The key physiological stressors associated with air transport operations conducted above 55,000 ft, which may potentially impact the health and performance of aircrew and passengers, include: Lowered atmospheric pressure (hypobaric hypoxia, decompression), Acceleration (G forces, push-pull effect), Microgravity, Cosmic radiation, Neuro-vestibular effects and spatial orientation, Vibration, Noise, potential immunological changes, Cabin air quality, and Psychological effects.The causal physical mechanisms and their (patho) physiological effects on human health and performance will be discussed with emphasis on lowered atmospheric pressure, accelerations, and cosmic radiation.Moreover, the further steps in the project and considerations for future rulemaking and development of operational medical guidelines will be discussed.

Keywords: Higher Airspace Operations, aero-medical fitness, aerospace medicine, passenger health standards, aero-medical requirements, regulatory framework

[Abstract:0145]

Toward Space Reproductive Medicine: A Framework for Women's Health During Long-Duration Spaceflight

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Background

Human space exploration is entering an era of prolonged missions to the Moon and Mars, where maintaining astronaut health throughout all mission phases is essential. Although operational standards have substantially advanced in cardiovascular, musculoskeletal, behavioral, and radiation medicine, women's reproductive health remains comparatively underrepresented despite the increasing participation of women in exploration-class missions. This interdisciplinary review examines whether current evidence supports the development of a dedicated framework for Space Reproductive Medicine.

METHODS: A structured literature review was conducted using PubMed, the NASA Life Sciences Data Archive, international clinical trial registries, astronaut health guidelines, and aerospace medicine literature. Additional evidence was identified from terrestrial analog environments, including Antarctic expeditions, underwater habitat missions, and confinement studies. Literature addressing reproductive endocrinology, menstrual health, fertility preservation, circadian biology, neuroendocrine adaptation, radiation exposure, and operational medical management was systematically reviewed and synthesized.

RESULTS: Current evidence indicates that female reproductive physiology may be affected by multiple spaceflight-associated stressors, including microgravity, ionizing radiation, circadian disruption, confinement, and chronic psychological stress. These factors may influence hypothalamic-pituitary-ovarian axis regulation, ovarian reserve, menstrual function, bone metabolism, immune responses, and long-term reproductive health. Existing countermeasures - including menstrual suppression strategies, fertility preservation, circadian light interventions, radiation mitigation, telemedicine, and behavioral health support - address individual risks but are not yet integrated into a comprehensive reproductive health strategy for long-duration missions.

CONCLUSIONS:
Future exploration-class missions require an integrated approach to women's reproductive health that extends beyond traditional aerospace medicine. Current evidence supports the development of Space Reproductive Medicine as an interdisciplinary framework integrating gynecology, reproductive endocrinology, chronobiology, radiation biology, and aerospace medicine. Establishing this framework may facilitate coordinated research priorities, evidence-informed operational protocols, and improved protection of women's reproductive health during future human exploration beyond Earth.

Keywords: Space medicine, women's health, reproductive medicine

[Abstract:0146]

Diabetes in Aviation: Safety, Performance, and Aeromedical Certification Implications for Pilots and Air Traffic Controllers

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EASA, European Commission

Background
To support potential updates to aeromedical requirements for pilots (Class 1, 2, and LAPL) and air traffic controllers (ATCOs, Class 3), the European Union Aviation Safety Agency (EASA) commissioned a three-year research project on diabetes mellitus to evaluate whether individuals treated with insulin could safely perform aviation duties and to assess associated operational, social, and economic impacts. The project was funded by the European Union's Horizon Europe Programme. Modern diabetes technologies, in particularly continuous glucose monitoring (CGM) and automated insulin delivery (AID) systems, offer the potential for enhanced glycaemic stability, reduced hypoglycaemia risk, and improved operational performance; however, their suitability in aviation requires rigorous evaluation.

Description
Evidence from hypobaric chamber simulations, real-world in-flight monitoring, and long-term observational datasets demonstrates that multiple CGM systems maintain adequate accuracy across aviation-relevant pressure changes. Simulated-flight studies showed strong correlations between CGM, plasma, and capillary glucose values ($r = 0.85–0.96$), with comparable performance at ground level and at cabin-equivalent pressures (~550 mmHg). CGM measurement times were substantially shorter than self-monitoring of blood glucose (SMBG) (mean 6.1 s vs. 46.9 s), reducing cockpit task load. In-flight evaluations within the ARA.MED.330 protocol further confirmed acceptable concordance (MARD 9.39%) and demonstrated pilot preference for CGM owing to real-time trend information, configurable alerts, and ease of use.AID and hybrid closed-loop systems were assessed both in vitro and in vivo. Although hypobaric conditions can displace small volumes of insulin within pump reservoirs, long-term operational data from certified pilots recorded no clinically significant hypoglycaemic events and demonstrated tighter glycaemic control in pump users compared with multiple daily injection regimens.

Discussion
Across all studies, CGM and AID technologies demonstrated robust performance, operational feasibility, and meaningful safety advantages. These systems reduce monitoring workload, improve detection of glycaemic excursions, and maintain reliability under aviation-specific environmental conditions. Collectively, the findings support the safe integration of modern diabetes technologies into future EASA aeromedical certification frameworks for pilots and ATCOs.

Keywords: Diabetes mellitus, continuous glucose monitoring, automated insulin delivery, aero-medical certification, hypoglycaemia, aero-medical requirements

[Abstract:0147]

How to develop an adverse outcome pathway for radiation-induced female infertility: a framework for space health risk assessment

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Background
As human space exploration expands toward longer duration missions, understanding reproductive risks associated with ionizing radiation has become an important priority in aerospace medicine. Radiation exposure can adversely affect female reproductive health through ovarian damage and disruption of the hypothalamic-pituitary-gonadal axis, in addition to ovarian-function long-term sequelae. Adverse Outcome Pathways (AOPs) provide a structured framework for organizing mechanistic evidence and translating biological knowledge into risk assessment tools. This tutorial review describes the process used to develop an AOP for radiation induced female infertility and highlights its application to space health research.

Description
The development of AOP 620 was undertaken through an international collaboration, beginning with defining the adverse outcome of interest (female infertility) and identifying the molecular initiating event associated with radiation exposure. A structured scoping review was then performed to collect mechanistic evidence from in vitro studies, animal models, human observations, and relevant spaceflight literature.Key events were identified, evaluated, and organized according to biological plausibility and empirical support. The resulting pathway links radiation energy deposition to oxidative stress, DNA damage, oocyte apoptosis, and depletion of the ovarian follicular reserve, ultimately leading to infertility. Existing pathways within the AOP-Wiki (AOPs 238, 311, and 396) were integrated where appropriate to strengthen mechanistic consistency and avoid duplication of evidence. The final framework was refined through expert review and consensus building among multidisciplinary contributors.

Discussion
This review demonstrates a practical approach for developing an AOP in support of space health risk assessment. The methodology can be applied to other spaceflight hazards and health outcomes where mechanistic evidence must be integrated across multiple disciplines and model systems. In addition to supporting astronaut health protection, the framework may facilitate biomarker discovery, countermeasure development, and evidence based evaluation of reproductive risks associated with radiation exposure on Earth. The experience gained from developing AOP 620 provides a transferable roadmap for researchers seeking to construct AOPs for complex biomedical challenges in aerospace medicine.

Keywords: Space Medicine, Space Radiation, Female Reproductive Health, Adverse Outcome Pathway (AOP), Diminished Ovarian Reserve, Space Health Research

[Abstract:0148]

From arrhythmic risk to operational risk: aeromedical decision-making in a fighter pilot with low-risk ventricular pre-excitation

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BACKGROUND:
Current cardiology guidelines allow conservative management of many asymptomatic patients with low-risk Wolff–Parkinson–White (WPW) pattern and consider catheter ablation reasonable when ventricular pre-excitation limits eligibility for high-risk occupations such as piloting. However, they do not distinguish between different aviation environments, where operational demands and the acceptable level of residual risk may vary considerably. This case illustrates how aeromedical decision-making may extend beyond conventional electrophysiological risk stratification when assessing fitness for fighter flying.

Case presentation:

A 25-year-old Royal Moroccan Air Force fighter pilot presented a Wolff-Parkinson-White (WPW) pattern during his annual medical assessment. He was asymptomatic and had no history of structural heart disease and no family history of WPW or of sudden cardiac death (SCD). He was deemed temporarily unfit to fly pending further cardiological evaluation and risk stratification of his WPW pattern. Holter monitoring showed intermittent accessory pathway (AP). Stress test showed abrupt disappearance of the delta wave. Electrophysiological study (EPS) identified a right anterolateral AP with an accessory pathway effective refractory period (APERP) of 360ms suggesting a low-risk accessory pathway. All the same, our pilot underwent radiofrequency ablation (RFA) given the operational demands of fighter aviation. The procedure was successful, with a complete disappearance of AP conduction confirmed on EPS. After a six-month observation period in which serial electrocardiograms (ECG), ambulatory Holter monitoring and an in-flight Holter recording demonstrated no recurrence or significant arrhythmias, our pilot was granted a waiver and returned to his flying duties.

DISCUSSION:
This case illustrates the limitations of relying solely on conventional cardiological risk stratification when assessing fitness for combat aviation. While AP showed low-risk characteristics, fighter aviation imposes unique physiological and operational constraints such as hypoxia, intense cognitive workload, single-pilot operations and most importantly repeated +Gz exposure which increase the operational impact of otherwise low-probability events. This high-demanding environment with a low tolerance of risk combined with the high success rate and low complications of RFA were all taken into consideration to justify the chosen management strategy.

CONCLUSION: Electrophysiological investigations estimate the probability of an arrhythmic event, whereas aeromedical assessment must determine whether the residual risk is acceptable within a mission where even transient subtle or sudden incapacitation may have catastrophic consequences. This once again highlights the role of aeromedical experts in integrating cardiological risk stratification with operational considerations to individualize aeromedical decision-making with flight safety as the ultimate priority.

Keywords: ventricular pre-excitation, fighter aviation, radiofrequency catheter ablation, aviation medicine, Wolff-Parkinson-White pattern

[Abstract:0149]

Photon-Counting CT in Cardiac Imaging—Impact and Potential for Aviation Medical Risk Stratification

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The early and reliable detection of coronary artery disease (CAD) represents a key challenge in aeromedical evaluation. Given the potentially serious consequences of an acute cardiac event during flight operations, highly sensitive, noninvasive diagnostics are of particular importance. The relevance was recently underscored once again by the results of the SUSPECT study as well as the current recommendations of the NATO Aerospace Cardiology Working Group at this year's annual meeting of the Aerospace Medical Association (AsMA) in Denver.Conventional screening methods such as resting ECG, and exercise ECG have insufficient diagnostic sensitivity, particularly when it comes to detecting subclinical coronary lesions. Coronary CT angiography (CCTA) has therefore established itself in recent years as a key pillar of noninvasive CAD diagnostics due to its high sensitivity and excellent negative predictive value. However, limitations have existed to date, particularly in patients with severe coronary calcification or those who have already had coronary stents implanted. This is due in particular to blooming artifacts, which lead to an overestimation of the stenosis and often necessitate further diagnostic procedures such as invasive coronary angiography or functional ischemia testing. Although continuous technical advancements in CT systems have led to improvement in image quality, they have not been able to completely overcome the physically inherent limitations of conventional energy-integrating detectors.With the introduction of photon-counting detector CT (PCD-CT), a detector technology is now available for the first time that directly detects individual X-ray photons and distinguishes them based on their energy. This achieves an unprecedented isotropic spatial resolution of up to 0.2 mm, a significant reduction in blooming artifacts, and an improved contrast-to-noise ratio. In particular, this significantly improves the ability to assess heavily calcified coronary segments and intracoronary stents. Furthermore, the high spatial resolution enables more reliable detection of vulnerable plaques, whose rupture can lead to an acute cardiac event long before the onset of hemodynamically significant stenosis.We present exemplary cases from the first five months of clinical use of a PCD-CT system at our Centre for Aerospace Medicine in Cologne in pilots and flight crew.From an aeromedical perspective, photon-counting detector CT makes it possible to identify CAD requiring treatment earlier and with greater diagnostic certainty. Particularly in light of an aging pilot population, this technology has the potential to make an important contribution to further enhancing flight safety.

Keywords: Photon-Counting-CT, Cardiac CTA, aeromedical risk stratification, flight safety, aging pilots

[Abstract:0150]

Multi-Modal Physiological and Behavioral Fatigue Risk Assessment in Student Pilots: Integrating Resting HRV, In-Flight Autonomic Monitoring, Neurobehavioral Performance, and Subjective Workload

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ICAM 2026 Category: Original Research

TITLE:
Multi-Modal Physiological and Behavioral Fatigue Risk Assessment in Student Pilots: Integrating Resting HRV, In-Flight Autonomic Monitoring, Neurobehavioral Performance, and Subjective Workload
INTRODUCTION: Fatigue is a leading contributory factor in aviation accidents, yet operational monitoring remains largely dependent on self-report. Student pilots are a particularly vulnerable population due to high cognitive load, irregular sleep, and limited flight experience. This study examined whether convergent multi-modal physiological monitoring could differentiate fatigue risk profiles within a student pilot cohort undergoing flight simulator training.

METHODS: Seven student pilots (mean age 24.3 ± 7.1 years) at a flight training academy underwent a structured multi-layered protocol. Resting evaluation included 5-minute supine HRV recording, photoplethysmography-based arteriography (blood pressure, pulse wave velocity, augmentation index), dry-electrode EEG (frontal alpha power), near-infrared muscle oximetry (Moxy), skin temperature, and a PHAPA subjective questionnaire. Each pilot completed a flight simulator session (48–96 minutes) with continuous beat-to-beat cardiac recording (Movesense), from which time-domain HRV metrics (SDNN, RMSSD, pNN50) were extracted. Post-session assessments included the NASA Task Load Index (TLX) and Psychomotor Vigilance Task (PVT). Morning sleepiness was evaluated via the Karolinska Sleepiness Scale (KSS).

RESULTS: Three fatigue mechanisms were identified through cross-domain convergence. Chronic autonomic depletion manifested as resting RMSSD below 20 ms, blunted in-session heart rate response (delta HR +10.5 bpm), near-zero RMSSD plasticity, elevated pulse wave velocity (8.2 m/s), and the worst PVT performance (mean RT 356 ms, 3 lapses). Acute sleep-debt compensation produced paradoxical RMSSD elevation during the task (+38.2%) with the highest session mean heart rate (118.5 bpm), KSS of 7, and partially preserved but costly behavioral output. Adaptive workload response showed expected parasympathetic withdrawal (RMSSD change -18% to -28%) with preserved PVT performance. A strong correlation emerged between morning KSS and in-session mean heart rate ($r \approx +0.82$), demonstrating that sleep deprivation imposes measurable cardiovascular cost independent of behavioral performance.

CONCLUSIONS:
Single-modality assessment — resting HRV, self-report, or behavioral testing alone — was insufficient to characterise fatigue risk in this cohort. The rest-to-task RMSSD change (autonomic plasticity index) emerged as the most operationally informative derived metric. These findings support integration of continuous in-flight autonomic monitoring into fatigue risk management systems for flight training environments.

Keywords: fatigue risk management, heart rate variability, aviation medicine, student pilots, psychomotor vigilance, NASA-TLX, autonomic nervous system, flight simulation

Keywords: Fatigue Risk Management, Heart Rate Variability, Aviation Medicine, Flight Simulation

[Abstract:0153]

ARTEMIS 4557 - Mitigating Hypoxic Stress and Supporting Early Autonomic Adaptation Through Virtual Reality Mindfulness: An Operational Countermeasure for High-Altitude Deployments

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BACKGROUND: Rapid deployment to high altitude exposes military personnel to concurrent physiological hypoxia and psychological stress, impairing operational readiness and cognitive performance. Scalable, non-pharmacological countermeasures are needed to accelerate acclimatization and enhance resilience. These challenges also affect military and civilian personnel operating in Isolated, Confined, and Extreme (ICE) environments.

OBJECTIVE: To evaluate the efficacy of immersive Virtual Reality (VR) mindfulness compared with standard audio-guided mindfulness in mitigating autonomic and psychological stress during acute high-altitude exposure, with implications for maintaining cognitive and operational performance in aerospace and ICE environments.

METHODS: Twenty-four participants completed a 2-week baseline phase at low altitude followed by acute altitude exposure (Days 15–19). Participants were assigned to one of five experimental groups across two operational altitudes: 4,557 m above sea level (a.s.l.) with VR mindfulness (G1) or audio mindfulness (G2/Reference); or 3,600 m a.s.l. with VR mindfulness (G3), audio mindfulness (G4), or no-intervention control (G5). Daily PPG measured heart rate and Heart Rate Variability (HRV; RMSSD). Psychological outcomes were assessed weekly (T1–T5) using the Perceived Stress Scale (PSS) and Toronto Mindfulness Scale (TMS), analyzed via Linear Mixed-Effects Models (LMM) with baseline covariance control.

RESULTS: Acute exposure to 4,557 m markedly increased psychological stress; the standard audio-mindfulness group (G2) exhibited a near-doubling of perceived stress from pre-intervention to altitude (PSS increase of +14.00 points, $p < 0.001$). The VR-mindfulness intervention at 4,557 m (G1) significantly attenuated this stress surge by 7.20 points compared with audio support ($p = 0.002$). Acute hypoxia elevated mean heart rate across all groups, peaking at 4,557 m (+18.7 bpm). However, a significant between-group effect emerged for parasympathetic modulation (RMSSD) during the altitude phase (Kruskal–Wallis $H = 12.22$, $p = 0.016$). Individual trajectories showed concurrent increases in heart rate and RMSSD only in participants utilizing VR mindfulness at extreme altitude.

Conclusion & Operational Relevance: VR mindfulness demonstrated greater psychological protection against acute high-altitude stress than conventional audio guidance while promoting an autonomic profile consistent with enhanced physiological resilience and early adaptation to hypoxia. As a lightweight, field-deployable intervention, VR mindfulness represents a promising countermeasure for pre-deployment use. These findings support its application to military personnel, aircrew, and pilots operating in hypoxic, isolated, confined, and extreme environments, where maintaining stress regulation, autonomic resilience, cognitive performance, and decision-making is critical for flight safety and mission success.

Keywords: Mindfulness, High-Altitude Hypoxia, Heart Rate Variability, Virtual Reality, Autonomic Resilience

[Abstract:0154]

Historical Evolution of Cardiovascular and Diabetes Rulemaking in FAA Aerospace Medicine

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BACKGROUND: Cardiovascular disease and diabetes provide illustrative examples of how aeromedical policy has evolved in response to changing medical evidence, operational experience, and regulatory priorities. Over the past decades, the FAA Office of Aerospace Medicine has examined whether evolving medical evidence justified changes to certification standards and screening practices. This review examines how these conditions have shaped FAA rulemaking.

Description: Publicly available Federal Register notices, final rules, and FAA policy documents related to cardiovascular disease and diabetes were reviewed. Emphasis was placed on the comprehensive 1996 revision of Title 14 Code of Federal Regulations (CFR) Part 67, including proposals involving cardiovascular screening (including serum cholesterol testing and electrocardiograms for Second Class applicants), evolution of certification pathways for diabetes, and more recent congressional direction affecting aeromedical policy. The historical record demonstrates that several proposed preventive screening requirements were ultimately withdrawn after public comment and cost-benefit analysis. Other initiatives, including modernization of diabetes certification, were implemented following accumulation of operational and medical evidence. This revision maintained diabetes as specifically disqualifying but formalized pathways for special issuance certification for certain applicants with controlled diabetes, reflecting improved understanding of disease management and risk. Recent provisions of the FAA Reauthorization Act of 2024, including congressional direction to reevaluate emergency medical equipment aboard commercial aircraft, specifically address cardiac arrest, among other emergency medical needs, in calling for a need for updated regulation.

DISCUSSION: The history of FAA cardiovascular and diabetes policy demonstrates that successful aeromedical rulemaking has depended upon a demonstrable aviation safety need, contemporary medical evidence, transparent consideration of stakeholder comments, and a favorable balance between expected safety benefit and regulatory burden. Understanding these historical precedents provides context for future discussions regarding cardiovascular and diabetes risk assessment and other emerging preventive strategies within aeromedical certification.

Keywords: Aeromedical certification, rulemaking, cardiovascular disease, diabetes mellitus

[Abstract:0156]

Cardiovascular Diseases in Pilots and Air Traffic Controllers: New Treatments and Diagnostic Measures

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INTRODUCTION
Cardiovascular disease remains a major challenge in aeromedical assessment, with direct implications for aviation safety and the professional careers of pilots and air traffic controllers (ATCOs). Cardiovascular events represent a significant operational risk, while unnecessary grounding of personnel must be avoided. Recent advances in cardiovascular diagnostics, treatment, and monitoring enable more accurate risk stratification and individualized aeromedical decision-making. The CaVD-PACE Research project was initiated to evaluate these developments and assess their relevance for aviation medicine.

METHODS
The CaVD-PACE Research project, commissioned by the European Union Aviation Safety Agency (EASA) and conducted by DLR, reviewed current scientific evidence on cardiovascular diagnostics, treatments, and medical technologies relevant to pilots and ATCOs. Operational implications under flight and air traffic control conditions were assessed, and an impact assessment of potential regulatory updates was performed. Key focus areas included advanced imaging and monitoring technologies, modern pharmacological therapies, implantable cardiac devices, and the development of cardiovascular risk management tools. Guidance and training materials for aeromedical examiners were also developed.

RESULTS
Advanced diagnostic and monitoring techniques enabled earlier and more accurate detection of cardiovascular conditions, improving risk prediction. Modern treatment strategies, including minimally invasive procedures and improved medications, supported safer and earlier return to duty. A flexible, role-specific, matrix-based risk assessment approach improved aeromedical decision-making while reducing unnecessary restrictions. Expanded assessment criteria, including early coronary dysfunction, subtle arrhythmias, modern pacemaker systems, valvular and aortic disease, myocarditis, long-COVID effects, and unexplained syncope, strengthened the overall safety framework. Updated guidance and structured training improved consistency and alignment with current cardiology standards.

CONCLUSIONS
The CaVD-PACE Research project provides an evidence-based foundation for updating cardiovascular aeromedical requirements in line with current medical advances. Integration of new diagnostic technologies, refined risk estimation tools, and tailored assessment strategies enhances aviation safety while supporting workforce sustainability for pilots and ATCOs.

Keywords: Aeromedical cardiovascular risk assessment, Advanced cardiac diagnostics, Risk stratification, Aviation safety

[Abstract:0157]

You Star What You Eat: Fueling the Next Generation of Crewed Exploration

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Background
The Artemis missions and subsequent crewed missions to Mars present many barriers to success. One barrier is the high energy needs of crew members during long-duration spaceflight. Fueling the human body in the hostile environment of space leads to caloric deficits, muscle breakdown, bone density loss, immune system dysregulation, and gastrointestinal dysfunction. Advancements in nutrition science will be a priority to maximize crew performance and combat the myriad deleterious effects of spaceflight on the human body.

OBJECTIVE: The main aim of this review is to capture the current state of space nutrition science. Specifically, we aim to define the nutritional challenge, identify key knowledge gaps, identify emerging technologies for Artemis and beyond, and highlight research pertinent to long-duration spaceflight.

METHODS: A structured literature review of publications from 2015-2026 was conducted using PubMed, NASA Technical Reports Server (NTRS), and ClinicalTrials.gov. Domains included macronutrient and micronutrient requirements, bone and muscle physiology, immunology, oxidative stress, gut microbiome dynamics, and food systems technology. Fifty key references were used for the review.Key Findings We identified six key knowledge gaps: (1) lack of of pharmacogenomic frameworks for personalized nutritional countermeasures; (2) incomplete understanding of how spaceflight-induced insulin resistance interacts with systemic inflammation; (3) inadequate characterization of micronutrient degradation due to cosmic radiation; (4) scant evidence on dietary modulation of the gut–brain axis during prolonged isolation and confinement; (5) limited high-Z, high-energy (HZE) particle-specific data validating protective antioxidant strategies; and (6) sex-stratified nutritional evidence gaps relevant to Artemis crew diversity. Artemis introduces novel challenges that the ISS-era food systems cannot fully address, including Orion’s refrigeration-free design, strict mass constraints, and full deep-space radiation exposure. Emerging technologies include bioregenerative plant growth systems, precision fermentation bioreactors, 3D food printing, and biosensor-guided personalized nutrition. The Enhanced Diet ISS flight study and SANS B-vitamin supplementation trials are two research projects that will inform next-generation nutritional countermeasures.

CONCLUSIONS: Artemis missions will serve as the translational bridge between ISS-era nutrition knowledge and Mars mission readiness. Closing these identified gaps through personalized, technology-enabled, and evidence-based dietary and nutritional measures is necessary to ensure crew health, crew performance, and long-duration mission success.

Keywords: Space medicine, nutrition, Artemis, Mars, long-duration spaceflight

[Abstract:0161]

The gut microbiome under cosmic radiation: implications for astronaut health during long-duration spaceflight

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The gut microbiome has emerged as a fundamental regulator of immune homeostasis, metabolic function, intestinal barrier integrity, and neuroimmune communication, making it a critical determinant of astronaut health during long-duration spaceflight. As human exploration expands beyond low Earth orbit toward Artemis and future Mars missions, exposure to galactic cosmic rays (GCR) and solar particle events (SPE) represents one of the greatest biomedical challenges due to the unique biological effects of high-linear energy transfer (high-LET) radiation.While spaceflight-induced gut dysbiosis has been consistently documented, the independent contribution of cosmic radiation has remained difficult to define because of its interaction with other environmental stressors, including microgravity, confinement, circadian disruption, and dietary changes. This review synthesizes current evidence examining cosmic radiation as a specific driver of gut microbiome dysbiosis and its implications for astronaut health. Available data demonstrate that radiation exposure promotes depletion of butyrate-producing bacterial taxa, particularly *Lachnospiraceae* and *Ruminococcaceae*, transient expansion of *Proteobacteria*, and alterations in the *Firmicutes/Bacteroidetes* ratio, resulting in reduced production of short-chain fatty acids and disruption of intestinal microbial homeostasis.These microbial alterations are consistently associated with downregulation of tight junction proteins, increased intestinal permeability, persistent activation of the TLR4/NF-κB inflammatory pathway, impaired tryptophan metabolism, immune dysregulation, and dysregulation of the RANKL/OPG signaling axis, contributing to systemic inflammation and trabecular bone loss. Emerging evidence further suggests that probiotic strains such as *Lactobacillus rhamnosus* GG and *Lactobacillus reuteri*, together with synbiotic interventions, may partially preserve microbial homeostasis and attenuate radiation-induced inflammatory responses, highlighting their potential as microbiome-directed countermeasures. Collectively, current evidence identifies the gut microbiome as a central mediator of the physiological response to deep-space radiation and supports its incorporation into aerospace medical risk assessment, health surveillance, and precision countermeasure development. Advancing our understanding of radiation-induced microbial dysbiosis will be essential for safeguarding crew health and maintaining operational performance during future exploration-class missions beyond low Earth orbit.

Keywords: Gut Microbiome, GCR, Dysbiosis, Probiotics, Long-duration Spaceflight, Intestinal Permeability

[Abstract:0162]

Evaluation of Basic Life Support Algorithm Feasibility in a Microgravity Analogue Using the Crew Medical Restraint System Integrated with the Atmed Restraint System

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INTRODUCTION: Performing cardiopulmonary resuscitation (CPR) in microgravity environments poses a severe physiological and physical challenge for astronaut-rescuers. The lack of perceptible gravity prevents rescuers from utilizing their body weight during manual external chest compressions (meCC). Furthermore, the absence of a stable support point induces critical shifts in movement biomechanics and kinematics. This study aimed to evaluate the feasibility and performance of the standard BLS chest compression sequence within a microgravity analogue.

METHODS: Microgravity conditions were simulated utilizing the Neutral Buoyancy Training Pool (NBTP) and the Human Training Centrifuge (HTC), involving cohorts of four and nine healthy volunteers, respectively. Rescuers assumed a kneeling position, straddling the patient simulator's hips. Structural stabilization was maintained using an enhanced Crew Medical Restraint System (CMRS) integrated with specialized anchoring handles from the Atmed Restraint System (ARS) to secure the lower limbs. The experimental protocol required executing meCC according to American Heart Association (AHA) and European Resuscitation Council (ERC) guidelines. Statistical analysis was performed to evaluate the differences between the conditions.

RESULTS: A marked increase in the rescuer's subjective fatigue level and an elevation in physical exertion were observed during meCC in simulated microgravity compared to the 1g control trials. Electromyographic data demonstrated a two-fold increase in the muscular activity of both the limbs and the torso relative to Earth conditions. Consequently, standard chest compression effectiveness targets—comprising a rate of 100–120 compressions per minute and a depth of 5–6 cm—were maintained only during the first three to four cycles, and could not be sustained throughout the full five-cycle protocol.

CONCLUSIONS:
Microgravity environments force an increased recruitment of postural and core muscles to generate the downward forces necessary for standard meCC. These findings indicate that manual chest compressions are highly strenuous in microgravity analogues. This suggests a critical need to re-evaluate spaceflight emergency resuscitation guidelines, specifically by recommending more frequent rotation changes between rescuers to prevent fatigue-induced drop in compression quality. Definitive validation requires operational testing onboard the International Space Station (ISS).

Keywords: Space Medicine, Microgravity Analogue, Cardiopulmonary Resuscitation (CPR), Crew Medical Restraint System (CMRS), Atmed Restraint System (ARS)

[Abstract:0163]

Obstructive Sleep Apnea Screening in Military Pilots: Performance of the STOP-BANG Questionnaire and Development of a Novel Predictive Model

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BACKGROUND:
Obstructive Sleep Apnea Syndrome (OSAS) is a condition of major relevance in aerospace medicine, as it is associated with excessive daytime sleepiness, impaired cognitive performance, and increased operational risk. Early identification of individuals at risk is therefore essential, particularly in highly selected populations such as military pilots. The aim of this study was to evaluate the effectiveness of the STOP-BANG questionnaire as a screening tool for OSAS in this specific population.

METHODS: A total of 115 first-class military pilots undergoing periodic medical evaluation were enrolled in the study. All subjects underwent OSAS risk assessment using the STOP-BANG questionnaire, a validated screening tool for sleep apnea risk stratification. Pilots with a score between 3 and 4 subsequently underwent specialist otolaryngological evaluation, including fiberoptic laryngoscopy and Müller maneuver, to identify anatomical and functional abnormalities predisposing to upper airway obstruction. Subjects considered at risk were then referred for polysomnography, the diagnostic gold standard for OSAS.

RESULTS: Among subjects selected through second-level screening, polysomnography confirmed the diagnosis of OSAS in 12% of cases. However, only 3% of the overall cohort required treatment with Continuous Positive Airway Pressure (CPAP), indicating clinically significant disease. These findings highlight a discrepancy between positive initial screening results and actual therapeutic need.

CONCLUSIONS:
The STOP-BANG questionnaire confirms its high sensitivity as an initial screening tool for OSAS; however, its specificity appears limited in the military pilot population, which is characterized by unique physical and clinical requirements. These findings suggest the need for more specific screening tools tailored to the aeromedical setting, integrating objective parameters and subjective clinical features to improve identification of individuals truly at risk for OSAS.

Keywords: OSAS, Stop Bang, Risk assessment, Risk prediction

[Abstract:0164]

Predictive neural artificial intelligence for autonomous cognitive, emotional, and operational support during long-duration spaceflight

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Long-duration spaceflights represent one of the greatest challenges to the physical, mental, and operational health of astronauts due to prolonged exposure to extreme conditions such as isolation, confinement, distance from Earth, disruption of sleep cycles, psychological pressure, and the need to make critical decisions during highly demanding situations. For this reason, astronaut candidates and crew members are evaluated and trained through simulation exercises, analog missions, and controlled environments that make it possible to observe their performance, emotional adaptation, teamwork, and ability to respond to complex situations.As space missions increase in duration and move farther away from Earth's orbit, crew autonomy becomes a determining factor, since communication with Earth may experience significant delays and limit immediate assistance from control centers. In this context, a proposal is presented for the development of a neural system connected to predictive artificial intelligence, aimed at supporting decision-making, emotional control, and the monitoring of astronauts' cognitive-behavioral state during extended missions.The goal is to integrate biometric data, behavioral patterns, emotional indicators, and environmental variables in order to analyze the user's state in real time and anticipate potential risks related to stress, fatigue, anxiety, decreased performance, interpersonal conflicts, or impulsive decision-making. Based on this analysis, the artificial intelligence could generate early alerts, personalized recommendations, and emotional regulation strategies that allow the astronaut to recognize timely changes in their physical and mental state, strengthening their self-control, well-being, and ability to collaborate with the crew.

Keywords: Artificial Intelligence, Neural System, Astronaut Health, Biometric Data, Emotional Regulation

[Abstract:0168]

A Multidimensional Framework for Fatigue Monitoring in Long-Haul Airline Pilots: A Wearable-Based Proof-of-Concept Study

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INTRODUCTION: Long-haul operations expose pilots to prolonged wakefulness, circadian disruption, and sustained operational demands, increasing sleepiness and cumulative fatigue. Although wearable monitoring has been proposed to support Fatigue Risk Management Systems (FRMS), continuous in-flight physiological monitoring using algorithms validated against polysomnography (PSG), the gold standard for sleep assessment, has not yet been evaluated in operational settings. Furthermore, the feasibility of acquiring high-quality physiological signals throughout different flight phases remains unclear. This proof-of-concept study aims to assess the feasibility of continuous wearable monitoring while exploring multidimensional determinants of fatigue in long-haul pilots.

METHODS: This prospective observational study will enrol 20 active long-haul pilots operating flight sectors exceeding 10 hours. Participants will wear a Garmin smartwatch for three months to record photoplethysmography-derived heart rate (HR), RR intervals, heart rate variability (HRV), actigraphy, and peripheral oxygen saturation. Wearable data will be analysed using validated algorithms for sleep staging and HRV-based sleep prediction.Obstructive sleep apnoea (OSA) risk will be screened at baseline using the STOP-Bang questionnaire. Pilots with previously diagnosed or clinically confirmed moderate-to-severe OSA will be excluded. Primary feasibility outcomes will include signal quality across ground operations, cruise, controlled rest, and bunk rest, together with wear time, adherence, acceptability, and privacy-related concerns.Sleepiness, fatigue, affective state, and vigilance will be assessed before duty, after duty, and 24 hours post-duty using the Karolinska Sleepiness Scale, Samn–Perelli Fatigue Scale, Swedish Occupational Fatigue Inventory, visual analogue affect scales, and the Psychomotor Vigilance Task–Brief. Baseline, day-45, and day-90 assessments will include the Epworth Sleepiness Scale, reduced Morningness–Eveningness Questionnaire, Work Ability Index, Multidimensional Fatigue Inventory, Chrononutrition Questionnaire, and Caffeine Consumption Questionnaire–Revised.Controlled rest, bunk rest, crew role, flight direction, time-zone crossings, layover timing, and cumulative 168-hour workload exposure will be recorded. Linear mixed-effects models will evaluate associations between wearable-derived physiological metrics and subjective, cognitive, nutritional, and operational outcomes while adjusting for circadian and OSA-related factors.The study is observational and will not modify flight operations, crew scheduling, controlled-rest procedures, bunk-rest opportunities, or operational decision-making. No questionnaires or psychomotor testing will be conducted during active flight duty. In-flight data collection will rely exclusively on passive wearable monitoring.The study is expected to establish the feasibility, acceptability, and signal quality of continuous in-flight wearable monitoring, quantify relationships between physiological measures, subjective fatigue, and vigilance performance,

CONCLUSION: This study will provide a framework for fatigue monitoring in long-haul pilots and support integration of wearable physiology into FRMS.

Keywords: Fatigue, Risk Managemen, Wearable monitoring

[Abstract:0170]

Transitioning Aeromedical Responsibility From Public To Private Sector: A Practical Framework And Lessons Learned From Panafricare Clinic

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BACKGROUND:
The transition of aeromedical certification responsibilities for pilots, cabin crew, and air traffic controllers from the public to the private sector presents operational, regulatoryand cultural challenges. This is particularly relevant in small or resource-limited settings where legacy systems and data fragmentation are common. This review describes the structured approach adopted by Panafricare Clinic, the first and only TEMOS-accredited clinic in the Indian Ocean island nation of Seychelles, to implement aeromedical certification services in accordance with European Union Aviation Safety Agency (EASA) guidelines.

Description:
Panafricare Clinic assumed responsibility for aviation medical assessments for a cohort previously managed within the government sector. The transition focused on three key domains: regulatory alignment with EASA aeromedical standards, reconstruction of medical records, and implementation of standardized assessment processes. A major challenge was the absence of accessible historical medical data, requiring reconstruction through comprehensive baseline evaluations and patient-reported histories. esistance from some aviation personnel was encountered, driven by concerns over confidentiality, perceived stricter enforcement of medical standards, and uncertainty regarding private sector oversight. Compliance issues included missed appointments,incomplete documentation, and inconsistent follow-up. To address these challenges, a structured onboarding and engagement framework was implemented, inlcuding the formulation of a Safety Management System (SMS) Manual. This included targeted communication and education sessions to clarify EASA requirements and reassure staff regarding confidentiality and clinical governance. A centralized digital medical record system was introduced to ensure continuity and traceability. Standardized assessment templates, recall systems, and compliance tracking mechanisms were established to improve consistency and adherence. Collaboration with the aviation authority supported trust-building and facilitated operational integration.

DISCUSSION: This transition highlights that effective transfer of aeromedical services requires coordinated system design, local authority engagement, and adherence to international standards. Early establishment of data systems, transparent communication, and proactive compliance management are critical to success. Alignment with EASA guidelines provided a robust regulatory framework and improved standardization of care. This model offers a practical framework for similar transitions in comparable settings, emphasizing the importance of governance, digitalization, and workforce engagement in maintaining aviation safety standards.

Keywords: Aeromedical Certification, Aviation Medicine, EASA Part-MED, Regulatory Transition, Safety Management System, Digital Health Records

[Abstract:0172]

Coming Home, A Critical Phase of Adaptation: The Blind Spot of Preparation for Analogue and Space Environments

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Ever since humankind first looked up at the stars, it has prepared to reach them. Astronauts and professionals of isolated, confined, extreme and unusual environments (ICE/EUE) are selected and trained with the utmost rigour to meet the demands of their mission. Yet one moment escapes this preparation: the recovery upon return from a mission. Our successive studies converge on a largely overlooked finding. Recovery is an adaptive phase in its own right, critical and at times more deleterious than the mission itself, for which no dedicated provision currently exists. Our systematic review (Le Roy et al., 2023) had already underlined the scarcity of data on this period. Thus, the objective is to characterise, across four space analogues, the psychophysiological and sensory responses observed during recovery, in order to establish the return as a distinct adaptive transition. Recovery data from four ecological studies conducted on distinct populations were analysed: a five-day sea survival (n = 21), two parabolic flight campaigns (sleep, n = 17–20; space tourism, n = 17), and a nuclear ballistic-missile submarine patrol (n = 19), set against a one-year Antarctic overwintering (n = 17). These studies assessed interoceptive awareness, emotional state, physiological and perceived sleep quality, heart rate variability, and exteroceptive acuity.Across all contexts, the return reflected not restoration but persistent, sometimes worsening, impairment. After sea survival, sleep, interoception and sensory discrimination were not recovered, with some indices deteriorating further. In the space-tourism context, interoceptive awareness and affect declined as early as the following day and remained altered one week after the flight, most markedly in individuals with high parasympathetic tone. In parabolic flight, actimetry objectively revealed greater sleep fragmentation, contrasting with an improved subjective experience. In submariners, postural stability and bodily awareness remained impaired one month after the patrol. In Antarctica, the second day after return underline a decline in interoception, emotional state and flow, recovery proving as demanding as the mission. The recovery is a high-risk transition that is systematically underestimated. These findings argue for embedding, from the pre-departure phase onward, dedicated post-mission modules coupled with structured support throughout recovery. As humankind prepares to cross new frontiers, preparing the return as carefully as the departure becomes a condition for the health and success of crews on future long-duration missions.

Keywords: Adaptation, Extreme and Unusual Environements, Isolated and Extreme Environments, Recovery, Space Analogues

[Abstract:0173]

Cave Environments as High-Fidelity Analogues for Future Lunar Surface Missions: Human Factors Insights from the DEEP Time

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NASA's Artemis program and the renewed push for a sustained lunar presence require terrestrial analogs that reproduce the operational, psychological, and physiological constraints of long-duration missions: confinement, isolation, autonomy from mission control, disrupted temporal cues, and limited resources. Deep caves combine physical isolation, absence of natural light, communication constraints, and environmental uncertainty, making them promising planetary analogs. We report two complementary isolation missions conducted in the Lombrives Cave (France) that together position this environment as a high-fidelity lunar analog. A first mission, DEEP Time 40 days (15 participants, 8 men/7 women), placed a self-organized group in total temporal isolation—no daylight, clocks, or outside communication (~10°C, ~100% humidity), generating its own power and water. It opened a broad field of questions on temporal cognition, circadian regulation, and collective organization. A second mission, DEEP Time 15 days (17 participants, 9 women/8 men), refined these questions with intensive psychophysiological monitoring: sleep-wake cycles, cognitive performance, autonomic regulation, and psychobehavioral functioning. During DEEP Time 40 days, individual rhythms shifted to marked free-running (cycle length ~24→~32 h) while sleep-to-wake homeostasis was preserved. Core body temperature rhythms remained oscillatory but highly variable (periods 19.5–86.4 h), indicating early internal desynchronization followed by partial re-alignment. At the collective level, coordination progressively deteriorated, declining co-activity and only transient, weakly synchronized subgroups. Organization was rapidly restored once time cues returned. In parallel, vascular and organ imaging revealed no deconditioning, consistent with a protective role of the large habitat volume and sustained physical activity. DEEP Time 15 days clarified individual adaptation dynamics. Overall, sleep quality and the cardiac biosignal improved and every participant showed a circadian desynchronization followed by rapid resynchronization at mission end. Better sleep and autonomic regulation accompanied faster, more accurate information processing, whereas fatigue and inactivity decreased performance and physical movement enhanced both cognitive efficiency and mood. Decision-making reorganized progressively while operational capacity was maintained. Benefits were most pronounced in participants marked by specific mind–body associations, and adaptation trajectories were strongly conditioned by baseline profiles, with interoceptive awareness and physical activity as key moderators. With an environmental realism rarely achieved in laboratory isolation, the two missions deliver convergent evidence, mutually reinforcing findings that establish deep caves as a faithful analog for future lunar missions (other missions are underway). Beyond reproducing key operational constraints, they reveal individual adaptation trajectories that can inform astronaut selection, preparation, and monitoring, offering a long-term perspective for sustained lunar exploration.

Keywords: Adaptation, Cave, Isolated and Confined Environment, Lunar Missions, Space Analogues

[Abstract:0174]

The Future of Coronary Artery Disease Assessment in Aircrew

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INTRODUCTION: Coronary artery disease (CAD) remains the most significant cardiovascular threat to aircrew because it is common, frequently silent, progressive with age, and operationally consequential. Traditional aeromedical assessment has emphasized obstructive stenosis, ischemia, and symptoms; however, future risk is increasingly recognized to be related to total atherosclerotic burden rather than a single coronary lesion. The goal of future aviation cardiology is to identify disease burden early, prevent adverse events, and optimize safe return-to-flight decisions.

METHODS: We evaluated aircrew coronary imaging data examining the relationship between aggregate stenosis and coronary artery calcium score (CACS). Aggregate stenosis was defined as the cumulative percentage of luminal narrowing across the coronary arterial tree, representing overall anatomic disease burden. CACS was assessed using non-contrast CT as a marker of calcified coronary plaque burden. The association between CACS and aggregate stenosis was analyzed to determine whether CACS serves as a practical surrogate for total coronary atherosclerotic burden in an aviation population.

RESULTS: Aggregate stenosis demonstrated correlation with CACS, supporting the concept that CACS reflects overall coronary disease burden rather than simply the presence of isolated calcified lesions. These findings reinforce the importance of assessing the entire coronary disease process rather than focusing exclusively on the most severe stenosis. This approach aligns with aviation cardiology risk models that incorporate total coronary burden, including aggregate stenosis, when determining operational risk.

DİSCUSSİON: Emerging technologies, including coronary CT angiography (CCTA), CT-derived fractional flow reserve, CT perfusion, plaque characterization, radiomics, and artificial intelligence–assisted plaque analysis, provide increasingly detailed assessment of coronary anatomy, physiology, and plaque morphology. These modalities may improve individualized risk assessment; however, limitations include cost, contrast exposure, radiation, availability, interpretive variability, and less mature outcomes data in asymptomatic occupational populations. CACS remains uniquely valuable because it is inexpensive, reproducible, non-invasive, requires no contrast, and has extensive outcome validation. Aggregate stenosis provides complementary information when coronary angiography or CCTA is available. The future of CAD management in aircrew should move beyond symptoms, resting ECGs, and isolated stenosis severity. A modern strategy should incorporate early detection of coronary burden using CACS and cardiovascular risk assessment, followed by advanced imaging when clinically or operationally indicated. In aviation and space medicine, prevention must become operational medicine: identify total coronary burden early, modify risk aggressively, and preserve human performance through evidence-based cardiovascular care.

Keywords: Coronary artery disease, Coronary artery calcium score, Aggregate stenosis, Aviation cardiology, Coronary CT angiography

[Abstract:0175]

Redox Preconditioning and Recovery in Aerospace Hypoxia: A Translational Rationale for Controlled Systemic Medical Ozone

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BACKGROUND: Aerospace hypoxia and hypobaria challenge the oxygen cascade and may delay neurocognitive and psychophysical recovery. Flight and altitude studies report redox perturbation and fatigue-related biological stress in aircrew, suggesting that recovery-oriented countermeasure research should address both oxygen delivery and adaptive redox signaling. Controlled systemic medical ozone has been investigated outside aerospace medicine as a low-dose oxidative eustress capable of upregulating endogenous antioxidant responses, but direct evidence in pilots or astronauts is lacking.

Description: This Process/Tutorial Review proposes a translational, biomarker-guided framework for evaluating controlled systemic medical ozone in hypoxia analogue studies rather than for operational use. The framework maps four candidate domains: redox adaptation, including Nrf2-related signaling, glutathione homeostasis, superoxide dismutase, catalase, glutathione peroxidase, and advanced oxidation protein products; vascular oxygen distribution, including nitric-oxide metabolites and endothelial, neuronal, and inducible nitric oxide synthase pathways, interpreted conservatively as exploratory markers rather than established mediators; erythrocyte oxygen unloading, including 2,3-bisphosphoglycerate, P50, and hemoglobin oxygen-dissociation dynamics as candidate correlates of peripheral oxygen release; and psychophysical recovery, assessed with heart-rate variability, psychomotor vigilance, fatigue, sleep quality, and symptom burden after hypoxic or simulated-flight exposure.

DISCUSSION: The central hypothesis is not that ozone directly oxygenates tissues, but that carefully controlled systemic ozone may function as a hormetic redox-conditioning stimulus that merits testing in monitored aerospace analogues. At present, no direct efficacy dataset supports use in pilots, astronauts, or mission operations. Accordingly, any future study should prioritize ethics approval, public-release clearance, standardized dosing and route, exclusion of inhalational exposure, adverse-event surveillance, and objective recovery endpoints in normobaric or hypobaric hypoxia models. Framed this way, systemic medical ozone can be discussed as a candidate adjunct within aerospace performance medicine focused on recovery optimization and operational readiness, while remaining explicitly non-promotional and evidence-limited. Learning Objectives/CME: Participants will be able to distinguish a biomarker-guided redox-preconditioning hypothesis from unsupported performance claims and identify measurable endpoints for future aerospace hypoxia studies.

Keywords: systemic medical ozone, aerospace hypoxia, redox preconditioning, psychophysical recovery, oxygen transport

A Systemic medical ozone session



Figure. Controlled systemic medical ozone therapy session performed through an extracorporeal autologous blood circuit. The image illustrates a supervised clinical setting in which autologous blood is collected into a sterile container, processed through a dedicated medical device, and subsequently prepared for reinfusion according to the operator's protocol. In the context of aerospace medicine, this procedure is presented only as an example of a controlled systemic redox-conditioning intervention that may be investigated in future biomarker-guided analogue studies. No claim of operational efficacy in pilots, aircrew, or astronauts is implied.

[Abstract:0176]

Management of Cardiac Implantable Electronic Devices During Air Travel: What Should Clinicians Know?

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Background
The number of patients living with cardiac implantable electronic devices (CIEDs), including permanent pacemakers, implantable cardioverter-defibrillators (ICDs), and cardiac resynchronization therapy (CRT) devices, has increased considerably over the past decades. Consequently, commercial air travel has become increasingly common in this patient population. Although modern aircraft cabins are pressurized and commercial flights are generally considered safe, exposure to hypobaric hypoxia, electromagnetic fields, vibration, and cosmic radiation raises important clinical questions regarding device function and patient safety. This review summarizes the current evidence on the management of patients with CIEDs during air travel.

Description
A narrative review of the published literature was conducted, focusing on the physiological effects of flight and their interaction with implanted cardiac devices. Particular attention was given to cabin altitude and hypobaric hypoxia, electromagnetic interference from aircraft systems and airport security equipment, cosmic radiation, vibration, and considerations following recent device implantation. Current recommendations regarding pre-flight assessment, travel restrictions after implantation, patient education, and practical precautions during commercial flights were also reviewed.
Discussion
Available evidence indicates that the vast majority of patients with normally functioning pacemakers, ICDs, and CRT devices can safely undertake commercial air travel without clinically significant device malfunction or deterioration in cardiovascular status. Modern CIEDs are well protected against routine electromagnetic interference, while the effects of vibration and cosmic radiation appear to be minimal during standard commercial flights. Nevertheless, patients with recent device implantation, pneumothorax-related complications, unstable cardiovascular disease, or device dependency require individualized assessment before travel. Carrying a device identification card, understanding airport security procedures, and receiving appropriate pre-flight counseling may further improve travel safety. Although current evidence supports the safety of commercial air travel for most patients with CIEDs, additional clinical studies are warranted to better define the long-term effects of the aviation environment on device performance and patient outcomes.

Keywords: Cardiac implantable electronic device (CIED),Pacemaker,Implantable cardioverter-defibrillator (ICD),Air travel,Aerospace medicine

[Abstract:0180]

Evaluation of Malaria Cases Detected at Turkish Airlines Between the years of 2015 and 2025 and Disease Prevention Activities

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Background
Malaria is a vector-borne disease transmitted when parasite-carrying Anopheles mosquitoes bite humans. According to WHO and the Turkey Ministry of Health, while no indigenous malaria cases are observed inTurkey, cases imported from abroad are occasionally detected. As Turkish Airlines operates flights to regions where malaria is endemic, measures necessary to protect airline personnel from the disease are regularly implemented.

Description
Malaria data is systematically collected and analyzed, and prevention and control measures are implemented. Flight schedules to malaria-endemic regions are retrospectively reviewed for detected cases. The cases and all their team members are identified, and screening is conducted. Malaria kits are distributed to cabin and cockpit members to protect from vectors, and prophylactic treatment is provided, rapid antigen tests are administered to suspected cases for early diagnosis, and patients are referred to hospitals. Field visits to high-risk areas are organized, and training activities are carried out. Pre-flight trainings are organized for high risk areas which are determined.

Discussion
Analyses show that a total of 120 cases were determined among Turkish Airlines personnel between 2015 and 2025. Of these cases, 92 involved cabin crew and 28 involved cockpit personnel. While sporadic cases occur throughout the year, data shows that malaria cases are detected more frequently during the summer months and in the autumn. There is an increase in case numbers after the pandemic; this increase is thought to be linked to reduction in global vector control efforts because of pandemic duration. There is a remarkable decrease in the number of cases as of 2025. While protection against vectors and training activities are important in preventing malaria, early diagnosis and treatment are life-saving. It is believed that sharing information regarding the activities conducted by Turkish Airlines to protect flight crew members from malaria, along with the results of the evaluations of detected cases, will contribute to the efforts of other airline companies in combating this disease.

Keywords: Malaria, vector-borne disease, cabin and cockpit crew, disease prevention activities

[Abstract:0182]

An Aeromedical Centre Health-Trends Analysis

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INTRODUCTION: Aeromedical examination centres (AeMCs) accumulate population health data of regulatory and preventive value. In compliance with EASA regulation (ORA.AeMC.160), our AeMC analysed its 2025 activity to characterise cardiovascular (CV) risk, referral epidemiology and substance-screening outcomes among certificate applicants, and to inform aeromedical examiner priorities.

METHODS: Cross-sectional analysis. ESC CV risk factors were assessed in random one-week samples across five months (July–November 2025; n=544 medicals; 11% Initials; 23% female). All 2025 referrals to the Authority as well all cases of drug and alcohol testing (drawn from 5,188 exams) were reviewed by reason, certificate class and age, and outcome. All data were anonymised and analysed in aggregate, with no individual-level analysis performed.

RESULTS and CONCLUSIONS: Smoking was the commonest CV risk factor (circa 20%), evenly distributed across classes and sexes, followed by dyslipidaemia (10%), hypertension (5%) and obesity (4%). Clinical cardiometabolic burden concentrated in older applicants, revalidation/renewal exams and Class 2 holders (median age 61). Of 175 referrals (3 per 100 medicals; 16 per 100 Class 1 Initials; 84% Class 1; mean age 39), mental health (14%), cardiovascular (14%), urolithiasis (9%) and sleep apnoea (7%) predominated—mental-health, sleep and CV conditions together exceeding one third. Substance screening showed only isolated cases with no emerging trend. The population is predominantly low-to-moderate CV risk, with focused, regulation-aligned concerns.

Findings support smoking-cessation counselling, continued CV and sleep apnoea screening, improved capture of family history and physical activity, and use of routine medicals as early-prevention opportunities. Single-AeMC representativeness and probable under-recording of family history are limitations.

Keywords: aeromedical certification, health trends, risk factors, EASA regulation

[Abstract:0184]

Volcanic Ash and Gas Exposure in Aviation Operations: Lessons from the 2025 Hayli Gubbi Eruption in Ethiopia

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INTRODUCTION: Volcanic eruptions present significant operational and aeromedical challenges to civil aviation. Volcanic ash can damage aircraft engines, avionics, and environmental control systems, while sulfur-bearing gases may adversely affect cabin air quality and human performance. In November 2025, the Hayli Gubbi eruption in Ethiopia generated ash and sulfur dioxide plumes reaching cruising altitudes and intersecting major East African air routes. This study aimed to synthesize current evidence regarding the operational and health implications of volcanic ash and gas exposure in aviation and evaluate lessons arising from the Hayli Gubbi event.

METHODS: A narrative review was conducted using peer-reviewed literature, International Civil Aviation Organization (ICAO) guidance documents, Volcanic Ash Advisory Centre bulletins, satellite-derived atmospheric observations, and published reports related to volcanic aviation hazards. Sources addressing aircraft system effects, environmental control systems, human health impacts, operational responses, and volcanic plume monitoring were reviewed and thematically analyzed from an aviation medicine perspective.

RESULTS: Volcanic ash exposure was consistently associated with turbine erosion, compressor damage, avionics malfunction, windshield abrasion, and, in severe cases, engine power loss. Sulfur dioxide and other volcanic gases were linked to respiratory irritation, bronchospasm, headache, and potential cognitive effects. Modern aircraft environmental control systems substantially reduce direct cabin exposure; however, contamination may occur during penetration of dense plumes or following system malfunction. The Hayli Gubbi eruption resulted in significant flight rerouting across East Africa and highlighted the vulnerability of regional air operations to volcanic emissions. Emerging evidence suggests that sulfur dioxide hazards may extend beyond areas traditionally identified through ash advisories.

CONCLUSIONS: Volcanic ash and gases represent concurrent mechanical, operational, and aeromedical hazards. Effective risk mitigation requires improved exposure assessment, integration of health considerations into aviation safety management systems, enhanced surveillance of volcanic sulfur dioxide, and strengthened coordination between aviation, meteorological, volcanological, and public health authorities. The Hayli Gubbi eruption underscores the importance of CAPSCA-aligned preparedness frameworks to maintain aviation safety and operational resilience during future volcanic events.

Keywords: Volcanic Ash, aviation medicine,

[Abstract:0185]

Descent-Associated Barodontalgia in a Root Canal–Treated Mandibular Molar with Asymptomatic Apical Periodontitis

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INTRODUCTION: Barodontalgia is oral pain triggered by changes in barometric pressure and is usually associated with an underlying dental or maxillofacial condition. Although most reports focus on aircrew and divers, commercial airline passengers may also experience clinically relevant dental symptoms during flight. This case presents an aircraft–descent–associated painful episode in a previously asymptomatic root–canal–treated mandibular molar with a known periapical radiolucency.

Case Description: A 30-year-old female commercial airline passenger experienced sudden dental pain during the descent phase of an international flight to Kazakhstan. The pain was localized to the left mandibular first molar region (tooth #36 in FDI notation; Universal #19) and was rated 6/10 on a numeric rating scale. Vestibular swelling developed after landing. The patient reported no fever, trismus, or lymphadenopathy. The tooth had undergone root canal treatment 8 years earlier by another clinician, and the patient had been under routine dental follow-up for 2 years. Six months before the flight, radiographic examination had revealed a periapical radiolucency associated with the same tooth; however, it was asymptomatic at that time. During travel, the patient sought emergency dental care and was prescribed systemic antibiotics. On return, the patient was free of pain, and the vestibular swelling had resolved. A new radiograph was obtained and compared with the radiograph taken 6 months earlier. No obvious radiographic progression in the size or appearance of the periapical radiolucency was observed. Therefore, the tooth was placed under close clinical and radiographic follow-up. Endodontic retreatment or extraction followed by implant-supported rehabilitation will be considered if symptoms recur or radiographic progression is detected.

DISCUSSION:
The temporal relationship between aircraft descent and onset of pain supports a diagnosis of direct barodontalgia related to persistent apical pathology. This case shows that asymptomatic periapical radiolucencies may become clinically significant with changes in cabin pressure, even in non-aircrew passengers. Radiographic stability after the acute episode does not rule out flight-related symptom provocation, but it supports a conservative follow-up approach once symptoms have resolved. Dental practitioners should ask about recent or planned air travel when managing persistent apical periodontitis, particularly in frequent flyers and aviation personnel.

Keywords: Barodontalgia, aircraft descent, apical periodontitis, root canal treatment, aviation dentistry, commercial passenger.

[Abstract:0186]

UAS-related hazards to aircraft and humans

John Stephen Crowley
none; I am an employee of the US Army but the Army is not funding my travel and I am therefore not Army-affiliated for ICAM26

INTRODUCTION. The explosion of unmanned aerial vehicles of various sizes and capabilities presents a number of safety concerns--obviously of critical importance are potential collisions with other objects, either humans or aircraft. Any of these collisions could lead to direct injury, or worse, injuries related to subsequent UAV-mediated aircraft crashes. We sought to identify the frequency of these events and their effects to date

METHODS. The available databases on the internet were searched for collisions between UAS and humans or aircraft, including additional information regarding injury type, mechanism, and potential countermeasures.

RESULTS. As of June 2026, available public databases revealed 14 confirmed collisions between civilian aircraft and UAS; 3 of these involved helicopters. The FAA reported 256 UAS propellor strike injuries in 2022; Transport Canada recorded 67 fractures from falling drones in 2023. Additional detail will be presented.

CONCLUSIONS: The potential for injury due to direct collision between UAS and humans, or indirectly from secondary aircraft collision and crash, is a growing hazard. The ramifications of these hazards and potential countermeasures will be discussed.

Note: This abstract is an updated version of a previously submitted abstract with the same title. When the abstract deadline was extended, I wanted to correct some spelling errors in the original abstract, but there was no way to do that on the abstract website, as far as I could tell. Therefore, I am submitting the revised abstract as a new abstract. Please disregard the previously submitted abstract.

Keywords: unmanned aerial vehicle, UAS, drone, injury, midair collision, aircraft accident

[Abstract:0187]

Risks of neurovascular aging under lunar gravity: Forecasting progression, recovery, and countermeasures for Artemis missions

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Sustained lunar exploration will usher in an era in which astronauts will be exposed to gravitational environments never before experienced, such as the partial and irregular gravity of the lunar surface. While microgravity in low Earth orbit causes vascular changes comparable to 10–20 years of aging (changes that are partially reversible upon return to 1 g) the impact of prolonged exposure to lunar gravity on the neurovascular system remains largely unknown. We currently do not know whether 1/6 g accelerates, slows, stabilizes, or allows for recovery from cerebral vascular alterations; this becomes a critical question for the Artemis program's objectives, where extended stays on the surface could severely compromise blood perfusion in key brain regions and affect cognition and motor function. We propose a mechanistic theoretical framework aimed at evaluating prolonged exposure to 1/6 g and how its gravitational variability modulates neurovascular aging. To achieve this objective, we will develop a predictive model capable of quantifying the rate of progression and the degree of recovery from neurovascular changes under lunar gravity conditions, determining whether there is a temporal threshold beyond which the risk becomes irreversible. The study will be based on a systematic analysis of existing physiological data from astronauts, lunar simulation experiments, and studies on vascular aging. Its value lies in the calibration of heterogeneous data sources to generate progression and recovery curves specific to lunar gravity environments. The model may generate temporal projections of arterial stiffness, cerebral perfusion, and neuroplasticity throughout an Artemis mission, establishing the magnitude and timing at which vascular damage begins to translate into cognitive and motor impairment. Finally, countermeasures tailored to this environment (such as differential-pressure suits, partial-load exercises, and pharmacological countermeasure candidates) will be evaluated.

The results can provide medical and planning teams for the Artemis program with a predictive model of neurovascular behavior under lunar gravity, transforming a currently unknown biological risk into a quantifiable and manageable parameter. This will enable the design of phased countermeasure protocols, tailored to the actual duration of the surface stay, and will lay the groundwork for ensuring the crew's cognitive and motor integrity during increasingly longer missions, bringing humanity closer to the goal of sustained lunar occupation and eventual habitation.

Keywords: Lunar gravity, neurovascular aging, Artemis missions, predictive model, countermeasures, cognitive decline

[Abstract:0189]

Aircraft accident casualty identification using DNA techniques

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Commercial flying is safe. Current conflicts such as in eastern Ukraine and the Middle East may compromise flight safety. The identification of casualties in catastrophic accidents is a challenge both from forensic and legal viewpoints.Timely identification has profound implications for reuniting families. Disaster casualty identification has impoved with the use of modern DNA technologies. We summarize the advances while remind importance of privacy, security, and psychological values of victim identification. Identification of victims in fatal accidents has demonstrated the effectiveness of DNA profiling. In 1992, an Air Inter A320 crashed killing 87 passengers. DNA-based identification was used, when other forensic methods failed and as a result 18 extensively fragmented human remains were identified. Later in 1996 Spitsbergen aircraft accident marked another DNA-based milestone in aircraft disaster victim identification. In this accident because of scant antemortem dental data, DNA analysis became the most important identification method, and all 141 victims were identified. Initially DNA identification was based on minisatellite or microsatellite loci i.e., short tandem repeats (STRs). Later DNA analyses has moved towards high throughput massively parallel sequencing (MPS). This method enables analysis of genome wide single nucleotide polymorphisms helping to analyze highly degraded samples. Adoption of MPS also has led to a new discipline for human identification known as forensic genetic genealogy (FGG). If FGG is compared with STR typing and mitochondrial DNA sequencing, FGG expands the analytical space for identification of human remains. However, the data privacy and security with mass disasters also are very important considerations for adopting this technology. Timely identification of victims is a prerequisite for the provision of emotional support to families. Also it is important because of facilitation of financial compensation to bereaved relatives. Furthermore, identification enables issuance of death certificates, processing of insurance claims.

Reference

Vuorio A, Sajantila A, Bor R, Budowle B. Advances in aircraft accident disaster victim identification using DNA Techniques. Aerospace Medicine and Human Performance, 2026, In Press.

Keywords: DNA, identification, disaster, data privacy

[Abstract:0190]

Post-traumatic stress disorder and its practical application in turbulence-triggered trauma

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Recently U.S. Federal Aviation Administration (FAA) has instructed Aviation Medical Examiners (AMEs) how to assess pilots forpost-traumatic stress disorder (PTSD). At the same time European, Australian and International Civil Aviation Organization guidelines for the assessment of PTSD in aviation do not address the unique and specific circumstances of a flight crew. It has been shown that PTSD compromises aviation safety and has been related to fatal aviation accidents.FAA's guidance is giving different assessment protocol if a PTSD assessment is undertaken based on whether the condition is symptomatic and medicated, or whether more than 2 years have elapsed since showing symptoms and receiving medication.The International Classification of Diseases (ICD) criteria for stress disorders have been edited between versions ICD10 and the soon-to-be-released ICD-11. New ICD-11 criteria will differ from the current ICD-10 criteria. This issue is discussed in the presentation. In addition, PTSD, potentially caused by an incident of turbulence, will be discussed in the context of aviation mental health.So far there are no published studies on turbulence-caused mental trauma. We have identified major potential factors which are related to pilots' and cabin crew's stressors in incidents of severe and extreme turbulence.Additional three recommendations are provided:1) Harmonize assessment practices of PTSD internationally(2) Healthcare professionals taking care of traumatized flight crew should have a follow-up guide that takes specific and local conditions into account, and ensures the identification of patients who require follow-up treatment as early as possible (3) Aviation health care professionals should consider ICD-11 diagnostic criteria as the information may be more useful in the assessment and diagnosis of aviation-related trauma.

Reference
Vuorio A, Bor R, Budowle B, Gray A, Suhonen-Malm AS. Assessment policy of post-traumatic stress disorder in aviation and its practical application using turbulence-triggered trauma as an example. Front Public Health. 2025;13:1505004.

Keywords: mental health, post-traumatic stress disorder, turbulence, International Classification of Diseases

[Abstract:0191]

How to assess suicide risk in pilots with major depression?

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The US Federal Aviation Administration (FAA) and European regulators accept the use of selective serotonin reuptake inhibitors (SSRIs) to treat pilots with major depression (MD). FAA has recently approved some additional antidepressants in pilots MD. The assessment protocols allow return to flying after approximately 1 month after recovery in Europe and after at least 6 months in the United States. However, evidence suggests that suicide risk, including unrecognized risk, may persist for up to 1 year after treatment initiation There is a variation between antidepressants. Additionally MD related cognitive dysfunction may also outlast recovery. We propose that extending an initial grounding period could reduce pilot suicidality as a distinct flight safety risk. This will additionally support accurate differential diagnosis, and enable drug-specific guidance. It is utmost important to decrease barriers to seeking help for mental health concerns. Also strengthened monitoring protocols may better safeguard pilot well-being. Recommendations 1. There is evidence that suicide risk remains elevated throughout the first year of antidepressant treatment. Pilots should remain under close surveillance for at least 12 months after initiation of treatment, with return to work permitted after a minimum 6 months grounding period It is important to arrange conditional on monthly psychiatric review, proving stable medical regimen, and absence of suicidal ideation. Regulatory authorities should evaluate whether a longer grounding period would improve flight safety, while at the same time maintaining trust and disclosure among pilots. 2. Aviation regulators should revisit current guidelines assessment guideline especially in the context of pilot potential suicidality and neuropsychological assessment. Updates should aim to reduce barriers to seeking medical help while maintaining public safety. The revised protocols should be informed by the latest international evidence and regulatory. 3. Future guidance should adopt a risk-stratified approach, matching monitoring to illness severity, medication, and individual history. There is a lack of follow-up studies involving pilots returning to fly while using prescribed antidepressant medication.

Reference Vuorio A, Suhonen A-S, Budowle B, Gray A, Gordon S, Bór R. Assessing suicide risk in airline pilots with major depression. Aviation Psychology and Applied Human Factors (2026), 16(1), 55–63. https://doi.org/10.1027/2192-0923/a000313

Keywords: airline pilots, major depression, suicide, assessment, antidepressants

[Abstract:0192]

Prolonged grief disorder following the Malaysia Airlines MH 17 crash in 2014

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Prolonged Grief Disorder (PGD) can follow sudden and traumatic loss. The risk is high particularly after involving violent death, prolonged uncertainty, or limited recovery of human remains. Aviation disasters can cause very complex grief responses.We studied research relating to PGD and considers how the deliberate destruction of a civilian aircraft may evoke vulnerability to prolonged grief reactions. Literature published after the 2014 Malaysia Airlines (MH)17 disaster provides unique research data to examine long-term grief trajectories. It was shown that one in six bereaved individuals experienced persistent grief-related symptoms almost a decade after the MH17 crash. In addition, symptoms of bereaved relatives developed persistent PGD symptoms within the first year following the disaster. It was shown that these relatives may benefit from lower-intensity interventions such as psychoeducation, peer support, and structured psychological follow-up. However and unexpectedly, relatives who sought to participate actively, either by delivering written statements or speaking in court, reported significantly higher PGD symptom levels than those who did not intend to participate. These findings suggest that participation may reflect ongoing distress, despite a wish to 'bring psychological closure'. The association between intentions to participate in criminal proceedings was partially mediated by state anger. Those relatives who did not intend to participate in a trial reported lower levels of state anger. The findings suggest that anger following violent loss may emerge because of a persistent grief process. Here were several aviation specific factors present in the MH17 disaster, which may additionally have contributed to prolonged grief responses. The extent to which a traumatic event becomes central to an individual's identity and life narrative may represent an important mechanism linking traumatic loss and persistent grief symptoms.

From a public health perspective, the findings from the MH17 disaster highlight the need for long-term monitoring of bereaved individuals following large-scale traumatic events. Grief-focused cognitive behavioral therapy has demonstrated effectiveness in reducing prolonged grief symptoms. Early recognition, structured follow-up, and access to evidence-based interventions may improve long-term psychological outcomes. Recommendations1) Bereaved relatives affected by fatal aviation disasters should have access to long-term psychological follow-up.2) Aviation health professionals, primary care clinicians, and mental health practitioners should receive greater awareness training regarding assessment of PGD. ReferenceVuorio A, Budowle B, Suhonen-Malm A-S, Gordon S, Bór R. Prolonged grief disorder following the Malaysia Airlines MH17 crash in 2014: Effects on friends, families and society. Under review in Discovery Public Health.

Keywords: Prolonged grief disorder, Malaysia Airlines MH17, crash, criminal proceedings, anger

[Abstract:0193]

Aeromedical Stressors: Hypobaric Hypoxia, Mental Workload – A Digital Signal Processing (DSP) Architecture for ANS Physiological Mapping of Human Performance

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INTRODUCTION: From an Aviation Safety and Human Performance management perspective, via continuous real-time health monitoring and fatigue management, the possible mapping of ANS to abstract the Human Performance Status Picture may be very useful. Heart rate variability (HRV) is a primary non-invasive biomarker for assessing ANS regulation during cognitive workload, stress, and fatigue. However, current HRV analysis Digital Signal Processing (DSP) software tools mostly operate as "black boxes." Thus, obscuring their artifact correction methodologies and lack the temporal resolution required to dynamically map acute physiological shifts, thereby limiting reproducibility and data provenance in the domain of aeromedical/aerospace psychophysiological research.

METHODS: Focussing on these methodological gaps, we developed a highly transparent, fully auditable HRV processing DSP architecture. It integrates zero-phase Butterworth filtering, robust modified Pan-Tompkins's peak detection, and an adaptive local-median algorithm utilizing Piecewise Cubic Hermite Interpolating Polynomial (PCHIP) interpolation for ectopic beat correction. Via deployment of a sliding-window mathematical approach, the DSP tool continuously computes and visualizes SDNN (global variance), RMSSD (vagal tone), and the SDNN/RMSSD ratio (sympathovagal balance proxy) to dynamically track ANS state changes. Deterministic testing was carried out using raw ECG csv data recorded by a clinical grade system with sampling rate of 500Hz (Nyquist 250Hz) during hypobaric chamber 5500m flight profile examinations/trainings.

RESULTS: The DSP architecture guarantees absolute data traceability by linking every evaluated and corrected heartbeat directly to its original raw ECG signal index via automated, immutable audit logs (ledgers). Additionally, longitudinal compound mapping isolates the precise onset of mental overload. By visualizing the real-time interaction between total autonomic flexibility and high-frequency parasympathetic activity, the DSP tool distinctly differentiates between acute vagal withdrawal, active task habituation, and systemic autonomic blunting associated with central fatigue.

CONCLUSION: Integrating Synchronized stringent digital signal processing (DSP) with absolute accountability standards and high-resolution temporal mapping, this architecture provides investigators with a highly rigorous framework. It empowers Aeromedical researchers to confidently correlate dynamic autonomic (ANS) shifts with human performance outcomes, ensuring the highest standards of data integrity and reproducibility for aeromedicine psychophysiological research. Furthermore, such DSP methods may be incorporated within "On-board aircrew monitoring systems" in future aircraft systems designs, ultimately elevating aviation safety.

Keywords: Aviation Safety, Aeromedical Stressors, Human Performance, Digital Signal Processing, Hypobaric Hypoxia, Fatigue

[Abstract:0197]

Spaceflight Associated Neuro-ocular Syndrome (SANS) Research

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Spaceflight-Associated Neuro-ocular Syndrome (SANS) has emerged as one of the major biomedical challenges associated with long-duration human spaceflight. Approximately 70% of astronauts participating in long-term missions aboard the International Space Station (ISS) develop at least one ophthalmic manifestation of SANS, including optic disc edema, posterior globe flattening, choroidal folds, retinal nerve fiber layer thickening, hyperopic refractive shifts, and cotton-wool spots. These structural changes may compromise visual performance and represent a significant concern for future exploration-class missions to the Moon and Mars. Current research focuses on elucidating the underlying pathophysiological mechanisms responsible for SANS. The effects of cephalad fluid shifts induced by microgravity, altered cerebrospinal fluid (CSF) dynamics, impaired cerebral venous drainage, glymphatic dysfunction, and individual genetic susceptibility are investigated. Recent evidence suggests that SANS is a multifactorial condition rather than a consequence of potentially elevated intracranial pressure alone. Instead, localized CSF compartmentalization around the optic nerve and venous congestion appear to play central roles in disease development. Several ongoing and completed studies contribute to our understanding of SANS. The NASA Lifetime Surveillance of Astronaut Health (LSAH) program, as well as ESA and other International space agencies continuously evaluate astronauts before and after long-duration missions using optical coherence tomography (OCT), magnetic resonance imaging (MRI), orbital ultrasound, fundus photography, and visual function testing. Complementary Earth-based analog studies, particularly 6° head-down tilt bed-rest investigations at DLR and MEDES, simulate microgravity-induced fluid redistribution and allow evaluation of potential countermeasures under controlled conditions. Advanced imaging studies have further demonstrated structural changes within the optic nerve head, choroid, and cerebral perivascular spaces following prolonged spaceflightTo date, no single preventive or therapeutic strategy has proven fully effective. Current investigations evaluate lower-body negative pressure devices, artificial gravity concepts, nutritional interventions, and optimized in-flight monitoring using portable OCT and retinal imaging technologies. Recent expert consensus emphasizes standardized diagnostic criteria and longitudinal monitoring as essential components for future exploration missions. In conclusion, SANS remains a high-priority research topic in aerospace medicine. Ongoing multidisciplinary investigations integrating ophthalmology, neurology, radiology, and space physiology are essential to clarify disease mechanisms, develop effective countermeasures, and ensure astronaut health during long-duration missions beyond low-Earth orbit.

Keywords: Spaceflight Associated Neuro-ocular Syndrome, astronauts, bedrest studies

[Abstract:0200]

Fitness to Fly After Pre-flight Transcatheter Aortic Valve Implantation in a High-Risk Patient with Severe Aortic Stenosis: A Case Report

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INTRODUCTION: Assessing fitness to fly is an important aspect of aviation medicine, particularly in passengers with advanced cardiovascular disease. Long-haul commercial flights expose passengers to reduced cabin oxygen pressure, prolonged immobility, and limited access to emergency medical care. Although current ESC/EACTS guidelines recommend timely intervention for symptomatic severe aortic stenosis, evidence regarding air travel after transcatheter aortic valve implantation (TAVI) is limited

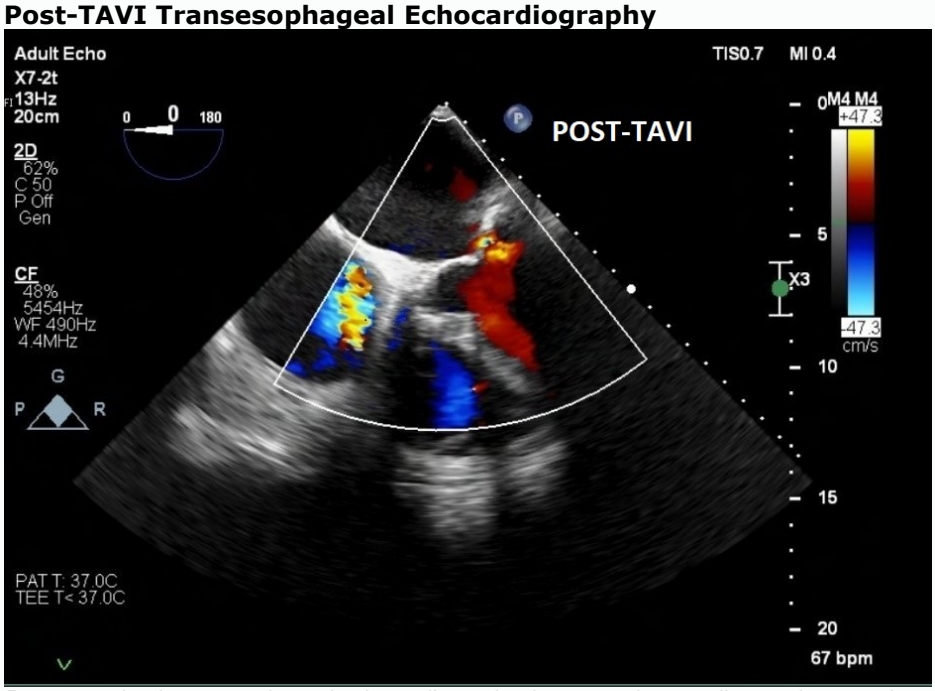
Case Description A 72-year-old woman with heart failure with preserved ejection fraction, hypertension, type 2 diabetes mellitus, chronic kidney disease, chronic obstructive pulmonary disease, and symptomatic severe degenerative aortic stenosis was evaluated before a planned commercial flight from Türkiye to the United States lasting more than 10 hours. She had New York Heart Association (NYHA) functional class IV symptoms, with shortness of breath at rest and inability to perform ordinary physical activity without discomfort. Pre-procedural transesophageal echocardiography showed a left ventricular ejection fraction of 60%, an aortic valve area of 0.90 cm^2, a peak transvalvular gradient of 66 mmHg, and a mean gradient of 40 mmHg. Considering her severe symptoms, multiple comorbidities, and planned long-haul flight, the multidisciplinary Heart Team recommended TAVI before travel. The procedure was successful and uncomplicated. Post-procedural echocardiography demonstrated a well-functioning bioprosthetic valve with a peak gradient of 16 mmHg and a mean gradient of 5 mmHg, while left ventricular systolic function remained preserved. Her symptoms improved to NYHA class I, with no or only mild limitation during ordinary daily activities. She had no dyspnea, cyanosis, or oxygen desaturation before discharge, and supplemental oxygen was not required for air travel. She was discharged on single antithrombotic therapy. The patient completed the planned flight without cardiovascular or respiratory complications. At six-month follow-up, she remained clinically stable, with preserved prosthetic valve function and no procedure-related complications.

Discussion This case demonstrates the value of individualized fitness-to-fly assessment in patients with severe aortic stenosis. Successful TAVI resulted in marked improvement in valve function and symptoms, with the mean transvalvular gradient decreasing from 40 mmHg to 5 mmHg and functional status improving from NYHA class IV to class I–II. Although current ESC/EACTS guidelines do not define a specific interval for commercial air travel after TAVI, this case suggests that travel decisions should be based on clinical stability, valve performance, oxygenation status, and multidisciplinary assessment rather than a fixed waiting period. Collaboration between cardiology and aviation medicine specialists may support safe travel decisions in selected high-risk patients.

Keywords: Fitness to fly, Transcatheter aortic valve implantation (TAVI), Severe aortic stenosis, Long-haul air travel, Aviation medicine

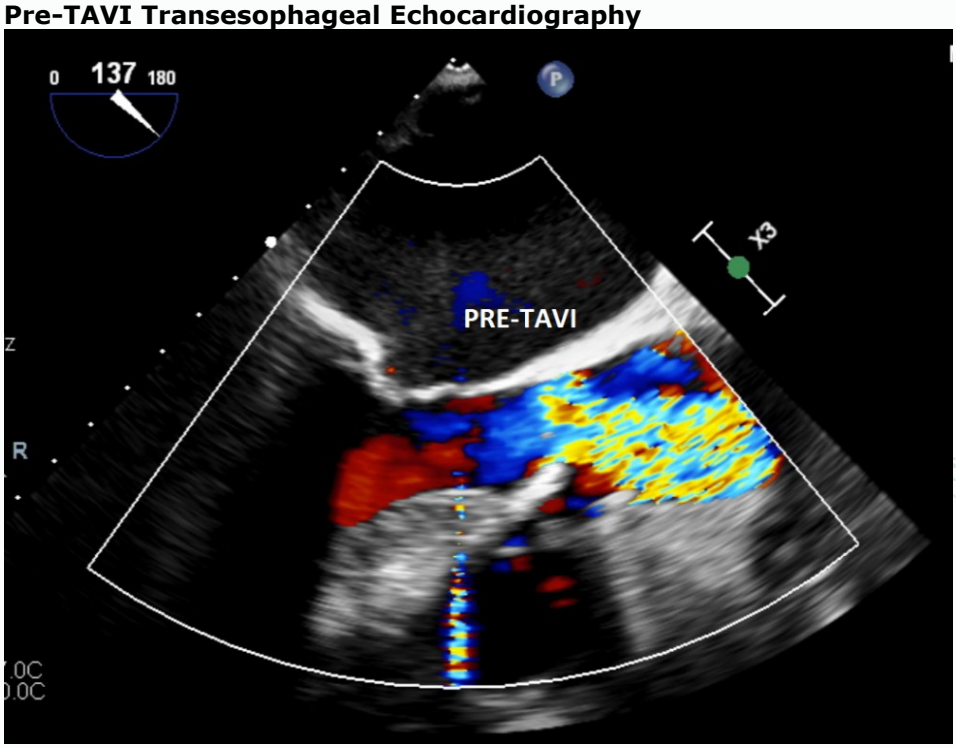
Oral Presentations

Post-TAVI Transesophageal Echocardiography



Post-procedural transesophageal echocardiography demonstrating a well-seated transcatheter bioprosthetic aortic valve with improved transvalvular flow after TAVI.

Pre-TAVI Transesophageal Echocardiography



Pre-procedural transesophageal echocardiography demonstrating severe degenerative aortic stenosis with restricted leaflet opening and turbulent transvalvular flow.

[Abstract:0201]

Crew Resource Management in Cardiology: Great Functional Similarity

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BACKGROUND: Crew Resource Management (CRM) was developed in commercial aviation to reduce human error and improve safety through structured teamwork, effective communication, leadership, and decision-making. Because healthcare professionals work in similarly complex, dynamic, and high-risk environments, CRM principles have increasingly been adopted in medicine to enhance team performance and patient safety. In cardiology, where multidisciplinary collaboration is essential during complex diagnostic and interventional procedures, CRM provides a systematic approach to minimizing preventable errors and optimizing clinical outcomes.

Description: This reviews the core principles of Crew Resource Management and describes their practical application in contemporary cardiology practice. The major CRM domains discussed include mission analysis, leadership, communication, assertiveness, situational awareness, decision-making, adaptability, and confidence. Their implementation is illustrated using examples from high-risk cardiovascular procedures, including transcatheter aortic valve implantation (TAVI), ventricular tachycardia ablation, chronic total occlusion interventions, and other catheterization laboratory procedures requiring coordinated multidisciplinary teamwork. Particular emphasis is placed on pre-procedural planning, structured briefings, procedural time-outs, closed-loop communication, standardized checklists, effective leadership, and continuous reassessment of the clinical environment. The tutorial also discusses the importance of creating a psychologically safe culture in which every team member, regardless of experience or professional hierarchy, is encouraged to identify hazards, question assumptions, and communicate concerns promptly to interrupt potential chains of error before they affect patient outcomes.

DISCUSSION: As cardiovascular interventions become increasingly sophisticated, technical expertise alone is insufficient to ensure optimal patient outcomes. Non-technical skills, including communication, teamwork, leadership, and situational awareness, play a fundamental role in procedural success and patient safety. CRM offers an evidence-based framework for strengthening these competencies while improving coordination among physicians, nurses, technicians, and anesthesiology teams. Many CRM practices can be integrated into routine clinical workflows with minimal financial investment through standardized communication strategies and team-based training. Wider adoption of structured CRM education, simulation exercises, and multidisciplinary training programs has the potential to further reduce preventable adverse events, improve procedural efficiency, strengthen safety culture, and enhance both patient outcomes and healthcare team performance.

Keywords: Crew Resource Management, Communication, Teamwork, Interventional Cardiology, Healthcare

[Abstract:0202]

Restoring Safe Air Travel After Percutaneous Left Main Coronary Artery Stenting for Extrinsic Compression by a Dilated Pulmonary Artery in Pulmonary Arterial Hypertension: A Case Study

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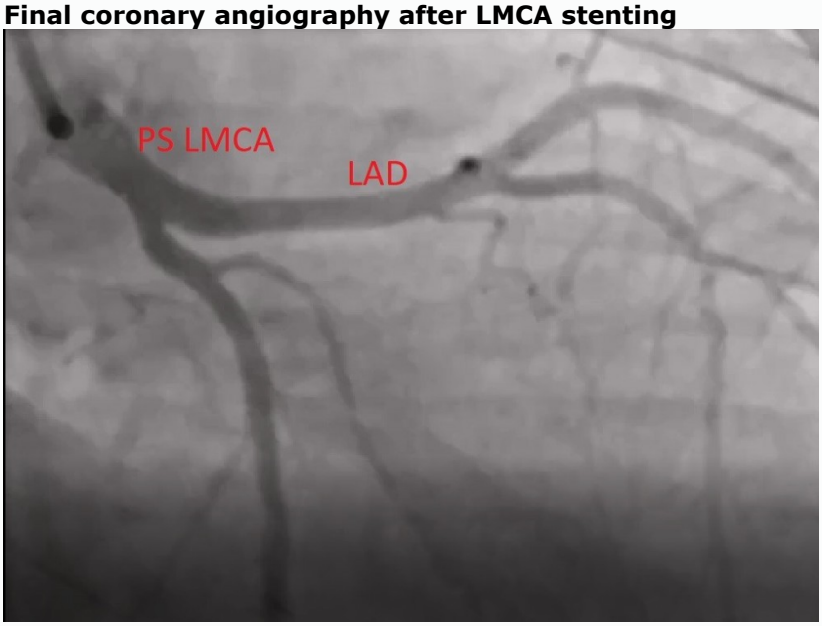
INTRODUCTION: Extrinsic compression of the left main coronary artery (LMCA) by a dilated pulmonary artery is a rare but potentially life-threatening complication of pulmonary arterial hypertension (PAH). It may lead to myocardial ischemia, ventricular arrhythmias, heart failure, or sudden cardiac death. Early diagnosis using multimodality imaging and timely percutaneous coronary intervention are essential for preventing adverse outcomes.

Case Description A young woman with severe PAH presented with progressive chest pain and worsening dyspnea. Because commercial air travel was considered unsafe owing to her advanced cardiopulmonary condition and suspected myocardial ischemia, she traveled approximately 15 hours by ground to reach our tertiary referral center. Transthoracic echocardiography demonstrated severe pulmonary hypertension with marked pulmonary artery dilatation. Coronary angiography revealed critical ostial LMCA stenosis, while cardiac computed tomography confirmed severe extrinsic compression of the LMCA by the dilated pulmonary artery. Percutaneous coronary intervention was successfully performed using a drug-eluting stent followed by high-pressure post-dilatation, resulting in complete restoration of coronary flow without procedural complications. Dual antiplatelet therapy and targeted PAH treatment were continued. The patient's symptoms resolved rapidly, exercise capacity improved significantly, and follow-up imaging confirmed sustained stent patency.

Discussion LMCA compression secondary to pulmonary artery dilatation is an uncommon but reversible cause of myocardial ischemia in patients with PAH. This case highlights the importance of considering coronary compression in symptomatic patients with severe pulmonary artery enlargement and demonstrates the effectiveness of percutaneous LMCA stenting. Beyond relieving myocardial ischemia, successful revascularization restored the patient's functional capacity and quality of life. After initially requiring a 15-hour ground transfer because commercial air travel was considered unsafe, the patient was discharged in stable condition and deemed fit for unrestricted commercial air travel. This case emphasizes that prompt recognition and timely percutaneous intervention can provide not only life-saving treatment but also meaningful functional recovery in patients with this rare complication.

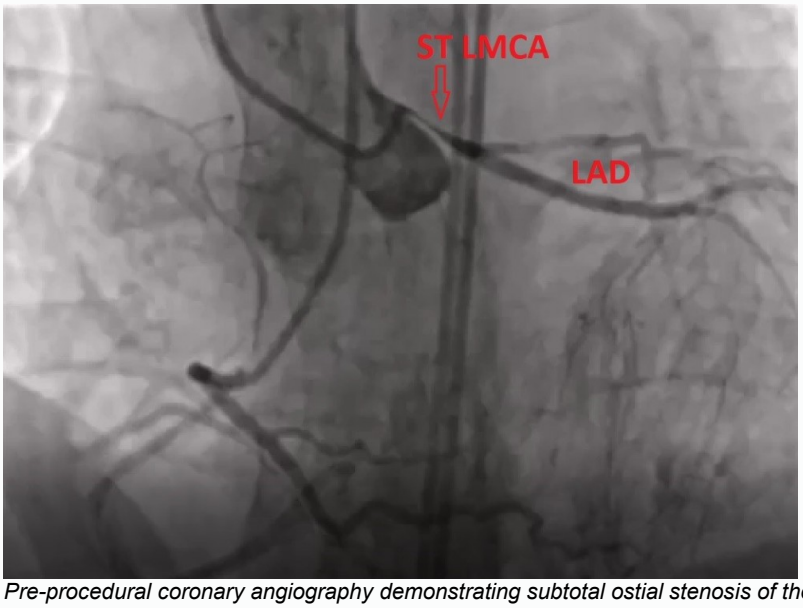
Keywords: Pulmonary arterial hypertension,Left main coronary artery compression,Percutaneous coronary intervention,Pulmonary artery dilatation,Air travel,Myocardial ischemia

Final coronary angiography after LMCA stenting



Final coronary angiography demonstrating successful drug-eluting stent implantation with restoration of normal coronary flow.

Subtotal ostial LMCA stenosis before PCI



Pre-procedural coronary angiography demonstrating subtotal ostial stenosis of the left main coronary artery caused by extrinsic compression from the dilated pulmonary artery.

[Abstract:0203]

Pregnancy among Civil Flight Attendant and Pilot: criteria for maintaining flight duty and pregnancy prognosis. A retrospective study of 255 pregnancies between 2020 and 2024

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Crew members in civil aviation either flight attendant or pilot are submitted to specific rules in case of pregnancy. In such a case flight security and individual safety must be considered. Briefly in our setting crew members can be legally waived for flight duty up to 16 GA and pilot up to 26 GA. This is done under strict individual and medical supervision. Few studies have assessed the determinants and the consequences of this attitude. We present a retrospective study of 255 pregnant crew members of a major European airline. With approval of Cochin University Ethic committee 800 crew members who were identified as having been pregnant between 2020 and 2024 were reached and asked to answer an online questionnaire. Half of them answered. At the time of drawing up this abstract 255 answers were deemed workable. There were no differences between answering and non-answering crew members for most demographic data. 226 crew members were flight attendant and 29 were pilots. 90 % were full time workers. Long haul flight represented 76% of the cases. Pregnancy obtained by ART represented 16,5% of cases what is much higher than the general population. Only 33 (12,9%) crew members kept on flying until legal term. For those who chose to be grounded, it was a personal choice for 44 %, an identified medical risk for 28 % and due to pregnancy related symptoms for 28%. The rate of prematurity (8%) and C section (26%) was similar to the general population. Interestingly the rate of prematurity was lower in the women waived to keep on flying. Rate of other complications were similar in both groups and even slightly higher in the grounded group.

Our study although not exempt of flaws display important points. First the policy of our occupational medicine department helped to select pregnant crew members with obstetrical issues similar to the general population. The obstetrical prognosis of crew members regardless of grounding is the same. Based on the wishes of the crew members our policy of maintaining on flight duty under strict follow up appears to be safe for the crew and the flight safety.

Keywords: Air crew, Pregnancy, Flight duty, Complications

[Abstract:0204]

Incidence of Barotrauma-Related Otologic Episodes in Commercial Airline Pilots: A Retrospective Cohort Study

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Background
Barotrauma-related otologic disorders remain an important occupational health concern in commercial aviation. However, their incidence at both pilot and operational levels, as well as the influence of pilot rank and aircraft type, has not been well characterized. This study aimed to determine the incidence of barotrauma-related otologic episodes in a commercial airline pilot cohort and evaluate recurrence patterns, aircraft-related differences, and seasonal variation.

METHODS: A retrospective cohort study was conducted using occupational health records from a major international airline between January and December 2025. The airline employed 7,164 active pilots and performed 570,775 flight operations during the study period. Medical visits containing barotrauma-related otologic diagnoses were identified, yielding 757 clinical records from 531 unique pilots. Follow-up visits occurring within 14 days were considered part of the same clinical episode, resulting in 616 distinct episodes. Pilot-level incidence and operational incidence were calculated. Comparisons according to pilot rank, aircraft type, recurrence, associated diagnoses, and seasonal distribution were performed using chi-square, Mann–Whitney U, and Kruskal–Wallis tests.

RESULTS: Among 7,164 pilots, 531 (7.4%) experienced at least one barotrauma-related otologic episode during the study period, resulting in 616 distinct episodes (86.0 episodes per 1,000 pilots). The operational incidence was 1.08 episodes per 1,000 flight operations (approximately one episode per 927 flight operations). Annual recurrence occurred in 75 pilots (14.1%). Upper respiratory tract infection was the most frequent associated diagnosis, accompanying 25.0% of episodes. Second officers demonstrated a significantly higher incidence than captains *($p<0.001$)*. Incidence also differed significantly according to aircraft type *($p<0.001$)*, ranging from 11.61% among A320 pilots to 2.65% among B777/787 pilots. A significant seasonal variation was observed, with the highest episode frequency during winter *($p<0.001$)*.

CONCLUSIONS: Approximately one in 13 commercial airline pilots experienced at least one barotrauma-related otologic episode during 2025. Second officers had a significantly higher incidence than captains, likely reflecting differences in accumulated flight experience and familiarity with pressure equalization techniques. Pilots operating narrow-body aircraft also demonstrated a higher incidence than those flying wide-body aircraft. This difference may be attributable to variations in aircraft cabin pressurization characteristics and/or the higher flight frequency typically associated with narrow-body operations, leading to greater cumulative exposure to pressure changes. These findings highlight the potential benefit of targeted educational interventions for less experienced pilots in reducing the risk of barotrauma in commercial aviation.

Keywords: barotrauma, commercial airline pilots, aviation medicine, occupational health, recurrence

[Abstract:0205]

From Evidence to Checklist: Development of a Mental Health Quick Reference Handbook (QRH) for Pilot Self-Assessment and Help-Seeking

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INTRODUCTION: More than a decade after the loss of Germanwings Flight 9525, European regulation mandates pilot peer support programmes (PPSPs), yet evidence indicates that symptomatic pilots remain the least likely to seek support, with fear for the medical certificate repeatedly identified as the decisive barrier. This doctoral study examined how pilots and their families perceive stress, disclosure risk and support systems, and whether presenting aeromedical pathways in familiar operational language could reduce perceived barriers to early help-seeking.

METHODS: A sequential mixed-methods design combined documentary analysis of the post-Germanwings European regulatory and guidance framework; a cross-sectional survey of 345 respondents, comprising 212 commercial pilots (including 37 cadets) and 133 spouses and partners, measuring psychological traits, stigma, confidentiality trust and PPSP engagement; and semi-structured interviews with pilot and partner volunteers (ongoing). Quantitative and documentary findings informed the design of a single-page self-assessment aid modelled on the Quick Reference Handbook (QRH), the checklist format pilots are trained to apply in abnormal operations.

RESULTS: Fewer than half of pilots trusted PPSP confidentiality (47%) or would use a programme (48%). Free-text accounts described concealment and a preference for anonymous, external support, explicitly linked to fear of losing the Class 1 medical certificate. Documentary analysis found confidentiality to be the most elaborately engineered element of the European framework, indicating that documented safeguards alone do not generate trust. Yet published European certification data show that 99.6% of pilot medical assessments involve no psychiatric or psychological unfitness. In response, the Mental Health QRH (MH-01) was developed: four sequential checklist gates (immediate safety items, symptom thresholds, certification questions, default) route the pilot to colour-coded pathways from RED (formal aeromedical involvement) through AMBER (assessment; advice) to GREEN (confidential peer or psychological support, no automatic aeromedical consequence), anchored to EASA Part-MED and displaying base-rate data to counter catastrophic risk perception.

CONCLUSIONS: Pilots' perceived aeromedical risk of help-seeking substantially exceeds the documented risk, and engineered confidentiality is not, by itself, trusted. Presenting graduated support pathways as a checklist reframes help-seeking from an unbounded career threat into a bounded, proceduralised task, extending the trajectory by which CRM and HIMS translated human factors and substance-use recovery into operational culture. The QRH is a discussion and self-orientation aid rather than a fitness determination; stakeholder evaluation with pilots, peer volunteers, AMEs and aviation psychologists forms the next phase.

Keywords: pilot, mental-health, peer-support-programmes

[Abstract:0206]

Evaluation of Dentistry Students' Perceived Knowledge and Awareness of Aviation Dentistry

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OBJECTIVE: Aviation dentistry focuses on maintaining the oral and dental health of military and civilian aircrew, as well as individuals who frequently travel by air. Barodontalgia refers to oral pain or dental injury triggered by changes in ambient pressure at high altitudes or underwater and is considered a symptom rather than a pathological condition. This study aimed to evaluate dental students' knowledge, awareness, and attitudes regarding the effects of altitude- and pressure-related environmental changes on oral and dental tissues and to identify factors associated with their level of awareness.

METHODS: This cross-sectional study was conducted among undergraduate dental students. Data were collected using a structured, anonymous, self-administered online questionnaire consisting of 22 items covering demographic characteristics, perceived knowledge and awareness, educational experiences, and future expectations. The questionnaire included both dichotomous (Yes/No) and five-point Likert-scale questions. Categorical variables were summarized as frequencies and percentages, and associations between categorical variables were analyzed using Pearson's chi-square test. Statistical significance was set at $p < 0.05$.

RESULTS: A total of 321 dental students (182 females and 139 males) participated in the study. Overall, participants demonstrated limited knowledge of aviation and underwater dentistry. Only a small proportion correctly identified barodontalgia as pressure-related tooth pain or recognized that changes in cabin pressure during flight and pressure variations during diving could cause dental pain. Likewise, few students had encountered information or news related to toothache associated with flying or diving. Despite these limited knowledge levels, a substantial proportion of participants expressed interest in receiving education in aviation and underwater dentistry.

CONCLUSION: Dentistry students did not possess sufficient knowledge regarding changes in teeth and associated tissues related to altitude changes. Incorporating introductory educational content on aviation dentistry into undergraduate dental curricula may enhance students' awareness and better prepare future dentists to manage pressure-related oral health conditions.

Keywords: Aviation medicine, dentistry, altitudes, hyperbaric, awareness, dental students

[Abstract:0207]

Contrast Sensitivity Vis-A-Vis Visual Acuity as Measures of Visual Adaptation Time

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INTRODUCTION: Night vision goggles (NVGs) enable aircrew to overcome the inherent limitations of human night vision and operate safely in low-light environments. Despite their operational advantages, NVGs impose visual constraints that must be clearly understood to define safe flying envelopes. Of particular concern is the effect of NVG display luminance —operating within the twilight to low-photopic range, on subsequent dark adaptation once the goggles are removed. This study aimed to estimate visual adaptation time (VAT) after de-goggling Gen-2++ NVGs under varying illumination levels, using contrast sensitivity (CS) and visual acuity (VA) as primary measures.

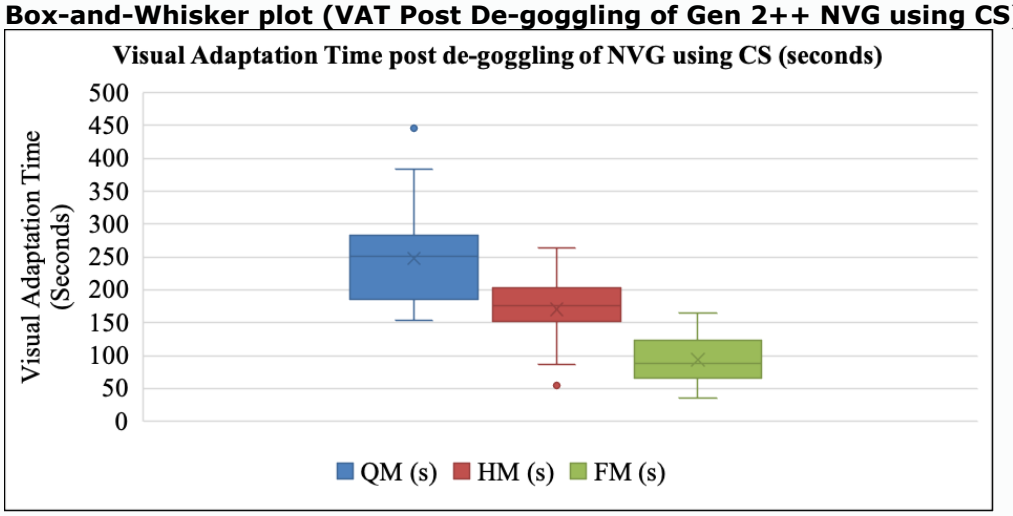
METHODS: A prospective repeated-measures design was used involving 64 volunteers tested in NVG laboratories at two locations. Visual adaptation time was assessed following de-goggling under three ambient moonlight conditions: full moon (FM), half-moon (HM), and quarter moon (QM). CS was measured with the Pelli–Robson chart and VA with the USAF 1951 tribar chart. Log CS values and VA were also recorded under unaided and NVG-assisted conditions.

RESULTS: The average recovery time post-de-goggling of NVG for CS was 1 min 34 s for FM, 2 min 50 s for HF, and 4 min 01 s for QM conditions. The average recovery time for VA was 1 min 29 s for FM, 3 min 01 s for HF, and 5 min 32 s for QM conditions. The results of this study brought out that visual adaptation time post-de-goggling of Gen 2++ NVG increased significantly for both CS and VA with decreasing ambient moonlight illumination ($P < 0.001$). This study also brought out that log value of CS and VA under three ambient light illuminations decreased significantly with a decrease in illumination both during unaided eye and NVG usage. Post hoc analysis revealed that there was a significant difference in visual adaptation time in both CS and VA between all three ambient light conditions ($P < 0.001$).

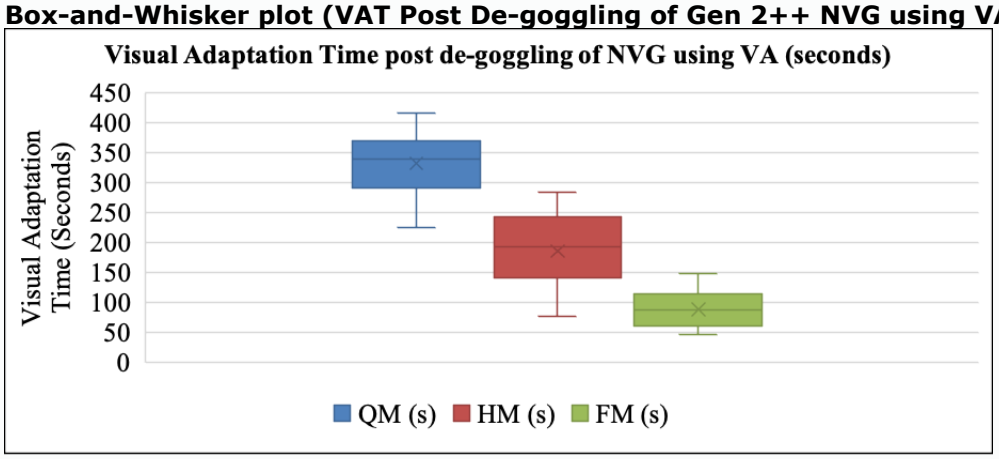
DISCUSSION: This study has estimated the time for dark adaptation required after de-goggling NVG use in different ambient moonlight levels for Gen 2++ NVG using CS and VA charts. The values based on CS can be considered in terms of time required for the detection of objects while that of VA can be attributed to the time for recognition of the object. The visual adaptation time post-de-goggling of NVG is very crucial and critical during approach, landing, and taxiing on the runway under dim light conditions for the accomplishment of mission safety.

Keywords: Contrast sensitivity, Dark adaptation, Night vision, Rhodopsin, Visual acuity

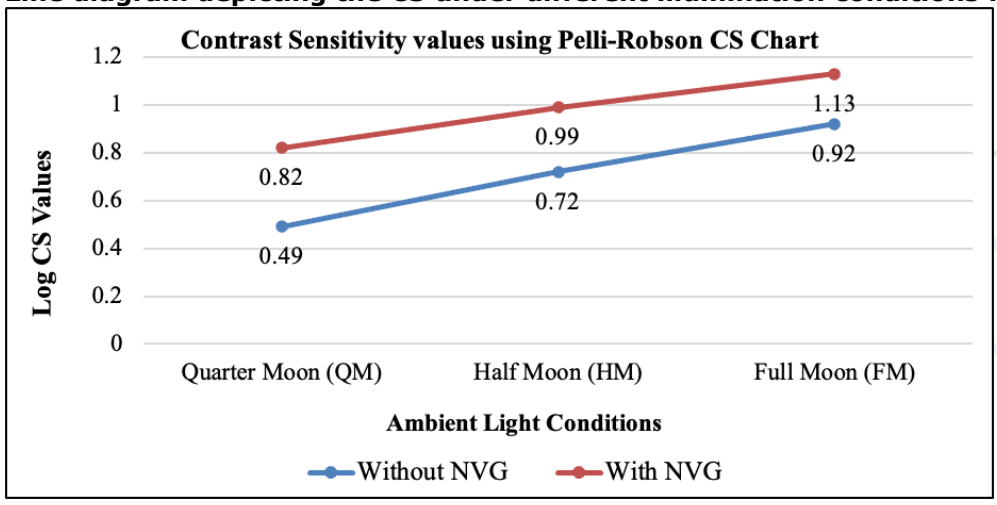
Box-and-Whisker plot (VAT Post De-goggling of Gen 2++ NVG using CS)



Box-and-Whisker plot (VAT Post De-goggling of Gen 2++ NVG using VA)



Line diagram depicting the CS under different illumination conditions for Gen 2++ NVG



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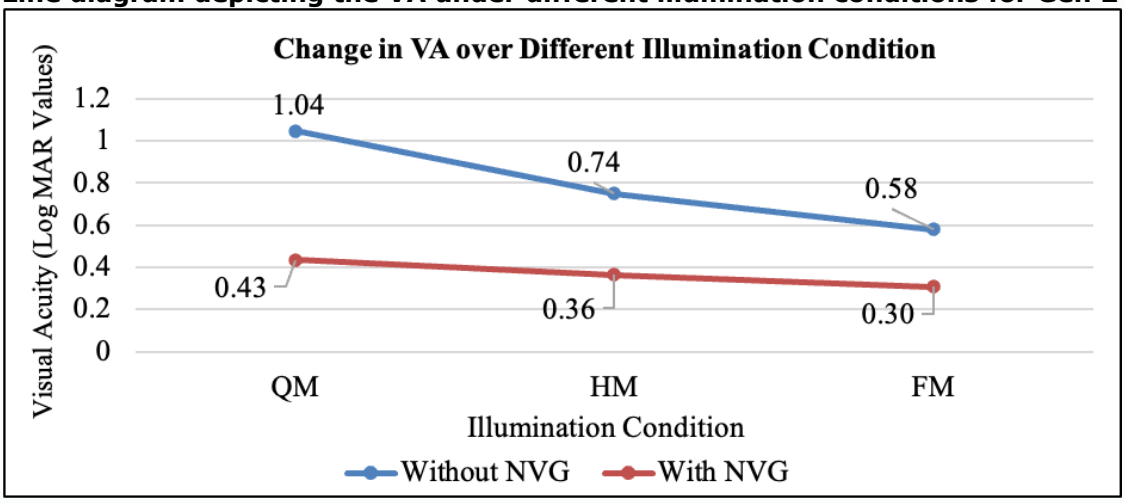
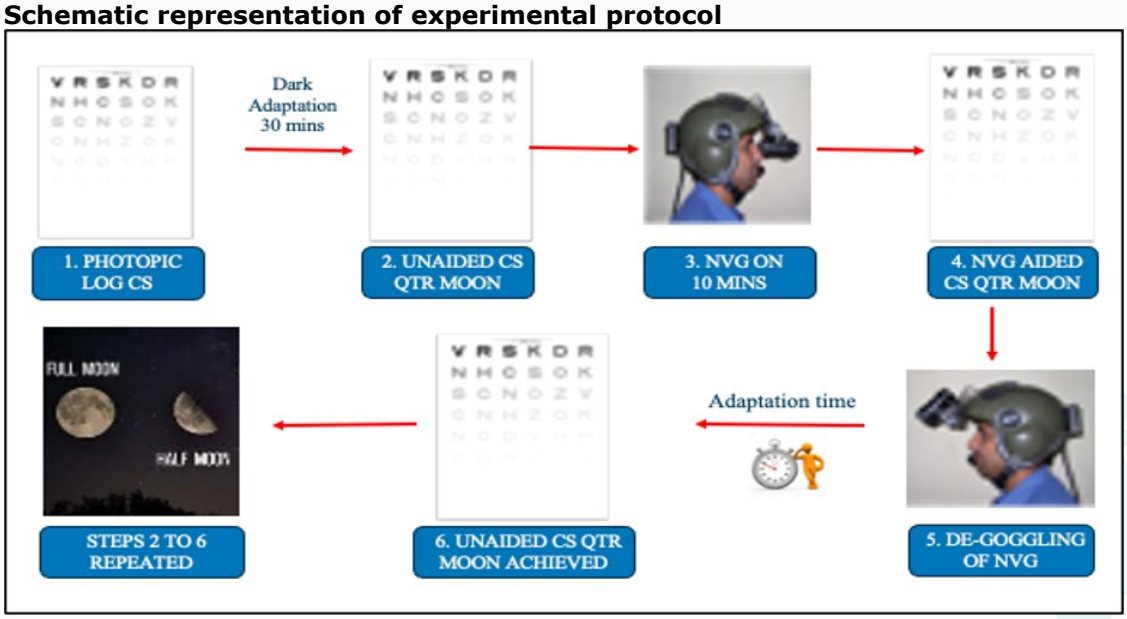
Line diagram depicting the VA under different illumination conditions for Gen 2++ NVG



Schematic representation of experimental protocol



[Abstract:0213]

Risk Assessment in Aviation Medicine - Using the Risk Matrix

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Norwegian Armed Forces Institute of Aviation Medicine, Oslo, Norway

The "1% rule", which started to be used in the 1980s, was the first attempt in Aviation Medicine to assess risk as part of an aviation system. The 1% rule refers to a specific acceptable risk in a specified type of flight operation - commercial airline flights with 2 pilots - given a total incapacitating event from medical causes. It has primarily been used for evaluation of cardiovascular and other total incapacitation events, since it does not apply to partial incapacitation. In the last decade, emerging methodologies have been developed to broaden the scope of risk assessment to include partial incapacitation as well as different types of aviation operations. In order to be able to not only assess, but also communicate risk levels, risk matrices such as the ICAO risk matrix may be used for aeromedical assessment. Aviation safety being the goal, a more aviation centred approach rather than a diagnosis centered approach may be beneficial. Such matrices allows risk to be assessed quantitatively. This presentation presents verious versions of recent aviation medicine risk matrices, and the methods by which such matrices may be usefully emplioye for aeromedical assessment.

Keywords: Aeromedical assessment, clinical aviation medicine. Risk assessment, acceptable risk.

[Abstract:0214]

Arrhythmia and conduction disorders in aging aircrew

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German Air Force Centre of Aerospace Medicine, Cologne, Germany

BACKGROUND: The age limits for commercial pilots have been extended in many countries or completely abandoned in others in which fitness decisions are merely based on physical and mental examination results. As arrhythmia and conduction abnormalities are an important reason for the loss of flying license and also prognostically relevant for aircrew health, their age dependency has to be analyzed. The incidence of certain arrhythmias, including atrial fibrillation (AF), and certain conduction abnormalities increases with age. Endurance-exercise in sportive aircrew may have additional influence on pathophysiology and prognosis.

DESCRIPTION: According to current guidelines, the diagnosis of AF should entail investigation for underlying cardiac and non-cardiac disease and for risk factors leading to or facilitating AF. Increased AF incidence in endurance athletes may be caused by complex mechanisms, such as bi-atrial dilatation, pulmonary vein stretching, cardiac inflammation, fibrosis, and increased vagal tone, but the exact pathophysiology is still unclear. Interestingly, earlier diagnosis of AF seems to be associated with a higher hazard ratio of myocardial disease and shorter life expectancy. The presentation of AF with regard to symptomatology, arrhythmia burden, and thromboembolic risk is variable, and has to be considered for aeromedical decision. Such a variety of symptoms, arrhythmia burden and complications also exist for premature ventricular contractions (PVC); different origins depending on age, management and treatment indications will be discussed. In case of extreme bradycardia in middle-aged or older aircrew, evaluation has to focus on the differential diagnosis between sick sinus syndrome caused by intrinsic remodelling, and high vagal tone. Further evaluation as well as consequences for prognosis and treatment will be pointed out.

DISCUSSION: The incidence of arrhythmia and conduction disturbance increases in middle-aged and older aircrew. In some diseases including AF, there is an additional association with endurance exercise. Aeromedical assessment of such advanced age groups requires systematic or opportunistic screening for certain arrhythmia, advantages and disadvantages of screening devices including wearables, pathophysiology, prognostic aspects, modern treatment options, and aeromedical decision making will be discussed.

Keywords: arrhythmia, conduction disorders, aircrew

[Abstract:0215]

Practical cardiovascular risk assessment for aeromedical examiners

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German Air Force Centre of Aerospace Medicine, Cologne, Germany

BACKGROUND: Cardiovascular disease including coronary artery disease remains a major cause of sudden incapacitation, including death, in both the general population and among aviation personnel, and is an ongoing threat to flight safety and operations. The presentation of a coronary event is often unheralded and is mostly due to rupture of a previously non-obstructive coronary atheromatous plaque. Cardiovascular risk assessment is therefore one of the most important tasks of the aeromedical examiner (AME) often examining apparently healthy individuals. General aeromedical risk assessment can be differentiated from specific cardiovascular risk assessment.

DESCRIPTION: For general aeromedical risk assessment, the 1% rule was introduced in the 1980s, postulating that the risk of an incapacitating medical event should not be more than 1% per year. As there are some weaknesses of this rule, several modifications have been proposed over time. A different concept is the use of a risk matrix plotting the aeromedical impact (severity) of a medical event against the probability of its occurrence. There are some modifications of such a risk matrix, one is currently used by the European Union Aviation Safety Agency (EASA). For specific cardiovascular risk estimation, different risk calculators are used, which should be evaluated for the population they are used for. The most recent risk calculators recommended by the European Society of Cardiology (ESC) are SCORE2 (Systematic Coronary Risk Evaluation), SCORE2-OP (older persons), and SCORE2-Diabetes. The practical use of all these tools will be explained during the presentation.

DISCUSSION: The consequences of certain risk calculator results concerning further examinations, aeromedical decision making, and treatment are mostly not specified in aeromedical regulations and are interesting questions. Currently, computed tomography gains more and more importance in advanced cardiovascular evaluation. The informative value of this and other methods will be discussed as well as strategies for aeromedical decision making.

Keywords: cardiovascular risk assessment, aeromedical examiner, risk matrix, risk calculator

[Abstract:0217]

Analysis of spinal imaging findings in post ejection cases: A retrospective study

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INTRODUCTION: Ejection is one the most stressful event an aviator has to undergo during their flying career. Among the numerous physical injuries to which an aircrew is susceptible to during an ejection, spinal injuries are most common and have the most serious after-effects. Early detection and proper management of spinal injuries is important to avoid serious long-term consequences. In this study we compared serial MRI scans done at different time intervals of 19 post ejection cases for ejections taking place between Jan 2019 to Dec 2024. The objectives of the study were to determine the prevalence and distribution of acute spinal injuries detected on MRI after ejection, record instances of newly detected injuries during follow-up scans, assess changes in MRI findings over time and determine the proportion of injuries detected only on follow-up MRI.

MATERIALS-METHODS: A retrospective observational study was carried out at Department of Human Engineering, Institute of Aerospace Medicine (IAM) during which records of aircrew who had ejected from Jan 2019 to Dec 2024 were analyzed. Imaging findings in each case were analyzed for pattern of injuries sustained.

RESULTS and DISCUSSION: 19 aircrew had reported for review during the period. A total of 45 imaging reports were found and analyzed. The reports showed a wide range of findings in different cases. 73.7% (n=14) cases had findings suggestive of acute injury involving at least one vertebral segment, while 36.3% (n=5) only had incidental findings indicating chronic degeneration or anatomical variants. Acute injury findings were not reported in 03 of the 14 individuals at the time of initial imaging but were reported in later scans. 14 compression fractures were reported in 08 aircrew and laminar fracture of cervical vertebrae was reported in 01 case. 06 aircrew were found to have soft tissue injuries in addition to other findings. Serial scans showed either progression or resolution of various injuries sustained by the aircrew.

CONCLUSION: Pattern of injuries observed was similar to previous studies. Acute injuries showed resolution of injuries across scans while degenerative changes remained unchanged. Acute injuries were missed in 03 cases in initial scans, thus, warranting a second MRI before upgrading the aircrew to check for any masked/ under reported injuries that were missed the first time and mitigate preventable aggravation of morbidity from the injury.

Keywords: Pilots, MRI, Spinal Injuries, Vertebral Fractures, Incidental findings

[Abstract:0219]

When High Altitude Mimics Myocardial Infarction: Arrhythmogenic Mitral Valve Prolapse in a Professional Mountaineer

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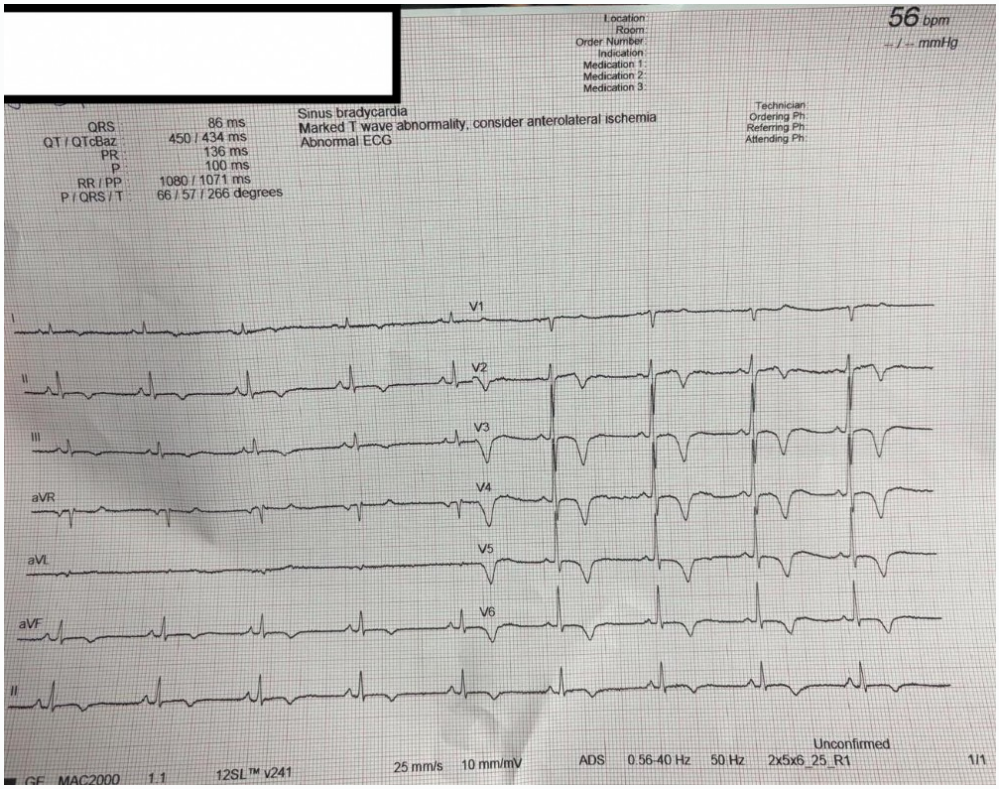
ISTANBUL UNIVERSITY, CERRAHPASA, INSTITUTE OF CARDIOLOGY

Temporary exposure to high altitude results in hypobaric hypoxia, leading to sympathetic activation, increased cardiac workload, and elevated pulmonary artery pressures.Although transient electrocardiographic abnormalities may occur during acclimatization, these physiological stresses can also unmask previously silent cardiovascular disorders.We report a rare case of arrhythmogenic mitral valve prolapse(MVP) presenting as a pseudo-myocardial infarction during high-altitude exposure in a professional mountaineer. A 52-year-old female professional mountaineer presented with acute chest pain and severe dyspnoea while climbing at an altitude of approximately 2500 m.Electrocardiography demonstrated deep,symmetrical T-wave inversions,and high-sensitivity-troponin-I was markedly elevated(1170 ng/L),raising suspicion for acute myocardial infarction. Emergency CAG revealed angiographically normal-coronary-arteries. Transthoracic/transoesophageal echocardiography demonstrated a myxomatous bileaflet MVP with moderate mitral-regurgitation.Cardiac magnetic resonance(CMR) confirmed a 7mm systolic leaflet displacement without evidence of mitral annular disjunction(MAD), myocardial infarction, myocarditis, or stress cardiomyopathy.Exercise stress testing demonstrated ventricular premature beats during peak exercise and early recovery, while 24-hour Holter monitoring revealed a low burden of ventricular ectopy and supraventricular tachycardia episodes.Following optimization of medical therapy, the patient underwent a structured return-to-altitude program,successfully reaching 3000m asymptomatic at six-month follow-up.High-altitude exposure may independently produce transient electrocardiographic abnormalities and modest cardiac biomarker elevation, making differentiation from acute-coronary-syndrome particularly challenging.In our patient, the finding of angiographically normal coronary arteries prompted a structured multimodality evaluation to identify alternative causes of myocardial injury and determine whether an underlying arrhythmogenic substrate was present. CMR was performed to exclude myocardial infarction,myocarditis, stress cardiomyopathy, and MAD.The coexistence of bileaflet-myxomatous-MVP, exercise-induced ventricular ectopy, and the absence of another identifiable diagnosis suggests that altitude-related physiological stress may have unmasked a previously silent arrhythmogenic-MVP phenotype rather than representing an isolated altitude response.Although causality cannot be established from a single case, hypobaric hypoxia, sympathetic activation, increased myocardial oxygen demand, altered hemodynamic loading, and physical exertion constitute biologically plausible mechanisms capable of increasing arrhythmic susceptibility and exacerbating symptoms in patients with underlying MVP.These findings suggest that exercise testing and ambulatory-rhythm-monitoring may provide valuable additional information for arrhythmic risk assessment, particularly in highly active individuals and those with occupational exposure to high-altitude environments.Conservative management with medical therapy and periodic clinical and imaging surveillance was appropriate in this patient with moderate-primary-MR and preserved ventricular function.This case highlights the value of multimodality imaging and structured rhythm evaluation in troponin-positive patients with non-obstructive coronary-arteries following high-altitude exposure. From an aerospace medicine perspective, individualized aeromedical risk stratification and fitness-to-fly assessment are essential before returning personnel with structural heart disease to aviation or other high-altitude occupations.

Keywords: High altitude, Arrhythmogenic mitral valve prolapse, Pseudo-myocardial infarction, Hypobaric hypoxia

ECG

Oral Presentations



ECG shows deep symmetrical T-wave inversions in leads V1–V6

[Abstract:0220]

Peer Support in Aviation: What Are We Learning from 1,000 Cases?

Aedrian Bekker, Sarah Gordon, Rob Bor, Ruth Henderson
Centre for Aviation Psychology, London, United Kingdom

Peer support programmes have become an increasingly important component of aviation safety management, with implementation now mandated for commercial pilots in Europe, the UK, India and other jurisdictions, and actively promoted by regulators worldwide. Despite their growing adoption, there remains relatively little empirical evidence describing how aviators—predominantly pilots—use these programmes or the outcomes they achieve. This presentation reports findings from one of the largest case-level evaluations of a commercial aviation peer support programme to date. Drawing on approximately 1,000 de-identified cases from pilots across multiple airlines operating in 12 European countries, it explores the diverse reasons why aviators access peer support, the severity of issues at presentation, and outcomes at case closure. Associations between presenting concerns, case severity and outcomes, together with demographic and occupational factors—including sex, pilot role and fitness for work status—will be examined to identify patterns associated with successful resolution. Beyond presenting the findings, the session will discuss the methodological and practical challenges of collecting robust outcome data within a confidential peer support environment, highlighting the complexities of evaluating effectiveness in a rapidly evolving field. As peer support programmes continue to expand across the global aviation industry, establishing a stronger clinical evidence base is essential to inform best practice, guide regulatory policy and demonstrate programme value. With a focus on both operational safety and human performance, the presentation will consider the implications of these findings for the future design, implementation and evaluation of aviation peer support programmes. Ultimately, it aims to contribute to the development of evidence-informed approaches that enhance the mental wellbeing, resilience and safety of aviators across all professions, sectors and regions.

Keywords: Aviator Peer Support, Mental Health, Evidence-based Practice, Outcomes

[Abstract:0222]

Self-assessment of mental health in aircrew and cooperation with peer support

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In 2026, assessing the mental health of the applicant constitutes one of the most important components of an aeromedical assessment. While history-taking and clinical observation remain the principal sources of information, technological developments mean that AMEs must also be attentive to information derived from apps and other digital sources. Advances in Artificial Intelligence (AI) may render such information considerably more powerful, and potentially more consequential, than was the case only a few years ago. How should the AME handle this type of information? Under what circumstances can it provide a meaningful supplement to the aeromedical assessment? And can these technologies also be used to reduce aeromedical risk? These questions will be explored in this presentation with reference to an initiative in which the speaker is personally involved. Particular attention will be paid to the legal and ethical conditions that must be satisfied. In principle, the use of these modalities should be voluntary, and the individual concerned should retain control over his or her own data. These developments cannot be considered in isolation from peer support. A pilot or other aviation professional experiencing mental health difficulties—particularly when advised by an app or another source of digital support to seek help—will often initially turn to a peer support organisation. What may the AME expect from peer supporters in such circumstances? And what should the AME not expect? The presentation will propose an optimal model for collaboration with peer support organisations. The underlying premise is that peer support is a highly valuable adjunct to aeromedical practice, but not a substitute for it. Peer support may certainly lead to consultation with the AME, but it cannot assume the AME's responsibilities. Nor is it desirable for peer support to be used as a risk-mitigating measure in the context of aeromedical certification. Rather, it is a form of support that exists alongside the work of the AME, not in place of it. The aim of this presentation is to provide AMEs with an understanding of how best to handle data from apps and other information sources, and how to structure collaboration with peer support organisations as effectively as possible.

Keywords: Mental Health, Peer Support, Assessment, Screening

[Abstract:0224]

Emphasis on elements of the Aeromedical Examination and Assessment

Declan Maher
Declan Maher

Emphasis on elements of the Aeromedical Examination and Assessment. The Aeromedical Examiner Refresher Training Session Declan Maher, Glencairn Medical Centre, Dublin D18 YK54, Ireland.

INTRODUCTION: Presentation focusing on elements of the Aeromedical Assessment of Pilots and Air Traffic Controllers including Structure and content of the Examination (Physical and Psychological) Aeromedical Assessment Referrals The 15-point Oncology Report A report on Aeromedical Assessment Oversight (2025)

Method.
Following discussion with the European Aviation Medical Assessors Congress and the Medical Experts of the European Union Aviation Safety Agency (EASA) areas of focus were shared with me, as Chair of the Advisory Board Committee ESAM. The output of these discussions led to the content of this Session

RESULTS and CONCLUSIONS: The "Structure and content of the Examination…" is based on the on-line training module used as part of the Advanced AME Training (ESAM). This highlights the difference between the screening assessment against the assessment carried out by treating physicians and puts emphasis on elements relevant to the Aeromedical Assessment. The Aeromedical Assessment Referral can be improved in structure and relevance by using the ARA.GEN.160 form, highlighting the regulatory query. This should improve the quality of the communication between the AME and the Medical Assessor, The 15-point Oncology Report as designed by the UK CAA and adopted by many of the EU Medical Assessors. A report of Aeromedical Assessment Oversight looks at the review of 10,242 Class 1 and 3 Medical Assessments in 2025. The study identifies the top five medical categories: Mental Health; Cardiovascular; Neurology; Visual and Respiratory.

Keywords: Aeromedical Assessment, Referrals, Oversight

[Abstract:0225]

The Aeromedical Examiner Refresher Training Session

Declan Maher
Declan Maher

The Aeromedical Examiner Refresher Training Session

Declan Maher Chair.
Terje Saehle Co-Chair

Summary
• Practical AME Cardiovascular Risk Assessment. • Self-Assessment of mental health in aircrew and cooperation with peer support. • Health Trends in an Aeromedical Centre • What's the Impact on aeromedical certification referrals • Use of the 4-D Risk Matrix • Emphasis on elements of the Aeromedical Examination and Assessment.

Background.
Following discussion with the European Aviation Medical Assessors Congress and the Medical Experts of the European Union Aviation Safety Agency (EASA) areas of focus were shared with me, as Chair of the Advisory Board Committee ESAM. The output of these discussions led to the content of this Session. The session is approved by the Medical Assessor for AME Refresher Training in accordance with EU Regulation 1178/2011 AMC1 MED.D.030 Validity of AME certificates.

Keywords: Refresher Training. Aeromedical Assessment, Regulation Updates,

[Abstract:0226]

Correlation of Computerized Dynamic Posturography (CDP) Parameters with Lean Body Mass in Indian Air Force (IAF) Aircrew

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BACKGROUND & OBJECTIVES: Posture refers to the alignment of individual or collective body segments in relation to gravity, allowing for the maintenance of an upright position. The co-operative and summative effort by visual, vestibular and proprioceptive systems maintain postural stability of a person. Postural stability is a key element in performing tasks that require precision and balance, such as flying. In the demanding environment of aviation, factors like stress, fatigue, and physical fitness, particularly Lean Body Mass (LBM), are crucial in maintaining optimal postural stability. Computerized Dynamic Posturography (CDP) is used to evaluate postural stability by assessing the integration of sensory inputs. This study aims to explore the correlation between CDP parameters and LBM in Indian Air Force aircrew, providing insights into how physical fitness, specifically LBM, contributes to postural stability in this unique population.

METHODS: This analytical cross-sectional study involved 44 healthy Indian Air Force aircrew members. The participants underwent CDP evaluation, which included the Sensory Organization Test (SOT), Motor Control Test (MCT), and Adaptation Test (ADT) at the Neuro-vestibular Lab, Department of Acceleration Physiology and Spatial Orientation, Institute of Aerospace Medicine, Bangalore. LBM was assessed using bioelectrical impedance analysis. Data were collected and analysed to determine the correlation between LBM and postural stability as indicated by the CDP parameters.

RESULTS: The study found that higher LBM positively correlated with improved postural stability across multiple CDP parameters. Specifically, the SOT revealed that participants with higher LBM exhibited better equilibrium scores, particularly in conditions that challenged vestibular and visual systems. MCT results showed that participants with greater LBM had better weight symmetry and faster recovery responses to perturbations. However, no significant correlation was found between LBM and sway energy scores in the ADT, suggesting that while LBM influences general postural stability, its impact on rapid adaptation to sudden surface changes might be limited.

INTERPRETATİON & CONCLUSION: The findings indicate that in IAF aircrew, higher LBM is associated with better postural stability as measured by CDP. This suggests that maintaining or increasing LBM through targeted physical training could enhance postural stability, potentially improving performance and reducing injury risk in aircrew. These results support the integration of LBM-focused fitness programs in aircrew training regimens. Further research could explore specific exercises that most effectively increase LBM and consequently improve postural stability.

Keywords: Postural Balance, Computerized Dynamic Posturography, Lean Body Mass, Aircrew, Vestibular Function Tests, Motor Control

[Abstract:0227]

International Medical Operations for Human Spaceflight & The Most Unique Ward Rounds in the Solar System

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The International Space Station (ISS) Program is a beacon of successful international collaboration in a human space flight project of unprecedented scale and complexity. It seamlessly integrates resources of multiple nations in a mutually complementary fashion. Beyond the technical integration of spacecraft equipment and operations, the success of long-duration missions depends on a highly coordinated international medical system that ensures the health, safety, and operational readiness of every crewmember. The presentation will include description of how ESA Flight Surgeons and related disciplines integrate with other International Partner (IP) medical teams through the operational governance established through the Multilateral Medical Operations Panel (MMOP), the principal forum responsible for coordinating and overseeing international medical operations for ISS missions. The presentation will illustrate how multilateral decision-making enables a joint operational medical framework based on common medical standards and approaches in areas such as prevention, medical monitoring and care, environmental monitoring, performance, and human behavioral support. As with other IPs, ESA contributes valuable clinical and operational expertise to all discipline working groups and subgroups that support the MMOP. The presentation will also highlight the Space Medicine Operations Team (SMOT) weekly multidisciplinary clinical and operational forum bringing together Flight Surgeons from all ISS partner agencies to review the health status and well-being of each astronaut currently in orbit. With over 1,335 consecutive weekly sessions, the SMOT represents an exceptional sustained medical collaboration, referred to as the "most unique Ward Round in the Solar System." Lessons learned from over 25 years of ISS medical operations will be discussed, together with the importance of international trust, standardization, operational discipline, and shared medical responsibility as foundations for future exploration missions to the Moon and Mars.

Keywords: ISS, Space Medicine, Flight Surgeon, Multilateral Medical Operations Panel, Space Medicine Operations Team,

[Abstract:0228]

In-Flight Medical Events in a High-Volume Carrier: A Descriptive Analysis of 9,837 Passenger Cases and Evidence-Based Emergency Medical Kit Optimization Recommendations

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Turkish Airlines, Medical Department, Istanbul, Turkiye

BACKGROUND: In-flight medical events (IMEs) present unique challenges due to altitude-induced physiological changes, limited resources, and restricted access to definitive care. Comprehensive carrier-level epidemiological data remain limited.

METHODS: A descriptive retrospective analysis of 9,837 passenger IMEs recorded via a structured reporting system in 2025 was conducted across 92.6 million passenger trips. Cabin crew events (n=317) were excluded. Severity was classified using objective criteria (critical intervention/outcome markers). An important documentation characteristic of this carrier is that the sphygmomanometer is exclusively housed within the physician emergency kit (DR Kit), with no separate provision in the cabin crew first-aid kit; any blood pressure measurement therefore requires opening the physician kit and completing an incident form, contributing to the comprehensive event capture observed. A chi-square goodness-of-fit test was applied to the monthly case distribution.

RESULTS: Overall incidence was 106.2 per million passengers (10.62/100,000). Mean age was 42.6 years; 58.9% were female. Severity distribution: mild 88.3%, moderate 11.1%, severe 0.6%; the severe category accounted for 86.4% of all critical outcomes (diversion/death). Nausea (24.2%), dizziness (18.7%), and headache (18.6%) were the most frequent symptoms. Case volume peaked in May (10.4%) and was lowest in July (6.4%), with the monthly distribution significantly non-uniform ($\chi^2=123.2$, df=11, $p<0.001$). By flight-haul category, Extended-Range flights accounted for 46.6% of matched events. The physician kit was used in 60.0% of events; glucometry was performed in 858 cases (8.7%). The medical event registry documents 29 diversions, while operational records list 92 medically-coded diversions — a discrepancy reflecting both incomplete form completion during high-acuity events and inclusion of inadmissible (INAD) passenger diversions in the operational count.

CONCLUSIONS: Mortality (0.24/million) aligns with global benchmarks. The elevated raw incidence partly reflects a documentation protocol specific to this carrier. Evidence-based EMK recommendations include expanded antiemetic and glucometry provision, pediatric formulations, and improved documentation workflows for diversion events.

Keywords: in-flight medical events, aerospace medicine, emergency medical kit, aviation health, seasonal distribution

Age Distrubution

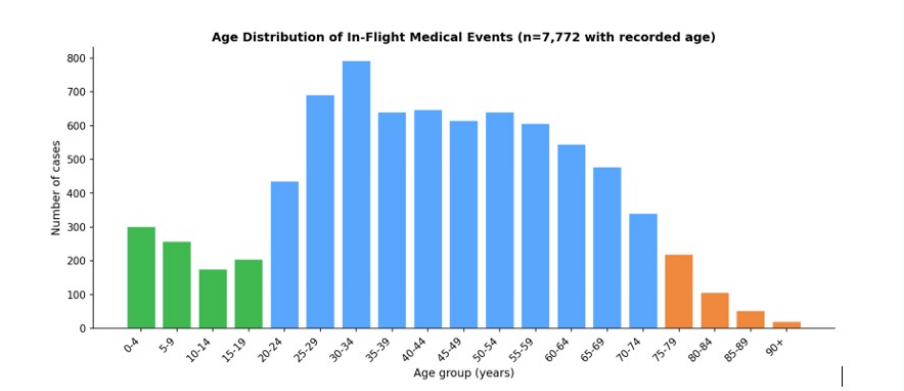
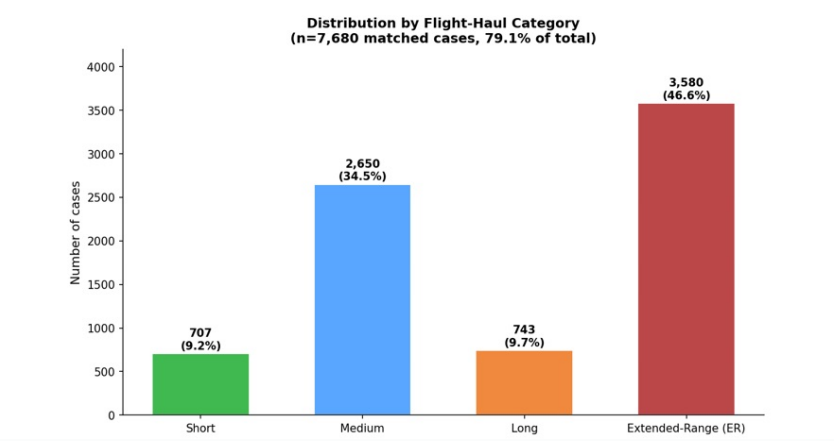


Figure 1. Age distribution of in-flight medical events (n=7,772 with recorded age).

Age data were available for 7,772 patients (mean 42.6, median 42, range 1–105). Distribution peaked in the 30–34-year group (792 cases, 10.2%), with a gradual decline through older age groups

Flight Haul Category



Among 7,680 events with identifiable flight-haul category, Extended-Range (ER) flights accounted for the largest share (3,580 cases, 46.6%), followed by Medium-haul (2,650 cases, 34.5%), Long-haul (743 cases, 9.7%), and Short-haul (707 cases, 9.2%). These proportions reflect the carrier's predominantly long-haul international route network. The remaining 2,157 events (21.9%) could not be matched to a haul category due to missing or unrecorded flight numbers and are excluded from this sub-analysis only.

Frequent Symptoms

Table 3. Ten Most Frequent Presenting Symptoms (n=9,837)

#	Symptom	n	% of Events
1	Nausea	2,383	24.2%
2	Dizziness	1,840	18.7%
3	Headache	1,833	18.6%
4	Weakness	1,352	13.7%
5	Diaphoresis	1,309	13.3%
6	Near-Syncope	1,056	10.7%
7	Vomiting	1,027	10.4%
8	Abdominal Pain	1,008	10.2%
9	Dyspnoea	820	8.3%
10	Fever	783	8.0%

Presents the ten most frequent symptoms. Nausea was the most common (24.2%), followed by dizziness (18.7%) and headache (18.6%), contrasting with the syncope-dominant profile reported in several Western carrier series (Peterson et al., NEJM 2013: 37.4%).

General Characteristics of In-Flight Medical Events (n=9,837)

Table 1. General Characteristics of In-Flight Medical Events (n=9,837)

Characteristic	Value
Total passenger trips (2025)	92,600,000
Total IMEs (passengers only)	9,837
Overall incidence	106.2/million (10.62/100,000)
Mean patient age (years)	42.6 (range: 1–105)
Median age (years)	42
Sex — Female	4,513 (58.9%)
Sex — Male	3,152 (41.1%)
Physician kit (Emergency Medical Kit) used	5,904 (60.0%)
Cabin crew first aid kit used	5,598 (56.9%)

Seasonal Distrubution

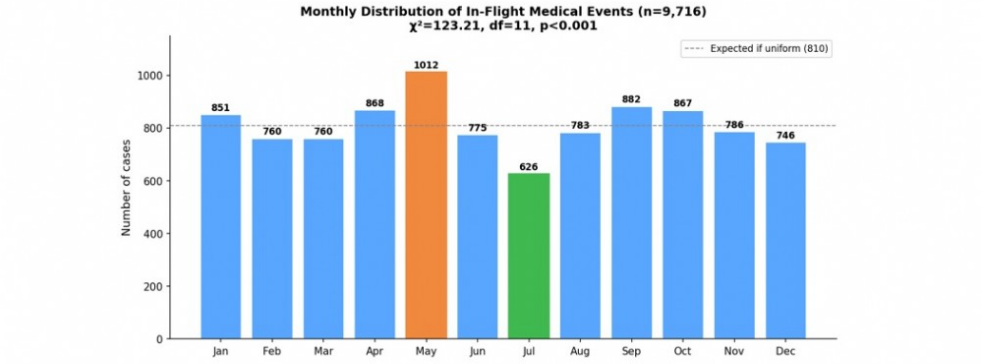
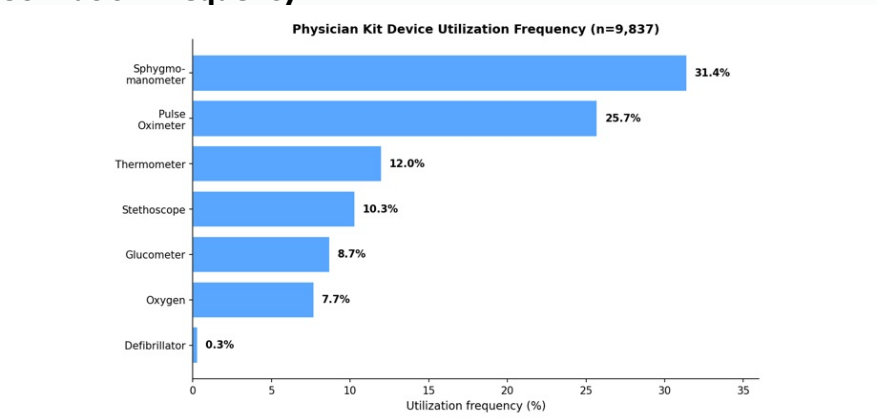


Figure 5. Monthly distribution of in-flight medical events. The dashed line shows the expected count under a uniform distribution. May (peak) and July (nadir) are highlighted. χ^2=123.2, df=11, p<0.001.

Date information was available for 9,716 events (98.8%). Case volume peaked in May (1,012 cases, 10.4%) and was lowest in July (626 cases, 6.4%). A chi-square goodness-of-fit test confirmed that the distribution departs significantly from uniformity (χ^2=123.2, df=11, p<0.001), indicating a genuine seasonal pattern in case presentation

Utilization Frequency



Emergency medical kit was used in 5,904 events (60.0%). The sphygmomanometer was the most frequently used device (31.4%), a finding directly attributable to the documentation protocol described in Section 2.4: as the only on-board location of this device, opening the physician kit for any blood pressure measurement automatically triggers form completion. Pulse oximetry was used in 25.7% of events, glucometry in 8.7%, and supplemental oxygen in 7.7%

[Abstract:0229]

Assessing the Impact of a Mental Health Questionnaire on AME Case Detection Using Aeromedical Certification Referrals as a Surrogate Outcome

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INTRODUCTION: Updated EASA Part-MED provisions added mental-health assessment items to the pilot medical examination, and a task force recommended strengthening the psychological aspects of aeromedical examiner (AME) practice; an Aerospace Medical Association working group, conversely, considered extensive routine psychiatric evaluation unwarranted. A mental health questionnaire (MHQ) addressing individually every mental-health assessment item of the updated EASA regulation was introduced at our aeromedical centre (AeMC) in June 2022 for all Class 1 initial and revalidation examinations. Effectiveness of case detection by the AME cannot be measured directly. We therefore used referral to the Civil Aviation Authority (CAA) as a surrogate outcome to assess whether a systematic MHQ improved detection.

METHODS: Ecological, observational, retrospective study at an AeMC. All Class 1 referrals to the CAA between 1 January 2021 and 31 December 2023 were anonymised and reviewed; mental-health referrals were selected and their clinical records analysed for demographics, reason for referral, the source prompting referral, and certification outcome. The proportion of referrals attributable to mental health was compared between the pre- and post-questionnaire periods.

RESULTS: Among 9,812 Class 1 examinations there were 423 referrals (4.3%), 70 of which (16.5%) were mental-health related (0.7% of examinations). Referred applicants were 85.7% male; 81.4% aged 18–50, 18.6% over 50; 48.6% revalidations, 32.9% renewals, 18.6% initials. Commonest reasons: depressive/anxiety disorders (61.5%) and psychoactive substance use (12.9%). Mental-health referrals rose from 28/214 (13.1%) pre-questionnaire to 42/209 (20.1%) post-questionnaire, without reaching significance (chi-square 3.764; p=0.0524). The clinical interview prompted 80.0% of referrals and discussion of MHQ responses 18.6% (13 cases, 31.0% of post-questionnaire referrals). Previous psychological or psychiatric follow-up was documented in 85.7%, psychotropic medication in 45.7% and interruption of aviation activity in 46.7%. Outcomes were fit (40.0%), fit with limitations (42.9%) and unfit (17.1%).

CONCLUSIONS: Using referrals as a surrogate for detection, the MHQ produced no statistically significant change, although the 13 questionnaire-prompted cases suggest it may facilitate case-finding. The surrogate is imperfect: cases may be managed without referral, and referral thresholds vary. Detection remained overwhelmingly interview-driven, supported by other pointers — examination type, previous psychiatric follow-up or psychotropic use, and interruptions in flying activity. AME training should prioritise interview technique and recognition of such pointers over reliance on tools, positioning the questionnaire as a structured prompt that opens/facilitates the conversation rather than a screening test. Larger samples across varied settings are needed. The AME interview remains paramount.

Keywords: aeromedical certification, mental health, questionnaires, case detection, AME training

[Abstract:0230]

Neurodivergence in candidates seeking aviation medical certification: Developing a Specialist Neurodevelopmental Assessment Pathway. Clear Aviation Psychiatry, Wilmslow, Cheshire, UK

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Neurodevelopmental conditions, in particular Attention-Deficit/Hyperactivity Disorder (ADHD) and Autism Spectrum Condition (ASC) are increasingly encountered amongst candidates seeking aviation medical certification, yet guidance for Aeromedical Examiners (AMEs) remains limited. Population estimates suggest that ADHD affects 5–8% of adults (Fayyad et al., 2017) and ASC approximately 1–2% (Zeidan et al., 2022), with consistent evidence of significant under-diagnosis across the general population. Under-reporting is likely to be amplified within safety-critical workforces including aviation, where fear of loss of medical suspension, professional stigma, and financial consequences constitute well-documented barriers to disclosure (Wu et al., 2016; Bor et al., 2016). Neurodivergence is not in itself, disqualifying for aviation medical certification under aeromedical standards; however, medical certification decisions need be informed by individualised specialist assessment. No published standardised assessment pathway currently exists to guide AMEs or specialist assessors in the evaluation of the full spectrum of neurodiversity. Neurodivergence may confer both operational strengths, including heightened pattern recognition, procedural precision, and dopamine linked focus and context-specific risks that require specialist assessment within an aviation operational context. We present a structured specialist multi-disciplinary neurodevelopmental assessment pathway. This pathway was informed from continuous learning from assessing neurodivergent and suspected neurodivergent candidates, case based discussions with AMEs and the wider multi-disciplinary team as well as guidance from existing and developing aeromedical standards. This neurodevelopmental pathway incorporates the nature of the clinical interview, need for longitudinal assessment in complex cases, psychometric assessments and where needed cognitive assessment using the Wechsler Adult Intelligence Scale (WAIS-IV), and neurodevelopmental tools including the Autism Diagnostic Observation Schedule (ADOS-2) and the Autism Diagnostic Interview (ADI-R). The pathway takes a stepped approach, with access to multi-disciplinary support and ensures suitability of candidates as well as maintaining aviation safety standards, and ensuring fairness for the candidate.

Keywords: Neurodiversity, ADHD, Autism, Psychiatry, Psychology, Mental Health

[Abstract:0232]

Morbidity Patterns and Medical Fitness of Cabin Crew Members: A 10-Year Retrospective Study

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INTRODUCTION: The medical fitness of cabin crew members is essential for the safe performance of their duties, for ensuring flight safety. Although ICAO does not establish detailed medical fitness standards for cabin crew members, and European Union Regulation 1178/2011 sets only minimum medical requirements for these personnel. The aim of this study was to analyze morbidity patterns among cabin crew members, as well as to evaluate the role of regular medical surveillance in reducing operational risks and promoting their health.

METHODS: The study analyzed medical examination reports of 1,475 cabin crew members collected over a 10-year period (2015–2024). The age distribution of the study population was as follows: 72% were younger than 30 years, 23% were aged 30–39 years, and 9% were aged 40 years or older. Cabin crews are exposed to multiple occupational hazards – reduced atmospheric pressure at altitude, barometric pressure fluctuations, increased exposure to cosmic radiation, noise and vibration, disruption of circadian rhythms, irregular and nutritionally inadequate meals, psychological stress, and musculoskeletal strain. These factors constitute significant occupational health risks. To evaluate morbidity patterns during the study period, data from annual medical examinations and records of short- and long-term medical unfitness for duty were analyzed.

RESULTS: The study has revealed the following rate of morbidity by system: musculoskeletal – 27,2%, digestive – 16,8%, mental health – 13,2%, cardiovascular – 6,5%, ENT – 5,8%, benign tumors – 5,6%, endocrine – 4,9%, urogenital – 4,8%, oncology – 0,5% and respiratory – 0,2%. No pathology was identified in 600 cabin crew members (41%). During the period 2020–2022, COVID-19 accounted for most short-term medical unfitness cases (<3 months). Excluding COVID-19-related cases, the most prevalent causes of short-term unfitness were digestive system diseases – 18,2%, followed by respiratory – 13,6%, mental – 9,1%, cardiovascular – 9,1%, and hematology – 4.5%. Pregnancy was the only cause of long-term unfitness. Permanent medical unfitness was recorded in 10 cases: ENT disorders (n = 3), infectious diseases (n = 3), hematological (n = 2), urogenital (n = 1), and neurological (n = 1).

CONCLUSION: The health status of cabin crew members is of critical importance for both their occupational performance and aviation safety. Therefore, it requires continuous monitoring and should not be underestimated. Regular medical examinations enable the early detection of both common and occupational diseases, facilitating timely intervention, supporting health maintenance, and helping to minimize the adverse effects of health conditions on cabin crew performance.

Keywords: cabin crew, occupational health, morbidity, hazards

[Abstract:0233]

"Psychological and occupational consequences of medical and operational certificate limitations in aviators: A Cross-Sectional Analytical Study"

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Medical Examination Center, Civil Aviation Organization (CAO), Tehran, Iran

BACKGROUND and OBJECTIVE: Aviation safety critically depends on the physical and psychological fitness of flight crews. Although periodic aeromedical examinations ensure fitness for duty, endorsing medical or operational limitations on medical certificates may induce psychological distress and alter professional behavior. This study evaluated the prevalence of various certification limitations and assessed their psychological impacts on civil aviators.

METHODS: In this cross-sectional analytical study, 580 commercial pilots (520 males, 60 females) holding at least one limitation were sampled from a total population of 3,200 aviators. Notably, all female participants had visual limitations requiring distance and astigmatism correction. Data were collected using demographic/occupational questionnaires alongside standardized psychological instruments, including GAD-7, PHQ-9, PSS-10, the Psychological Medical Limitations Perception Questionnaire (PMLPQ), and the Medical Concealment Scale. Statistical analyses comprised independent t-tests, ANOVA, Pearson correlation, and multiple linear regression performed via SPSS (version 26.0). RESULTS: The mean age was 42.1±8.5years ؛with a mean flight experience of11.8±6.2 years. Defective vision limitations (VDL, VNL, VML) were the most prevalent. Operational restrictions (e.g., OML, OCL, OPL, ORL) and time-bound/specific limitations (TML, SIC) correlated significantly with occupational anxiety, career insecurity, perceived loss of professional status, and self-doubt ($p < .001$). Furthermore, fear of non-renewal and perceived organizational stigma emerged as primary predictors of medical concealment ($p < .001$).

DISCUSSION: The psychological burden of aeromedical limitations varies considerably by restriction type. While visual limitations are generally perceived as benign and manageable, operational codes (such as OML and OCL) substantially impair professional autonomy, fostering self-doubt and organizational stigma. Moreover, limitations involving ongoing clinical uncertainty (TML and SIC) generate chronic career anxiety. Critically, the strong link between certification anxiety and medical non-disclosure reveals that fear of career degradation drives pilots to conceal medical conditions—directly threatening aeromedical surveillance and flight safety. CONCLUSION: Operational restrictions and uncertain medical outcomes impose a substantial mental burden on pilots, often triggering medical concealment. Establishing confidential psychological support systems and fostering a non-punitive culture within civil aviation medicine are essential to safeguard flight safety.

Keywords: Aeromedical Limitations, Medical Concealment, Occupational Anxiety, Flight Safety, Aviation Medicine, Fitness for Duty

[Abstract:0234]

"Prevalence and Associated Determinants of Metabolic Syndrome Among Commercial Airline Pilots: A Cross-Sectional Study"

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Medical Examination Center, Civil Aviation Organization (CAO), Tehran, Iran

BACKGROUND: Metabolic syndrome (MetS) comprises a cluster of interconnected cardiometabolic risk factors that markedly increases the incidence of cardiovascular disease and type 2 diabetes mellitus. In civil aviation, acute in-flight cardiovascular events pose critical threats to flight safety through potential pilot incapacitation. This study aimed to evaluate the prevalence of MetS and identify its associated risk factors among civilian aviation pilots.

METHODS: This cross-sectional descriptive-analytical study evaluated male commercial pilots attending the Civil Aviation Organization (CAO) Medical Examination Center for medical certificate issuance or renewal over a one-year period. From a total eligible population of 3,600 male aviators, 450 participants were selected via simple random sampling. Demographic parameters, flight tenure, lifestyle factors (smoking, alcohol consumption, physical activity, dietary habits), anthropometric measurements, and biochemical profiles were systematically collected. MetS was defined according to standard IDF/Harrison criteria (presence of ≥3 out of 5 components: abdominal obesity, elevated blood pressure, hypertriglyceridemia, low HDL-C, and elevated fasting plasma glucose). Data were analyzed using independent t-tests, chi-square tests, and multivariate logistic regression via SPSS.

RESULTS: The overall prevalence of MetS among pilots was 21.3% (n = 96/450). The mean age was 41.5±10.2 years (range: 20–65), and the mean body mass index (BMI) was26.8±3.4⟦" kg/m" ⟧^2 kg/m² (range: 18.0–39.9). The most prevalent components were elevated blood pressure (44.4%) and hypertriglyceridemia (42.2%). Multivariate logistic regression revealed that age ≥ [40 or 45] years (OR =,2.41,95%" " p <.001), BMI ≥ [25 or 30] kg/m² (OR =3.15,95%" ", p <.001), flight tenure ≥ [10 or 15] years (OR =1.85,95%" ", P=0.024), physical inactivity (OR =2.10,95%" ", p =0.005), and unhealthy dietary habits (OR =1.92,95%, p = 0.014) were independent predictors of MetS.

DISCUSSION: The 21.3% prevalence of MetS in this professional cohort reflects a substantial health burden. Occupational stressors, age-related metabolic decline, prolonged flight tenure, and a sedentary lifestyle are key determinants contributing to this elevated cardiometabolic risk.

CONCLUSION: Targeted occupational health interventions, rigorous cardiovascular risk screening during periodic aeromedical examinations, and structured lifestyle modification programs are essential to mitigate cardiometabolic risks and safeguard aviation safety.

Keywords: Metabolic Syndrome, Civilian Pilots, Aviation Safety, Aerospace Medicine, Cardiovascular Risk Factors, Occupational Health.

[Abstract:0235]

"Psychosocial and occupational consequences of geopolitical crises in Iranian civilian flight crews: Implications for human factors and operational safety"

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BACKGROUND: Military conflicts and geopolitical crises profoundly alter the psychosocial dynamics, mental health, and job security of civilian flight crews. This study evaluated the psychosocial and occupational impacts of war-related conditions on Iranian civilian pilots and cabin crew, examining their downstream effects on flight safety.

METHODS: This descriptive-analytical cross-sectional study was conducted in 2026. The target population comprised 3,600 pilots and 4,800 cabin crew members. A representative sample of 620 participants (200 pilots and 420 cabin crew) was selected using proportional stratified random sampling. Data were collected via demographic checklists, semi-structured clinical interviews, and standardized 5-point Likert questionnaires assessing Occupational Anxiety, PTSD symptoms, Acute Stress Disorder (ASD), Job Insecurity, Financial Stress, Sleep Quality (PSQI), and Coping Strategies (COPE). Data were analyzed using independent t-tests, Chi-square (χ^2) tests, and multiple linear/logistic regression models in SPSS v.26 ($p<0.05$).

RESULTS: Perceived job insecurity was significantly higher among cabin crew than pilots ($p<0.001$). Overall, 86 cabin crew members (20.5%) and 12 pilots (6.0%) met the clinical threshold for Acute Stress Disorder (ASD). Severe sleep disturbances were identified in 30 cabin crew members (7.1%) and 8 pilots (4.0%). Financial stress and job insecurity served as primary predictors for adopting maladaptive coping strategies (particularly emotional suppression and unprescribed medication use) across both cohorts ($R^2=0.38, p<0.001$). Furthermore, the additive cognitive load resulting from war-related trauma and sleep degradation significantly impairs instrument monitoring accuracy and intra-cockpit communication efficiency.

CONCLUSION: War-induced crises severely jeopardize operational safety by impairing crew mental health and elevating job strain. This pathological cascade can induce attentional tunneling and delayed critical decision-making during high-workload flight phases. Establishing confidential Peer Support Programs (PSP) and optimizing Fatigue Risk Management Systems (FRMS) are urgently recommended for civil aviation authorities.

Keywords: Flight Safety, Human Factors, Occupational Stress, Psychological Trauma, Aviation Fatigue, Civilian Flight Crew

[Abstract:0237]

First Intravenous Fluid Infusion Completed Onboard the International Space Station: A Medical Training Demonstration

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The first end-to-end intravenous fluid (IVF) administration during International Space Station (ISS) operations was performed in November 2025 as part of a NASA on-orbit medical training event. IVF administration is a fundamental procedure for a variety of potential medical conditions. In the more than 25-years of ISS operations, the need for IVF infusion has not yet been required. However, as human spaceflight continues, and mission durations increase, the potential for IVF necessity continues. Two Expedition 73 Crew Medical Officers (CMOs) successfully performed the first complete IVF infusion on the ISS during an on-board training demonstration. Under guidance from NASA Crew Flight Surgeons and medical trainers, the crew successfully inserted a 20-gauge IV catheter and infused 400-450mL of normal saline utilizing standard ISS health maintenance system medical kits and procedures. This demonstration represents a milestone achievement in space medicine and human medical capabilities during microgravity operations. IVF may be indicated in medical scenarios such as severe dehydration, trauma, sepsis, or suspected renal calculi. CMOs are trained prior to missions on IVF preparation, air bubble removal, antiseptic technique, catheter insertion, and fluid administration. However, prior on-orbit ISS demonstrations were limited to equipment preparation and have not actually infused IVF into a crewmember. In 1993, STS-55 crewmembers injected saline as part of a payload study to replace body fluids lost during space adaptation. This recent ISS medical demonstration focused on generating lessons learned to inform medical procedure development, hardware selection, and determine feasibility assessments in microgravity medical care.Video of the actual ISS medical demonstration will be shown and lessons learned discussed. Crewmember feedback during debriefs on procedural technique and resource utilization will be highlighted. Mitigation steps to minimize air within the IVF system continue to be a challenge, as the steps take disproportionate time compared to terrestrial IVF preparation. Additionally, hardware itself created unique barriers in microgravity, such as real-time feedback of flow rates without visualization of gravity-dependent drip chambers. The infusion indicated lower flow rates than terrestrially (15-20mL/min vs 100mL/min, respectively). This demonstration directly generated critical feedback to inform medical system design, training, and procedural planning for future lunar and exploration class missions.

Keywords: ISS, Medical Training, Intravenous Fluid Infusion

[Abstract:0244]

Public Health Management in Civil Aviation During the COVID-19 Pandemic: A Chronological Assessment at Global, National, and Institutional Levels

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Background
Pandemics are complex public health emergencies that extend far beyond the control of infectious disease, simultaneously affecting health systems, transportation networks, the economy, the workforce, and global governance. Civil aviation plays a critical role in this process, both as a sector implicated in the spread of the agent and as one essential to the sustainability of the global response. This process review aims to examine, through the experience of the Turkish Airlines Health Directorate, the period from the onset of the pandemic to the post-pandemic normalization phase, chronologically, at the global, national, and institutional levels. The study presents a multidimensional public health perspective that covers not only case management, contact tracing, and quarantine practices, but also occupational health, aviation medicine, regulations, and operational continuity.

Description
The pandemic process was examined across three fundamental levels along a timeline extending from the first reports of COVID-19 to post-pandemic normalization: (1) global developments (WHO, IATA, EASA and ICAO decisions, variants, international travel restrictions, and vaccination programs), (2) Türkiye's national outbreak management (practices of the Ministry of Health and the Directorate General of Civil Aviation, legal regulations, and surveillance strategies), and (3) the institutional practices carried out by the Turkish Airlines Health Directorate. The chronology was structured around the two dates on which the WHO declared and later terminated the Public Health Emergency of International Concern (PHEIC): 30 January 2020 and 5 May 2023, respectively. At the institutional level, case management and contact tracing were evaluated statistically, while biosecurity practices, aeromedical assessments of flight crews, and the integration of national/international authority guidelines into institutional processes were also assessed.

Discussion
In this way, the dynamic interaction between scientific evidence, public health policy, and operational decisions has been presented within a holistic outbreak chronology. This study demonstrates that pandemic management is not limited to infection control alone, but constitutes a multilayered biosecurity architecture requiring the simultaneous integration of public health, aviation medicine, occupational health, and institutional governance. The chronological outbreak report prepared here aims not only to document the institutional memory of the Turkish Airlines Health Directorate, but also to serve as an educational and strategic reference model for preparedness against future Public Health Emergencies of International Concern (PHEIC).

Keywords: COVID-19, Civil Aviation, Public Health Management, Aviation Medicine, Pandemic Chronology

[Abstract:0245]

Blood Flow Restriction and Neuromuscular Electrical Stimulation as Countermeasures to Spaceflight-Induced Musculoskeletal Deconditioning: A Comparative Review

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INTRODUCTION: Prolonged microgravity exposure causes skeletal muscle atrophy, bone loss, and cardiovascular deconditioning, limiting long-duration space missions. The current standard countermeasure, the Advanced Resistive Exercise Device (ARED), partially attenuates these losses. Blood flow restriction (BFR) and neuromuscular electrical stimulation (NMES), established in terrestrial rehabilitation and athletic training, have been proposed as low-load alternatives. This review compares their physiological mechanisms, efficacy, and limitations to identify critical knowledge gaps and guide future research.

METHODS: A narrative review of the PubMed and SCOPUS databases was conducted 2016 -2026, and 15 primary sources were subsequentlyselected for analysis.

RESULT AND CONCLUSION: Both modalities elicit hypertrophy at low mechanical load, but through different pathways. BFR combines low-load contraction with partial venous occlusion to produce metabolic stress, metabolite accumulation, and early recruitment of Type II motor units, activating PI3K/Akt/mTOR signaling to drive protein synthesis while HIF-1α and VEGF support angiogenesis. It thereby simulates the hypertrophic response to high-load training at reduced load, with concurrent vascular adaptation. NMES instead depolarises motor axons directly, evoking contractions that preferentially recruit Type II units and activate mTORC1, withrepeated contractions enhancing local perfusion. It preserves muscle mass and strength with minimal voluntary effort, suiting to the crew-time and energy constraints of long-duration missions. However, evidence in predominantly Type I musculature is limited and prolonged stimulation may reduce efficacy.

In summary, BFR confers combined muscular and vascular benefit but imposes metabolic stress, whereas NMES preserves targeted muscle with minimal effort but produces weaker vascular adaptation. To further the role of low-load countermeasures in spaceflight deconditioning, future work should examine fiber-type recruitment transition and distal vascular effects in both modalities.

Keywords: Microgravity, Blood Flow Restriction, Neuromuscular Electrical Stimulation, Muscle Atrophy

[Abstract:0249]

Impact of temporal feature engineering on machine learning prediction of cognitive performance during spaceflight-analogue bed rest

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INTRODUCTION: Cognitive performance is a safety-critical determinant in aviation and spaceflight operations. Pilots and astronauts are exposed to physiological stressors including cardiovascular deconditioning, musculoskeletal unloading, and sleep disruption that may degrade psychomotor processing speed and decision-making capacity. Current monitoring strategies rely on scheduled behavioural assessments that cannot detect early or subclinical performance decrements. Identifying physiological precursors of cognitive vulnerability through predictive modelling represents a significant unmet need in aerospace medicine.

METHODS: Longitudinal physiological and cognitive data were obtained from NASA Life Sciences Data Archive head-down tilt bed rest studies, a validated spaceflight analogue. Twenty-three participants contributed 266 cognitive test sessions; the primary outcome was Computerised Portable Test Reaction Time (CPTRT). To evaluate the contribution of temporal feature engineering, two model conditions were compared: a baseline condition without lag features and an experimental condition incorporating subject-wise lag features derived from each participant's immediately preceding cognitive session. Three machine learning regression models were evaluated under each condition: Support Vector Regression, Extreme Gradient Boosting, and Random Forest. All models were assessed under chronological 80/20 train-test splitting and 5-fold time-series cross-validation. Statistical comparison between conditions employed paired t-tests on cross-validated R2 scores.

RESULTS: Without lag features, cross-validated R2 values were 0.31 for SVR, 0.30 for XGBoost, and 0.42 for Random Forest. Incorporating subject-wise lag features improved cross-validated performance to 0.45 for SVR, 0.63 for XGBoost, and 0.68 for Random Forest. Improvement was statistically significant for XGBoost (delta R2=0.33, t=3.48, p=0.025) and Random Forest (delta R2=0.26, t=4.16, p=0.014), but not SVR (delta R2=0.15, t=1.84, p=0.140). Random Forest demonstrated the lowest cross-validation variance with lag features (SD=0.04), indicating superior temporal stability. Monosynaptic reflex latency, cardiac demand indicators, and prior cognitive state were the most consistent physiological predictors across models.

CONCLUSIONS: Subject-wise temporal lag feature engineering significantly improved the predictive accuracy and temporal stability of ensemble machine learning models for cognitive performance monitoring. These findings demonstrate that prior cognitive state, combined with peripheral sensorimotor and cardiovascular markers, provides meaningful predictive signal for psychomotor performance in spaceflight-analogue conditions. Ensemble methods are recommended over linear approaches when temporal feature structures are incorporated. This work provides a methodological foundation for passive, physiologically informed cognitive monitoring applicable to aviation and spaceflight operations.

Keywords: temporal feature engineering, machine learning, cognitive performance, spaceflight analogue, aerospace medicine, space cognition

[Abstract:0251]

Hypobaric Chamber Examinations and Training: The Aeromedical Flight Profile Analysis - *Evaluating an Autoregressive Burg Unified Spectral Transformation Program as a Clinical and Stress Management Utility*

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INTRODUCTION: Modern military and civilian flight environments impose intense cognitive workloads, physiological stressors, and gravitational (G-force) demands on the human operator (pilots, aircrew), heightening the risk of pilot (aircrew) incapacitation in-flight, fatigue-induced errors, and cardiovascular strain. Advanced biometric monitoring and Autonomic Nervous System (ANS) objective quantification are critical for ensuring operational safety, mitigating cognitive fatigue, and maintaining cardiovascular health in high-performance aviation environments. This study evaluates an inhouse customized automated analytical computer program for granular Aeromedical Flight Profile Analysis.

METHOD: Utilizing Hypobaric Chamber flight runs with high-definition 500 Hz electrocardiogram (ECG) data, deterministic testing was carried out. Industry standards' Data Processing (DSP) protocols were complied with using zero-phase digital signal filtering, Pan-Tompkins QRS extraction, Median Absolute Deviation (MAD) artifact rejection, and Autoregressive (AR) Burg Unified Spectral Transformation (UST) for heart rate variability (HRV) analysis. The DSP was applied to 71 distinct 60-second flight epochs across diverse mission phases, including ground preflight, take off, cruise (18044ft [5500m]), descent, land, taxi to docking, integrating multiple epochs (5 minutes) of instructed relaxation each followed with Combined Distributive Attention Tester (CDT) monotonous cognitive workload (stress) tasks.

RESULTS: The DSP program generated a complex compound visualization graphical map clearly extracting the abstract ANS status in conjunction with detailed flight profile characteristics, facilitating the combined granulated interpretation of environment (altitude), physiological and ANS statuses. The program successfully extracted high-resolution time-domain metrics (SDNN, RMSSD, pNN50) and frequency-domain spectral powers (VLF, LF, HF). Temporal mapping revealed that acute cognitive stress and high workload manoeuvres systematically suppressed parasympathetic vagal tone (RMSSD) while elevating heart rate and the sympathovagal SDNN/RMSSD ratio. Conversely, instructed relaxation phases demonstrated restorative parasympathetic reactivation. Furthermore, program simultaneously automatically generated accountability and audit traceability data in form of audit logs, CSVs, Excel workbooks and detailed PDF report (each 60 seconds epoch) files, facilitating specific detailed retrospective investigations.

CONCLUSION: The deterministic execution workflow ensures complete standards compliant audit traceability for Aeromedical Examiners (AMEs)/Flight Surgeons (FSs), Aviation Accident Investigators and Regulatory bodies. Overall, the AR Burg UST program proves to be a highly rigorous, objective Aeromedical Clinical Diagnostic tool and an effective real-time Stress Management utility for aviation safety operations.

Keywords: Hypobaric Chamber, Heart Rate Variability (HRV), Autoregressive Burg Spectral Estimation, Aeromedical Aviation Safety, Cognitive Workload Stress, Electrocardiogram (ECG) Signal Processing

[Abstract:0254]

Cardiovascular Implication of Occupational Noise Exposure in the Aviation Industry, A Systematic Review

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BACKGROUND:
There is an exceptional noise exposure in the aviation industry. Many studies have been conducted over the years on the effect of noise-induced hearing loss, and some suggest more systemic outcome especially on the cardiovascular system. The aviation fraternity often exposed to high intensity aircraft sound, and this can give rise to the risk of developing systemic diseases.

OBJECTIVES:
To study and emphasize the association between long term occupational noise exposure on the cardiovascular health of the aviation workers.

METHODS: Studies assessing cardiovascular outcomes among aviation workers, published between 2000 and 2025, were searched from the public literature websites, including peer-reviewed articles, systematic reviews, meta-analysis, and health reports. Data highlighting the population, sound exposure levels, the hearing loss prevalence, and cardiovascular outcomes were synthesized. 20 studies met the inclusion criteria: 10 epidemiological, 5 mechanistic, and 5 systemic reviews and meta-analysis.

RESULTS: These studies consistently present the association between chronic occupational noise exposure, and hypertension, stroke and ischaemic heart disease. Some reports even suggest high hypertension prevalence together with noise-induced hearing loss. Mechanistic study reveals the sympathetic trigger upon noise exposure that leads to endothelial dysfunction, catalysed by oxidative stress. Dose-response relationships between noise exposure and cardiovascular morbidity also evident in the systematic reviews.

CONCLUSION: There is a strong association between chronic occupational noise exposure, and cardiovascular outcome among aviation workers. This highlights the need for policy upgrade considering systemic effects of noise exposure in the aviation industry.

Keywords: Aviation noise exposure, cardiovascular health, occupational safety and health

[Abstract:0256]

The intertwined future of the aerospace industry and artificial intelligence: inevitable friend, foe, or both? A premortem analysis of the decades ahead

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Background

The aerospace industry is entering an era of accelerating technological transformation, with artificial intelligence (AI) increasingly integrated into systems, operations, decision-making, and human–machine interactions. The challenge extends beyond adopting AI as another technological capability: its increasing integration may fundamentally redefine how aerospace functions are performed, by whom, and with what consequences for safety, performance, responsibility, and human expertise.

Description

A premortem analysis will examine plausible future states of an increasingly AI-integrated aerospace industry by assuming that each state has already occurred and working backward to identify the technological, operational, organizational, and human factors that contributed to its emergence. This approach will be used to examine potential pathways toward transformation, obsolescence, dependency, and disruption while identifying opportunities to recognize and influence such trajectories before they become entrenched or extinct.

Discussion

The analysis will challenge the friend-or-foe dichotomy by examining whether increasing AI integration ultimately strengthens or undermines aerospace capability, recognizing that the same technological advances may simultaneously improve safety, efficiency, prediction, and human performance while introducing new forms of dependence, vulnerability, and loss of human oversight. Particular attention will be given to the redistribution of expertise, authority, and responsibility between humans and intelligent systems, and to the possibility that capabilities considered indispensable today may become obsolete while previously unanticipated competencies become essential.

Keywords: Artificial intelligence, Aerospace industry, Human factors

[Abstract:0257]

Weight Matters - Effects of Microgravity on Individual Cells

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Microgravity produces well-recognized clinical effects, including vestibular disturbances, orthostatic intolerance, anemia, immune changes, muscle atrophy, bone loss, and visual disturbances. Yet at the scale of atoms, molecules, and most intracellular organelles, gravity is extraordinarily weak compared with electrostatic, thermal, viscous, diffusive, and surface-tension forces. This creates an important paradox in aerospace medicine: how can removal of a force too weak to act directly on cellular structures contribute to major physiological changes during spaceflight? This presentation examines the evidence that the cellular effects of microgravity arise indirectly through loss of gravity-dependent mechanical and transport cues. At 1 g, cells function within tissues and fluids in which hydrostatic loading, buoyancy, convection, shear, tension, and compression help organize transport and mechanical signaling. In microgravity, these directional influences are reduced or absent. Convection diminishes, boundary layers become more stagnant, and exchange of nutrients, waste products, ions, and signaling molecules depend increasingly on diffusion. Reduced shear and mechanical loading may also alter cell adhesion, shape, cytoskeletal organization, organelle movement, and nuclear mechanics. These physical changes can be transmitted to chromatin and intracellular signaling pathways, leading to altered gene expression, epigenetic regulation, proliferation, apoptosis, and differentiation. Reported effects in cardiac, vascular, skeletal muscle, bone, blood, nervous, and other cell types include cytoskeletal disruption, altered ion transport, reduced proliferation, impaired osteoblast differentiation, and changes in genes involved in metabolism, repair, adhesion, and cell survival. Ionizing radiation may further intensify these responses through chromosomal damage and impaired stem-cell repopulation. Ground analogs such as bed rest and dry immersion reproduce important physiological consequences of unloading in the whole organism but retain 1 g at the cellular level, whereas cell cultures in parabolic flight, clinostats, random positioning machines, rotating wall vessels and magnetic levitation provide more direct approaches to studying reduced-gravity effects. A framework is presented that offers a biologically plausible link between altered cellular physics and multisystem deconditioning in astronauts and may help explain why weightlessness matters clinically even when gravity itself is too weak to act directly on molecules.

Keywords: Microgravity, Mechanotransduction, Cytoskeleton, Convection, Diffusion, Spaceflight

[Abstract:0258]

Acceleration Physiology for Clinical Orthostatic Hypotension: Applying 9G techniques to a 1G problem

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INTRODUCTION: Failing blood pressure upon standing can cause weakness, fainting, falling and injury. A disease of the elderly, it is most often caused by various forms of autonomic dysfunction. The definition from Weiling et al is useful: "Orthostatic hypotension (OH) is an unusually large decrease in blood pressure on standing that increases the risk of adverse outcomes even when asymptomatic. Improvements in hemodynamic profiling with continuous blood pressure measurements have uncovered four major subtypes: initial orthostatic hypotension, delayed blood pressure recovery, classic orthostatic hypotension, and delayed orthostatic hypotension. Clinical presentations are varied and range from cognitive slowing with hypotensive unawareness or unexplained falls to classic presyncope and syncope." OH is defined as a fall in systolic blood pressure of 20mm Hg, or 10mm Hg diastolic after 1, 3, or 5 minutes standing.

METHODS: A literature review was undertaken to define the current guideline treatments for OH and to discern the utility of higher-pressure compression. Searching the US National Library of Medicine PubMed database with the term "orthostatic hypotension" limited to reviews returned 490 publications. Of these 59 were directly relevant. Adding "compression" returned 8 relevant papers.

RESULTS: Most national guidelines are similar, and start with education, non-pharmacological measures, exercise, compression maneuvers when standing, stockings and abdominal binder, or a bolus of water before rising. Pharmacological treatments, after discontinuing exacerbating drugs, are directed at three systems: maintenance of central volume through fluorinated steroids, replacement of deficient dopamine precursors, droxidopa, and adrenergic augmentation, midodrine. Atomoxetine, a norepinephrine uptake inhibitor, and an acetylcholinesterase inhibitor, pyridostigmine, are also used, but with higher side effects. Documented pressures of stockings and abdominal binders are mild, 20-40mm Hg.

DISCUSSION:
In flight, aircraft acceleration in the z axis reduces cardiac preload, blood pressure, and blood flow to the brain from the downward displacement of central circulating volume into the capacitance spaces of the abdomen and legs. The compensation mechanism is a physical strain, the Anti-G Straining Maneuver (AGSM), which may raise blood pressure at 1G to 250mm Hg or higher, and automatic, on-demand compression of the abdomen and legs by an inflatable "g-suit" at much higher pressures than stockings and binders. Research on compression pressures and g-suit like devices offers the potential to reduce OH drug treatments, and the resulting hypertension while lying.

Keywords: Orthostatic Hypotension, Acceleration Physiology, pooling of blood

[Abstract:0259]

"Papillary Thyroid Carcinoma in a Commercial Aircrew Member: An Occupational and Aeromedical Case Study"

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INTRODUCTION: Thyroid carcinoma is the most common endocrine malignancy and 80-85% of thyroid cancers is papillary thyroid cancer. Airline crew are exposed to occupational factors such as cosmic ionizing radiation and circadian rhythm disruption during frequent long-haul travel. Although a connecting association between these factors and thyroid cancer remains uncertain, occupational health surveillance remains important.

CASE DESCRIPTION: A 29-year-old female cabin crew member with 18 months of international flying experience presented for review of elevated T4 levels. She admitted to having thyroid cancer diagnosed and removed the previous year. She reported undergoing a thyroid ultrasound as part of a health screening package offered in her home country. She had no symptoms suggestive of thyroid disease and no family history of thyroid malignancy. Thyroid ultrasonography identified a hypervascular, hypoechoic nodule with irregular margins that was highly suspicious for malignancy (TIRADS IV). Fine-needle aspiration cytology was consistent with papillary thyroid carcinoma (Bethesda Category V). Staging investigations showed no distant metastases. The patient underwent total thyroidectomy. Histopathological examination confirmed a 10 x 8.9 mm papillary thyroid carcinoma confined to the thyroid gland, with lymphovascular invasion. Radioactive iodine therapy was not indicated. Postoperative recovery was uncomplicated, and she returned to work shortly after surgery without disclosing her diagnosis to the Aviation Medical Examiner (AME) for approximately one year. At the 12-month follow-up, she remained disease-free, with undetectable thyroglobulin levels. She is on lifelong levothyroxine replacement therapy following total thyroidectomy.

DISCUSSIONS:
This case highlights the importance of routine health surveillance and early detection in aviation personnel. Timely investigation and management facilitated curative treatment and an excellent outcome. It also underscores the issue of non-disclosure of a significant medical condition to the AME, as well as fitness-to-fly considerations, occupational implications, regulatory considerations, and return-to-duty assessment. Further research is warranted to better understand potential occupational risk factors, inform long-term surveillance strategies, and develop innovative approaches to quantify cumulative radiation exposure and its association with thyroid cancer risk among flying crew members.

Keywords: Thyroid cancer, flying crew, radiation exposure, aviation medicine, occupational medicine

[Abstract:0261]

A Proposed Mental Health Risk Stratification Tool for Commercial Human Spaceflight and Civil Aviation

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BACKGROUND: Commercial human spaceflight is widening participation beyond traditional astronaut populations to people with diverse health histories and levels of operational responsibility. Mental health assessment must protect safety and mission success without treating a diagnosis or treatment history alone as a proxy for operational risk. The practical question is what operational significance, if any, a condition has for the individual, role and mission. Existing guidance addresses aspects of screening and fitness, while civil aviation offers relevant experience in individualised aeromedical assessment. The opportunity is to bring these principles together in a mental-health-specific approach for commercial operations.

DESCRIPTION: We propose a mental health risk stratification tool developed primarily for commercial human spaceflight, with potential relevance to civil aviation. When comprehensive psychiatric assessment is indicated, the tool links clinical findings to operational context. It considers clinical course, current function and treatment stability alongside role and mission demands, the operational impact of any change in mental health, and available supports and safeguards. Stratification reflects the full assessment rather than a diagnosis or single historical event. Each formulation is specific to the individual, role, mission and period under consideration, and can be reviewed as circumstances change. The tool supports, rather than replaces, expert clinical judgement, operator requirements and applicable regulation.

DISCUSSION: The purpose is to give clinicians and operators a clearer, more consistent basis for decisions that support safe, individualised participation. It identifies where preparation, support or monitoring may reduce risk, so that each person is considered in the context of the proposed role and mission rather than diagnosis alone. The presentation introduces the approach, explores its use through contrasting commercial human spaceflight and civil aviation cases, and identifies the work needed for further development and evaluation.

Keywords: Spaceflight, Mental Health, Operational Risk, Aviation

[Abstract:0262]

Aeromedical Hypobaric Examinations and Training Realtime Monitoring of ANS Performance Status: Artifact-Resilient Stress and Systemic Fatigue Prediction

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INTRODUCTION: Continuous, real-time monitoring of the Autonomic Nervous System (ANS) physiological states (ANS tone) via Heart Rate Variability (HRV) is critical for the early detection of systemic fatigue and physiological stress overload within the dynamic aero operating environment. However, transitioning biosignal analytics from controlled environments to live clinical applications frequently exposes limitations in current commercial software, notably their vulnerability to non-physiological artifacts and a critical lack of forensic audit traceability required for regulatory compliance.

METHOD: To address these gaps for Software as a Medical Device (SaMD) standards, we engineered a robust, thread-safe computer program architecture designed for real-time high-frequency (500 Hz) clinical ECG ingestion. The program workflow integrates a modified Pan-Tompkins peak detection algorithm, a stringent ectopic beat interpolator (0.10 tolerance limit), and a predictive Autoregressive (AR) machine learning model operating across an asynchronous 5-minute trailing window. A dynamic biological artifact failsafe was implemented to mathematically suppress mechanical sensor noise and impossible interval deviations (>250 ms). For strict regulatory accountability, the program executes simultaneous automated forensic captures of graphical alert windows and their exact underlying raw data matrices, locking all outputs with SHA-256 cryptographic hashes.

RESULTS: Validation strictly as a Proof of Concept / Architecture Design on an 83-minute clinical dataset demonstrated almost zero-latency asynchronous execution (<10ms). The predictive architecture effectively forecast critical vagal withdrawal and sympathetic overload. Furthermore, the biological failsafe successfully identified and suppressed extreme motion artifacts, preventing false-positive alarm cascades, reducing alarm fatigue, while maintaining continuous system stability.

CONCLUSION: This software architecture bridges the critical gap between raw predictive biosignal analytics and clinical utility. By embedding immutable cryptographic traceability and strict biological failsafes directly into the processing workflow, it establishes a highly accountable, artifact-resilient standard for real-time predictive SaMDs that may inform aeromedical clinical review and or as an adjunct to standard clinical assessment.

Keywords: Aeromedical Hypobaric Examinations, Autonomic Nervous System, Heart Rate Variability, Predictive Analytics, Software as a Medical Device (SaMD) Cryptographic Traceability, Biosignal Processing Artifact Rejection

[Abstract:0264]

Evaluation of Volume Changes in Root Canal Fillings Induced by Repeated Hyperbaric Pressure Exposure: A Pilot Study

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BACKGROUND: Pressure changes may affect tissues and restorative materials through mechanisms described by Henry's and Boyle's laws. In endodontically treated teeth, residual gas bubbles may remain after root canal obturation and potentially contribute to microleakage between the restoration and the walls of the pulp chamber. However, the effects of repeated pressure changes on the volume and structural integrity of root canal fillings remain unclear. This pilot study aimed to evaluate volume changes in root canal fillings following repeated exposure to a hyperbaric environment.

METHODS: Three extracted premolar teeth were included. To ensure standardization, all root canals were prepared and hermetically obturated by the same operator. The volume of each root canal filling was measured using micro-computed tomography (micro-CT) before hyperbaric exposure. The teeth were subsequently exposed to a pressure of 2.4 atmospheres absolute (ATA) during three sessions, each lasting 120 minutes. Immediately after the pressure exposure, the specimens were rescanned using micro-CT. The scanning parameters were 80 kVp and 125 mA, with a scanning duration of 34 minutes and 15 seconds.

RESULTS: Before hyperbaric exposure, the root canal filling volumes were 6.609, 6.620, and 6.880 mm^3, respectively. Following repeated exposure to 2.4 ATA, the corresponding volumes increased to 8.18, 7.20, and 6.95 mm^3. The greatest volumetric increase was observed in the first specimen, whereas the third specimen showed only a slight increase.

CONCLUSION: Repeated exposure to a hyperbaric environment was associated with an increase in the volume of root canal fillings in this pilot study. Although the sample size was limited, these preliminary findings suggest that pressure fluctuations may influence endodontic filling materials. Further studies involving larger sample sizes, different obturation materials, and controlled pressure cycles are warranted. These effects may be clinically relevant when planning dental treatment for personnel who are frequently exposed to substantial environmental pressure changes.

Keywords: Hyperbaric medicine, Endodontics, Root Canal Filling Materials, Volumetric changes, MicroCT

[Abstract:0268]

Air Transport of Highly Contagious Patients

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On 15 May 2026 an outbreak of Ebola, caused by Bundibugyo Virus was declared in the Democratic Republic of Congo. Soon, a PHEIC (Public Health Emergency of International Concern) and a PHECS (Public Health Emergency of Continental Security) had been declared. An American missionary physician was airlifted and treated in the isolation station of the Charité University Hospital in Berlin. A French Physician returning home after attending infected patients became symptomatic on his flight to Paris. These events put air transport of contagious patients into the limelight again. Physiological conditions on board make transmissions of infections very unlikely. It may only affect primarily co-passengers in the immediate vicinity of the index patient. The IHR (International Health Regulations) have been implemented to prevent spread of contagious diseases via international traffic, prohibiting transport of infectious individuals by means of mass transport. However, how could an air transport be realised? Stretchers within small containers with negative pressure have been developed to transport infectious patients. During the COVID-19 epidemic similar containers, designed by the same principle, have been used successfully to transport infected passengers. Only accessible by porthole gloves, this is a less than perfect solution for severely ill patients. For highly contagious diseases, there is another problem. In case of a sudden decompression such containers would explode, expose the inmates of the aircraft with highly infectious droplets and create an infectious hazard on the ground in case of a crash. During the 2015 Ebola epidemic in West Africa the Robert Koch was designed with a hypobaric 3-tent solution within an A 340. A big air container was attached in which the air inside the unit would be released to prevent an explosion in case of sudden decompression. Based on this model, a project sponsored by the EU involved a container solution, but was abandoned in 2020. In the meantime, Norway won the grant of the RescEU framework, the EU´s crisis management reserve. NOJAHIP (Norwegian Jet Ambulance for Highly Infectious Patients) was commissioned in 2022 and uses a Portable Medical Isolation Unit within a business jet. Highly contagious patients are transported within Europe. Another solution was designed by US CDC during the SARS epidemic of 2006. However, all means of transport available for the time being have one thing in common: A sudden decompression is not catered for. Nevertheless, they are all, what we actually have and probably better than nothing.

Keywords: Highly Contagious Diseases, Bundibugyo Virus, Air Transport, Hypobaric Container, Sudden Decompression

[Abstract:0276]

The Glymphatic System in Space: Effects of Microgravity on Cerebrospinal Fluid Dynamics and Neural Homeostasis

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BACKGROUND: Long-duration spaceflight induces cephalad fluid redistribution and changes in cerebrospinal fluid (CSF) dynamics that may contribute to neurological and neuro-ophthalmological alterations. The glymphatic system plays a key role in CSF circulation and metabolic waste clearance, but its response to microgravity remains incompletely characterized.

OBJECTIVE: To systematically evaluate the effects of microgravity and spaceflight on glymphatic function and CSF dynamics and their potential implications for neural homeostasis.

METHODS: A systematic review will be conducted according to PRISMA guidelines. PubMed, Scopus, Web of Science, and Embase will be searched for experimental and observational studies involving astronauts, spaceflight, or ground-based microgravity analogues. Outcomes will include glymphatic transport, CSF distribution, intracranial pressure, cerebral fluid clearance, perivascular spaces, and neuroinflammatory markers. Meta-analysis will be performed when sufficient quantitative homogeneity is present.

EXPECTED RESULTS: We anticipate identifying alterations in CSF circulation and glymphatic transport associated with microgravity exposure, potentially affecting cerebral waste clearance and neural homeostasis.

CONCLUSION: Characterizing glymphatic adaptations to microgravity may provide new insights into the neurological consequences of long-duration spaceflight and identify potential targets for astronaut neuroprotection.

Keywords: Spaceflight, Weightlessness, Glymphatic System, Cerebrospinal Fluid, Neuroinflammation

[Abstract:0281]

The Brain at High Altitude: Neurocognitive Adaptation to Chronic Hypobaric Hypoxia in Andean Populations

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BACKGROUND: Chronic exposure to hypobaric hypoxia at high altitude imposes substantial physiological demands on the central nervous system. Although acute exposure to high altitude may impair cognitive performance, populations chronically residing at altitude may develop physiological adaptations that modify the effects of hypoxia on cerebral function. However, the relationship between chronic high-altitude exposure, neurocognitive performance, and cerebral physiological adaptation in Andean populations remains incompletely characterized.

OBJECTIVE: To systematically evaluate neurocognitive performance and cerebral physiological adaptations associated with chronic exposure to high-altitude hypobaric hypoxia in Andean populations.

METHODS: A systematic review will be conducted following PRISMA guidelines. PubMed, Scopus, Web of Science, and Embase will be searched for observational and experimental studies involving populations residing at or exposed to high altitude in the Andean region. Outcomes will include attention, memory, executive function, processing speed, reaction time, cerebral oxygenation, cerebral blood flow, and peripheral oxygen saturation. Subgroup analyses will be considered according to altitude, duration of exposure, age, and degree of acclimatization when sufficient data are available.

EXPECTED RESULTS: identifying differences in neurocognitive performance and cerebral physiological responses according to altitude and duration of exposure, with evidence of adaptive responses among populations chronically residing at high altitude.

CONCLUSION: Understanding neurocognitive adaptation to chronic hypobaric hypoxia in Andean populations may provide valuable insights into human adaptation to extreme environments and contribute to strategies aimed at preserving cerebral function under prolonged hypoxic conditions.

Keywords: High-Altitude Hypoxia, Hypobaric Hypoxia, Neurocognition, Cerebral Blood Flow, Andean Populations, Acclimatization

[Abstract:0290]

Toward Autonomous Neurocritical Care for Space Exploration: Translating Aeromedical and Austere TBI Evidence into Secondary-Injury Monitoring and Decision Support

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BACKGROUND:
Traumatic brain injury (TBI) during exploration-class space missions could require neurocritical management without advanced imaging, continuous specialist support, or timely evacuation. Aeromedical and austere care provide terrestrial evidence for examining how secondary physiological vulnerability and constrained care may inform Earth-independent neurocritical capability.

OBJECTIVE:
To synthesize evidence linking aeroenvironmental and operational exposures to secondary brain-injury physiology after TBI and determine how far portable neuromonitoring, biomarkers, and decision-support technologies currently progress toward autonomy-enabling neurocritical care for space exploration.

METHODS: We conducted a PRISMA-ScR-informed scoping review with structured evidence mapping and stratified narrative and translational synthesis. PubMed/MEDLINE, Embase, Scopus, and Web of Science were systematically searched using a predefined eligibility framework encompassing TBI and secondary brain injury, aeromedical, hypobaric, hypoxic, and austere exposures, portable neuromonitoring, biomarkers, and decision support. Of 180 imported references, 7 duplicates were removed; three reviewers independently screened 173 records in Rayyan with concealed decisions and conflict adjudication. Four investigators extracted and verified included studies using a 14-domain, 287-variable matrix. Evidence was stratified by empirical status and directness.

RESULTS: Twenty-six publications spanning 1999–2026 were included; 5/26 (19.2%) provided primary empirical/technical evidence and 21/26 (80.8%) were secondary/conceptual. Only 2/26 constituted primary actual or simulated aeromedical-context evidence. In a 1,695-patient TBI cohort, mortality was 31.8% with ≥1 early systemic insult versus 19.0% without, reaching 45.2% with combined hypoxemia and hypotension. Conversely, the most directly aligned aeroenvironmental experiment (32 swine) demonstrated no discernible additional cerebral physiological, inflammatory, neuronal, or histological worsening during six hours of simulated aeromedical evacuation at 8,000 ft under controlled ventilation and oxygenation. Portable modalities provided complementary but incomplete information across systemic, cerebral, electrophysiological, and neurological domains. Biomarker evidence was more mature for injury detection, lesion/severity stratification, and prognosis than for continuous secondary-injury surveillance. Computational approaches reached classification, prediction, risk stratification, and prototype guideline-concordant recommendation; however, none of the five primary empirical/technical systems demonstrated autonomous treatment execution or closed-loop reassessment.

CONCLUSION: Secondary physiological instability, rather than moderate controlled hypobaria itself, emerged as the best-supported modifiable threat to the injured brain. Aeromedical evacuation therefore provides a partial physiological but stronger operational terrestrial analog for exploration neurocritical constraints. Portable multimodal sensing and decision support can enable local detection, interpretation, and risk stratification of correctable secondary insults; however, the evidence chain weakens toward treatment execution, and autonomous mitigation and closed-loop neurocritical management remain unvalidated.

Keywords: Traumatic Brain Injury, Aeromedical Evacuation, Secondary Brain Injury, Autonomous Medical Systems, Space Medicine

[Abstract:0291]

Neurospinal Readiness in Aerospace Operators: Integrating Biomechanical Demand, Spinal Vulnerability, and Operational Capacity Across High-G Aviation and Spaceflight

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BACKGROUND: High-G aviation and spaceflight expose the spine to fundamentally different mechanical environments, yet their implications for operational capability have largely been studied separately. High-G aviation imposes repeated cervical loading, whereas spaceflight involves prolonged unloading, neuromuscular and structural adaptation, and subsequent gravitational reloading. We synthesized evidence linking mission-specific biomechanical demand, spinal adaptation and vulnerability, and operational outcomes, and evaluated whether these dimensions support an integrated framework of Neurospinal Readiness.

METHODS: We conducted a PRISMA-ScR-informed scoping review with structured evidence mapping and stratified relational and translational narrative synthesis. PubMed/MEDLINE, Embase, Scopus, and Web of Science were systematically searched using predefined eligibility criteria encompassing aerospace operators, gravitational and aerospace-specific biomechanical exposures, neurospinal outcomes, operational consequences, monitoring, and countermeasures. Three reviewers independently screened records in Rayyan with concealed decisions and conflict adjudication. Four investigators extracted and verified included publications using a predefined multidomain matrix. Evidence was stratified by aviation versus spaceflight exposure, empirical status, relationship-specific directness, operational relevance, and monitoring/countermeasure maturity.

RESULTS: Thirty-nine publications spanning 2008–2026 were synthesized (28 primary empirical, 9 secondary, 2 other): 24 aviation-focused, 14 spaceflight-focused, and one mixed. High-G evidence directly demonstrated increased cervical biomechanical and neuromuscular demand associated with +Gz, head-supported mass, and non-neutral head movement, with neck pain consistently documented. However, cumulative +Gz exposure alone did not explain long-term operational limitation: cumulative Fatigue Index was not associated with permanent spinal flight-duty limitation (OR 0.96, 95% CI 0.87–1.06), whereas lower baseline muscular fitness was associated with later limitation. Spaceflight evidence demonstrated region-specific disc, muscular, vertebral, and geometrical adaptation; vertebral strength remained 5.1% below baseline 2–4 years postflight in one longitudinal cohort. Across both evidence streams, structural abnormalities, symptoms, functional impairment, and operational consequences were incompletely concordant. Aviation outcomes ranged from maneuver interference and flight-time loss to individualized maximum-G restriction, continued flying under modified exposure, and permanent limitation. Current monitoring characterized neurospinal state, but validated prediction of future injury or operational failure was absent.

CONCLUSION: High-G aviation and spaceflight affect spinal capacity through distinct biomechanical and adaptive pathways that converge on a common operational capacity–demand problem. Neither exposure dose, structural imaging, symptoms, nor muscular capacity alone adequately characterized operational status. Their complementary evidence supports Neurospinal Readiness as an evidence-informed multidimensional framework integrating mission-specific demand with structural, neuromuscular, and functional capacity. Prospective longitudinal validation is required before predictive or aeromedical implementation.

Keywords: Neurospinal Readiness in Aerospace Operators: Integrating Biomechanical Demand, Spinal Vulnerability, and Operational Capacity Across High-G Aviation and Spaceflight

[Abstract:0292]

Progressive Neurocritical and Neurosurgical Autonomy for Earth-Independent Medical Operations During Lunar and Martian Missions: A Scoping Review and Evidence-Informed Framework

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BACKGROUND: Lunar and Martian missions will progressively constrain medical evacuation, immediate specialist access, and real-time terrestrial support, requiring greater onboard capability for time-dependent neurological emergencies. Relevant evidence remains fragmented across space medicine, austere and military neurocritical care, clinical decision support, telemedicine, and procedural technologies.
OBJECTIVE: To map and integrate evidence on neurological threats, operational constraints, clinical capabilities, and enabling technologies to derive an evidence-informed framework for progressive Earth-independent neurocritical and neurosurgical support.

METHODS: We conducted a PRISMA-ScR-informed scoping review with structured evidence mapping and stratified narrative synthesis. PubMed/MEDLINE, Embase, Scopus, and Web of Science were systematically searched using a predefined PEO-based framework spanning direct space/Earth-Independent Medical Operations (EIMO), austere/military/remote analogues, and enabling technologies. Three reviewers independently screened records in Rayyan with concealed decisions and conflict adjudication. Four investigators extracted and verified data using a 12-domain, 106-variable matrix. Evidence was stratified by operational directness and empirical status and mapped across neurological threats, operational constraints, clinical capabilities, technologies, human factors, procedural support, and multidimensional autonomy/dependency. Included publications spanned 1997–2026.

RESULTS: Among 162 unique publications, 80 (49.4%) provided primary/preclinical empirical evidence and 82 (50.6%) secondary/conceptual/guidance evidence. Only 7/162 (4.3%) were directly space/EIMO-oriented, whereas 97/162 (59.9%) represented highly transferable austere, military, remote, or resource-limited operational evidence. Principal evidence clusters addressed neurotrauma, seizures, intracranial hypertension/secondary brain injury, spinal injury, and cerebrovascular emergencies. Monitoring (117/144, 81.2%) and serial reassessment (115/141, 81.6%) were strongly represented, while enabling technologies predominantly supported sensing, automated interpretation, prediction, and decision support rather than autonomous treatment. Explicit non-expert validation occurred in 39/117 informative publications (33.3%). Procedural evidence remained predominantly guided, assisted, mentored, teleoperated, or task-specific; no included publication demonstrated complete autonomous neurosurgery. A translational gradient emerged: direct space/EIMO evidence was sparse and concentrated in monitoring and information/interpretive autonomy, whereas advanced automation was predominantly terrestrial and task-specific. No integrated Earth-independent neurocritical/neurosurgical pathway was demonstrated.

CONCLUSION: The evidence supports an architecture of progressively greater local neurocritical capability as terrestrial support becomes less operationally available. The mapped evidence favored a hybrid capability–dependency framework, combining progressive clinical functions with independent dimensions of information, interpretive, decision, procedural, communication, specialist, infrastructure, and temporal autonomy, rather than a linear progression toward autonomous surgery. Prospective space/EIMO validation and integration across sensing, decision support, stabilization, reassessment, and selected procedural support remain the principal translational requirements.

Keywords: Neurocritical Care, Neurosurgery, Space Medicine, Medical Autonomy, Earth-Independent Medical Operations

[Abstract:0293]

Toward a Framework of Space Neurohydrodynamics: Integrating Venous, CSF, Cerebral, and Neuro-Ocular Adaptations to Microgravity

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BACKGROUND: Spaceflight-associated neuro-ocular syndrome (SANS) remains incompletely explained by isolated ophthalmic or intracranial-pressure models. Microgravity affects multiple fluid-sensitive central nervous system compartments, yet venous, cerebrospinal-fluid (CSF), cerebral, perioptic, and ocular responses remain fragmented across the literature.

OBJECTIVE: To synthesize microgravity-associated venous, CSF/pressure, cerebral structural, and neuro-ocular evidence and determine whether their convergence supports an evidence-informed framework of Space Neurohydrodynamics relevant to SANS and future physiological monitoring.

METHODS: We conducted a scoping review with structured evidence mapping and stratified narrative synthesis following PRISMA-ScR reporting principles. Literature published from 1990–2026 was systematically searched in PubMed/MEDLINE, Embase, Scopus, and Web of Science using a predefined PCC-based eligibility framework. Three reviewers independently screened records with concealed decisions and conflict adjudication. Four investigators extracted data using a predefined 15-domain, 186-variable matrix with subsequent verification. Evidence was stratified by directness and mapped across physiological compartments, biomarkers, mechanistic relationships, and countermeasure responses.

RESULTS: Among 258 unique publications, 46 (17.8%) provided direct human spaceflight evidence, 106 (41.1%) human spaceflight-analog evidence, 44 (17.1%) contextual/mechanistic evidence, and 62 (24.0%) secondary/conceptual evidence. Direct and analog evidence converged on gravity-sensitive cephalad fluid redistribution and altered jugular/cerebral venous geometry and flow, supporting altered venous physiology as an upstream component of the microgravity fluid response. CSF/pressure evidence was heterogeneous; surrogate evidence exceeded direct ICP characterization, and sustained global intracranial hypertension was not consistently established as a unitary explanation for SANS. Long-duration spaceflight was associated with reproducible ventricular/CSF-space redistribution and cerebral structural remodeling, with selected abnormalities persisting during recovery, without demonstrated causality for SANS. Formal SANS present/absent/mixed classification was available in only 62/258 (24.0%) publications, underscoring the distinction between neuro-ocular findings and formal SANS phenotyping. OCT, MRI, ONSD, and venous/hemodynamic ultrasound interrogated complementary compartments, while no single biomarker characterized the complete response. Countermeasures modified upstream fluid/hemodynamic physiology, providing perturbational evidence without establishing SANS prevention.

CONCLUSION: Evidence supports Space Neurohydrodynamics as an evidence-informed integrative framework describing a coupled, compartmental, and temporally dynamic neurovascular–CSF–brain–ocular response to microgravity, rather than a validated linear causal pathway. Simultaneous longitudinal multimodal studies in independent astronaut cohorts with standardized SANS phenotyping are needed to resolve inter-compartment coupling and establish space-specific physiological interpretation before autonomous monitoring can be validated.

Keywords: Microgravity, Spaceflight-Associated Neuro-Ocular Syndrome, Cerebrospinal Fluid, Cerebral Venous Physiology, Space Medicine

[Abstract:0294]

Toward Autonomous Neurocritical Care in Long-Duration Spaceflight: Mapping Non-Invasive Monitoring and Decision-Support Evidence

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BACKGROUND: Long-duration lunar and Martian missions may require management of time-sensitive neurocritical events without immediate neuroimaging, specialist support, medical evacuation, or real-time terrestrial assistance. Non-invasive monitoring and clinical decision support could enable early recognition, serial assessment, and triage; however, the evidence required to integrate these capabilities into autonomous neurocritical care remains unclear.
OBJECTIVE: To map and synthesize evidence on non-invasive neurocritical assessment, monitoring, and decision-support strategies potentially applicable to autonomous detection and triage of time-sensitive neurocritical conditions during long-duration spaceflight.
METHODS: We conducted a scoping review with structured evidence mapping and narrative synthesis using a PCC-based eligibility framework and PRISMA-ScR reporting principles. Literature published from 1990–2026 was systematically searched in PubMed/MEDLINE, Embase, Scopus, and Web of Science using predefined concepts, keywords, and Boolean combinations. Records were managed in Rayyan. Three reviewers independently screened records with decisions concealed between reviewers; disagreements underwent conflict resolution and final adjudication. Data were extracted by four investigators using a predefined structured matrix and subsequently underwent complete verification by two reviewers. Ninety-two unique publications were synthesized across neurocritical conditions, non-invasive technologies, physiological signals, clinical functions, decision-support capabilities, operational dependencies, and evidence directness.
RESULTS: Only 6/92 publications (6.5%) provided direct astronaut/spaceflight-derived evidence; 24/92 (26.1%) represented spaceflight analog/intermediate evidence and 24/92 (26.1%) indirect transferable evidence. Direct spaceflight-derived evidence concentrated predominantly on SANS/neuro-ocular physiology and monitoring, whereas evidence addressing acute neurotrauma and other time-sensitive neurocritical emergencies was predominantly terrestrial or austere, revealing fragmentation between space-specific physiological monitoring and acute-care evidence. Spaceflight and microgravity analogs modified ocular and neurovascular signals relevant to neurocritical assessment, indicating that terrestrial single-marker thresholds cannot be assumed to transfer unchanged without space-specific validation. Multiple non-invasive modalities provided complementary sensing and monitoring capabilities; however, no included publication demonstrated a prospectively validated closed-loop autonomous neurocritical-care system. Structured synthesis identified the principal translational bottleneck as validated integration of multimodal sensing into space-calibrated interpretation and actionable autonomous clinical decision-making.
CONCLUSION: Available evidence supports an evidence-informed conceptual architecture integrating multimodal non-invasive neurocritical sensing and serial monitoring for long-duration space missions. However, direct validation for acute neurocritical emergencies and autonomous interpretation, triage, and clinical decision-making remains insufficient. Progress toward Earth-independent neurocritical care requires space-specific signal calibration and prospective validation of integrated multimodal decision pathways.

Keywords: Neurocritical Care, Space Medicine, Autonomous Medical Care, Non-Invasive Monitoring, Clinical Decision Support



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Poster Presentations

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Accepted Poster Presentations

[Abstract:0007]

Study on the Regulatory Mechanism of Butyrate against Brain Cognitive Impairment Mediated by Repeated +Gz Exposure

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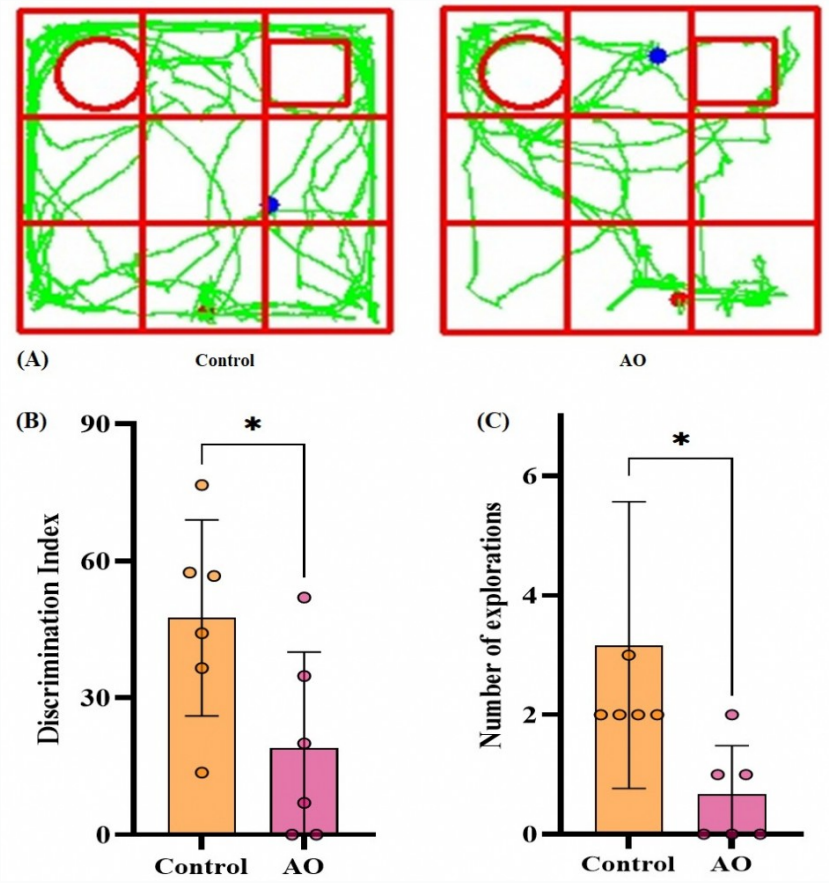
Acceleration overload (+Gz) is one of the most common core stressors in military aviation. Long-term repeated exposure can significantly increase the risk of cognitive impairment to pilots, but the molecular mechanisms have not yet been systematically elucidated. Intestinal flora homeostasis is a key link in maintaining central nervous system and regulating cognitive behavior. Short-chain fatty acids (e.g. butyrate), as key metabolites of intestinal flora, can freely cross the blood-brain barrier and play an important role in cognitive function regulation through regulating neuroinflammation and stabilizing neurotransmitter homeostasis. Preliminary experiments show: ① Repeated +Gz exposure can significantly impair the spatial learning and memory abilities as well as non-spatial recognition memory abilities of rats, accompanied by a significant downregulation of the expression of key cognitive regulatory molecules such as brain-derived neurotrophic factor (BDNF) and 5-hydroxytryptamine (5-HT) in the hippocampus, suggesting damage to central nervous system function; ② +Gz exposure can significantly reduce the species richness and diversity of intestinal flora, specifically induce a decrease in the abundance of beneficial butyrate-producing bacteria such as Roseburia, and enrich potential pathogenic bacteria such as Prevotella, leading to intestinal microecological imbalance; ③ Non-targeted metabolomics detection shows that +Gz exposure can cause a synchronous and significant downregulation of butyrate-related characteristic metabolites (4-(Dimethylamino)butanoate) in rat brain tissue and serum, accompanied by disorders of energy metabolism, abnormal lipid remodeling, and neurotransmitter homeostasis in the brain, confirming that the butyrate metabolic network is closely related to cognitive impairment. Based on this, a hypothesis is proposed: Repeated +Gz exposure induces intestinal microecological imbalance, inhibits the abundance of butyrate-producing bacteria such as Roseburia, reduces butyrate production, impairs the stability of the core pathways mediated by butyrate, including neuroinflammation regulation, synaptic plasticity maintenance, and neurotransmitter homeostasis regulation, thereby inducing central nervous system metabolic disorders and synaptic dysfunction, and ultimately leading to cognitive impairment. This project intends to integrate animal behavior, 16S rRNA gene sequencing, non-targeted metabolomics, and molecular biology techniques to systematically clarify the cascade regulatory mechanism of "+Gz stress-intestinal flora imbalance-butyrate metabolic abnormality-brain cognitive impairment"; and verify the protective effect of targeted regulation of intestinal flora and butyrate metabolism on cognitive impairment induced by +Gz exposure through experiments such as fecal microbiota transplantation (FMT), Roseburia gavage, and sodium butyrate intervention, so as to provide new theoretical basis, potential intervention targets, and experimental support for the protection of cognitive function in special military aviation occupational groups.

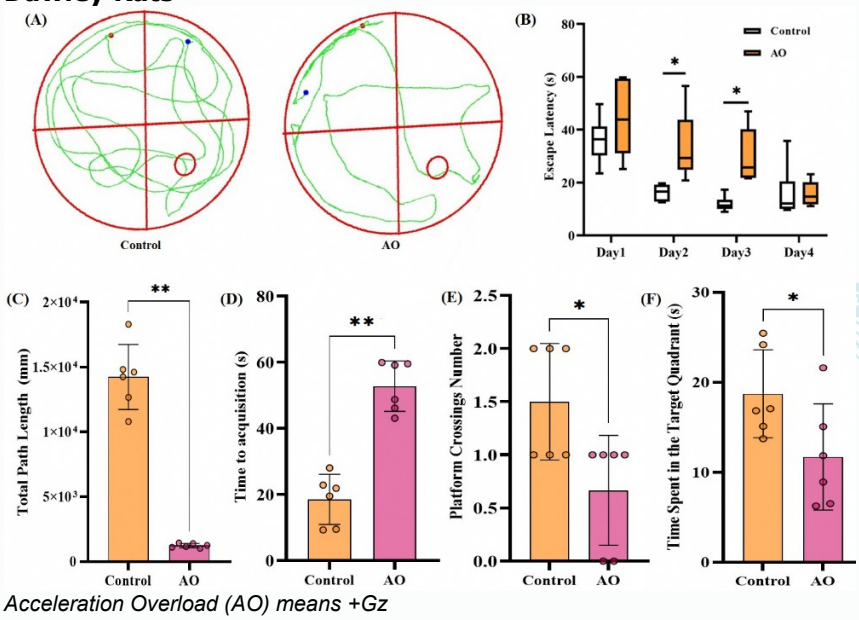
Keywords: Acceleration overload (+Gz), Cognitive impairment, Butyrate, Intestinal flora

Evaluation of the Effect of Acceleration Overload (AO) on Non-Spatial Recognition Memory and Exploration Motivation in Rats

Poster Presentations



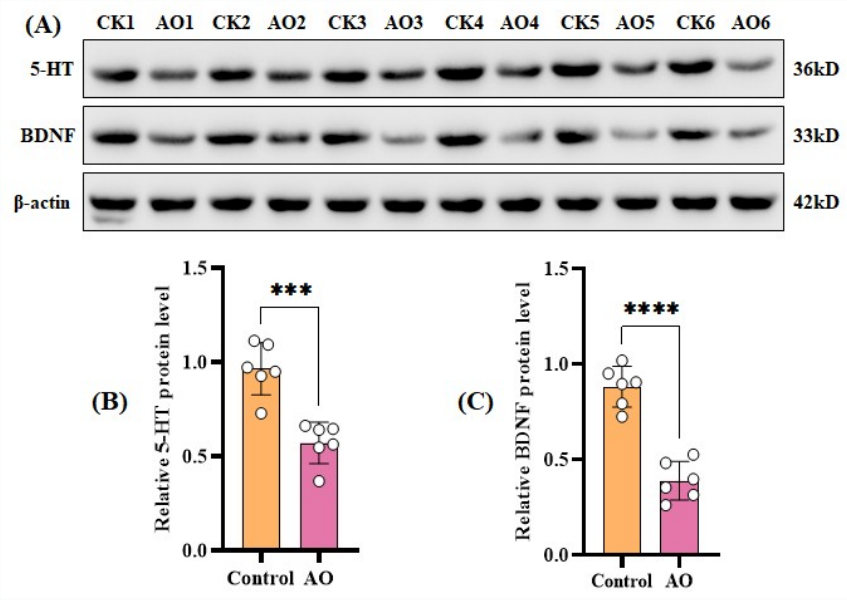
The effect of +Gz on Hippocampus-Dependent Spatial Learning and Memory in Sprague-Dawley Rats



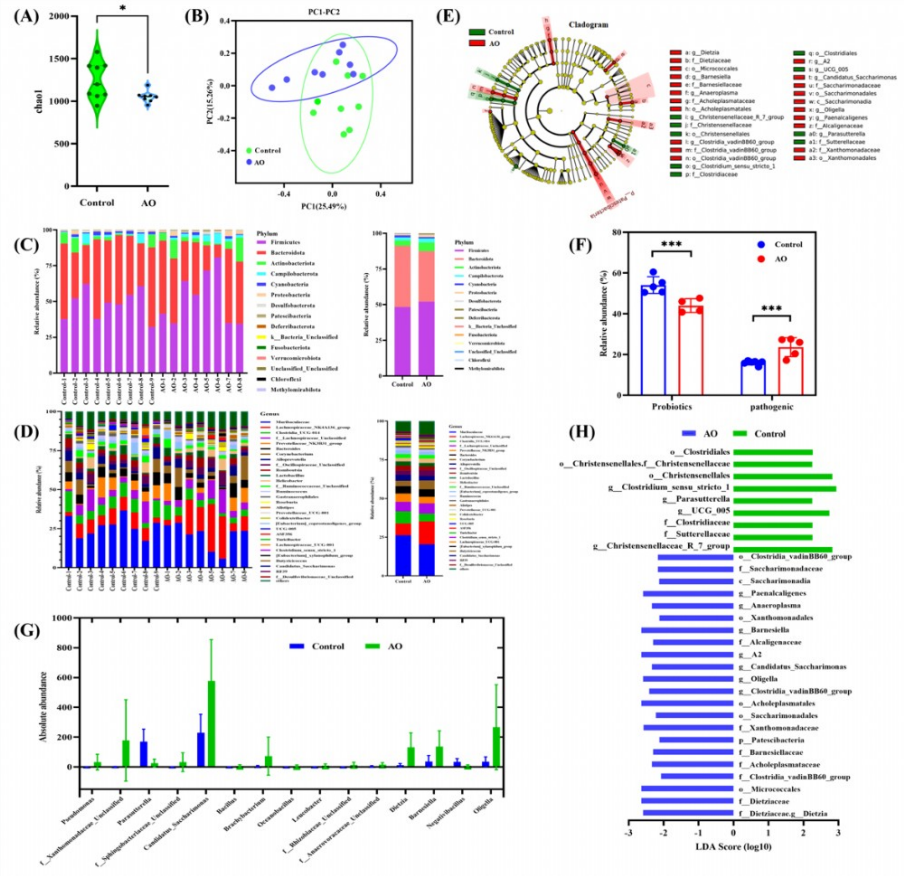
Acceleration Overload (AO) means +Gz

The Effect of Acceleration Overload (AO) on the Protein Expression of Brain-Derived Neurotrophic Factor (BDNF) and 5-Hydroxytryptamine (5-HT) in the Hippocampus of Rats

Poster Presentations

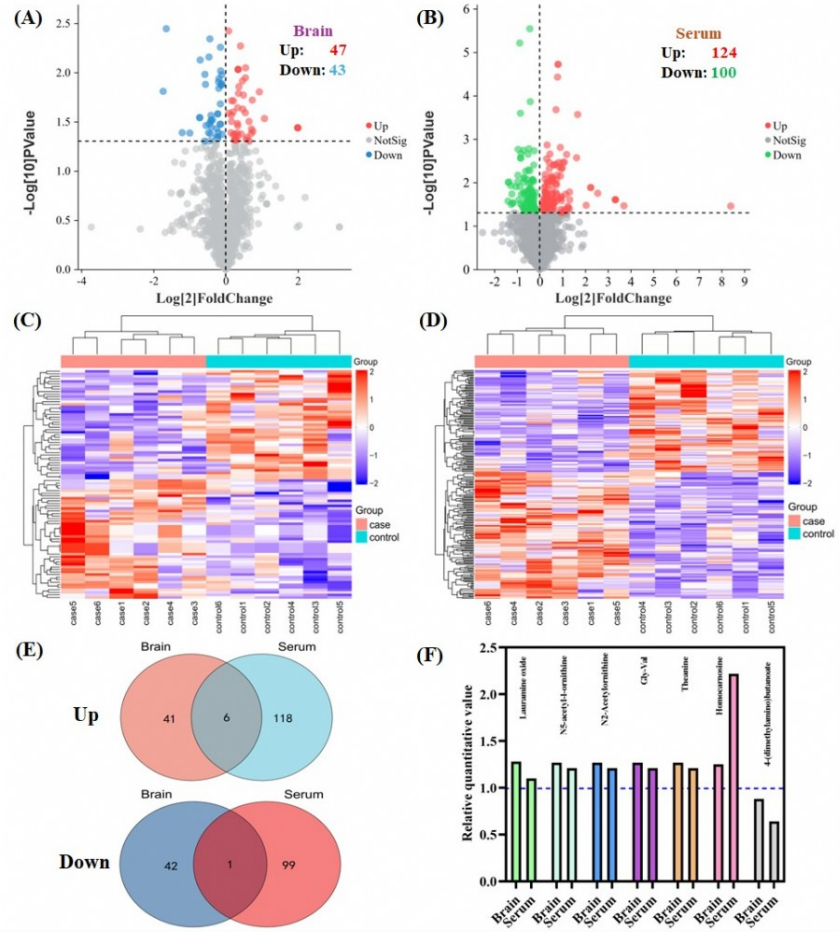


The Effect of Acceleration Overload on Changes in Intestinal Flora Composition in Rats



Poster Presentations

The Effect of Acceleration Overload on Metabolites in Rat Brain Tissue and Serum



[Abstract:0017]

Retrospective evaluation of medical board reports of flight personnel referred to a healthcare institution for final decision: A descriptive cross-sectional study

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In this study, health board reports of flight crew referred to a Flight Personnel Health Board of a City Hospital for a final decision were retrospectively analyzed. A total of 34 reports issued between January 2021 and December 2025 were analyzed in age, gender, body mass index (BMI), the nature of the final decision, the medical fields and disorders supporting the decision terms.

The median age of the 34 cases was 43 (IQR = 18) years. Of 91.2% subjects were male. The mean BMI was 26.2 kg/m² (SD = 3.2). The nature of the final decision was the following; 52.9% of the cases were reported as "Aircraft category change is appropriate", 38.2% as "Unfit for flight", and 8.8% as "Requiring re-evaluation before a final decision" (due to reasons such as a 6-month diet period or re-examination).

For category changes; of 44.1% cases were reported as "Fit to fly in Category-2/Category-3 aircraft", 5.9% as "Fit to fly in Category-4 aircraft", and 2.9% as "Fit to fly in Category-3 aircraft". Of 17.6% the cases had body weights beyond the upper limits specified in the standard weight chart according to height. Of these six cases; two (33.3%) were reported as "Unfit for flight", another two (33.3%) as "Fit to flight in Category-4 aircraft", one (16.7%) as "Fit to flight in Category-2/Category-3 aircraft", and the last one (16.7%) as "Re-evaluation for flight suitability after a 6-month diet is appropriate".

Looking at the distribution of medical fields, 38.2% of the cases had disease(s) from a single major area, while 64.7% had from two or more. The most frequently reported disorders were found in the medical fields of internal medicine (67.6%), musculoskeletal disorders (47.1%), and ophthalmology (14.7%), respectively. Thyroid disorders (32.4%), discopathies (32.4%), cardiovascular diseases like rhythm disorders, valve insufficiency (26.5%) and ophthalmic pathologies such as refractive errors, macular degeneration (14.7%) were the most prominent disorders.

The decision of the final report of 82.4% cases was exactly the same with the decisions given by the other two medical boards, while 17.6% of subjects' the final decision differed. One of the study's key findings is that pilots with a body weight that necessitates flight unsuitability or a category change constitute roughly one-fifth of the cases reported. This preventable medical condition can be averted through improving diet and regular exercise programs, resulting in intercept the skills and capabilities of flight personnel from being compromised.

Keywords: medical board, final decision, flight personnel, body mass index, unfit for flying, aircraft category change

[Abstract:0049]

Psychosocial factors related to pilots' perceived fatigue: A preliminary survey study from Türkiye

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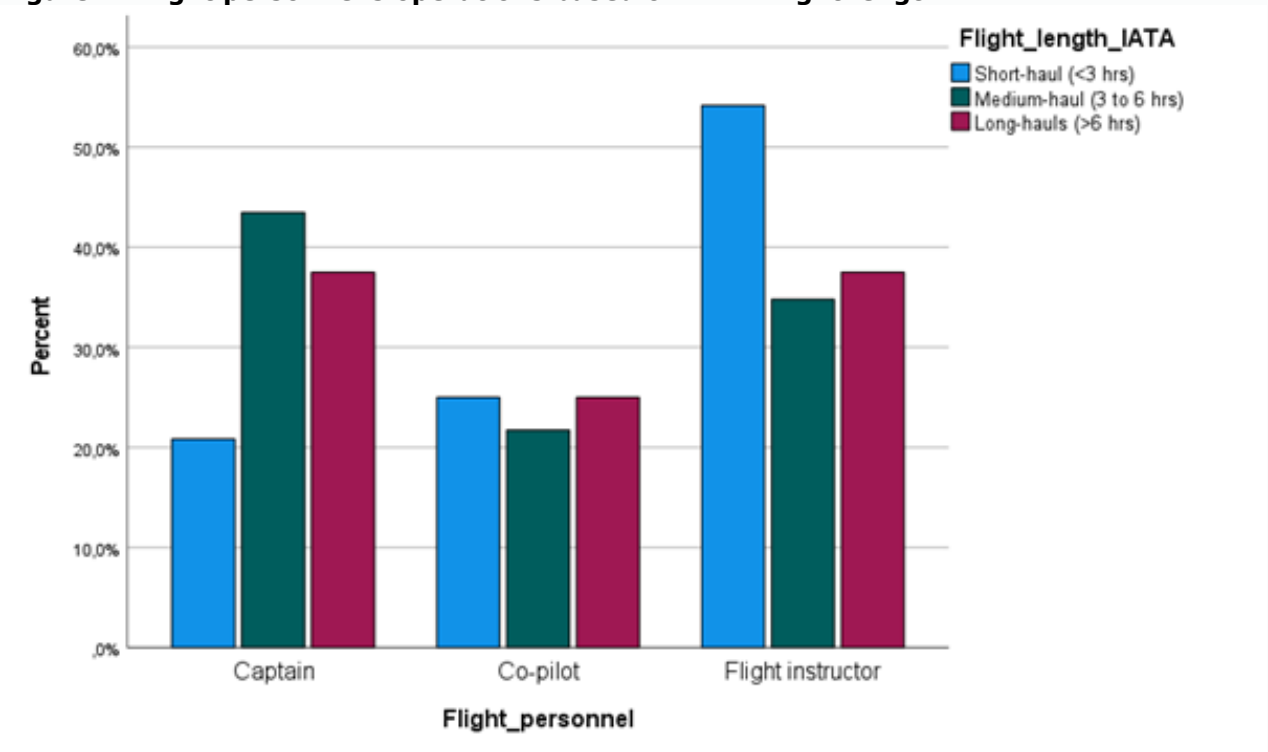
The responses of 55 pilots who participated in an online survey between May 3 and May 21, 2026, to questions related to perceived fatigue were analyzed. The mean age of the sample was 45.9 years. Of 90.9% the participants were male. The mean body mass index (BMI) was 25.4 years. Of 41.8% the participants were smokers. The mean smoking duration was 17 years. The median flight time was 15 years, and the median total flight hours was 4000 hours. Of 83.6% the cases were piloting an airplane, while 16.4% were using a helicopter. Of 32.7% the sample were captains, 23.6% were co-pilots, and 43.6% were flight instructors. According to the IATA classification, 43.6% of the subjects performed short-haul (<3 hours) operations, 41.8% performed medium-haul (3 to 6 hours), and 14.5% performed long-haul (>6 hours) operations. Autolanding usage was detected in 29.1% of the cases. Fatigue-induced microsleep was reported by 32.7% of the pilots. Fatigue-induced minor errors were reported by 32.7% of the sample. Fatigue-induced near-miss incidents were subjected in 5.5% of the pilots. The mean baseline fatigue score of the sample determined via The Fatigue Severity Scale (FSS) was found to be 33.5 (SD = 1.6). Fatigue was categorically detected in 45.5% of the pilots. Moderate level of emotional burnout measured by Maslach Burnout Inventory (MBI) – Emotional Exhaustion subscale was detected in 12.7% and high-level of emotional exhaustion in 9.1% of the cases. The mean baseline perceived workload of of the cases detected by The NASA TLX (Task Load Index) was 40.2 (SD = 2.8). Categorically, 30.9% of the pilots perceived their workload as low-moderate, while 69.1% reported a high level of workload. A positive correlation was found between flight hours and BMI (r =.310, p =.021); between total flight hours and total workload (r =.323, p =.016); and between total flight hours and NASA TLX total (r =.301, p =.026). While the only factor predicting medium-high levels of perceived fatigue was emotional exhaustion ($\chi 2(5)$ = 13.10, p =.022; B =.126, OR = 1.294 [95% CI: 1.011 – 1.656]), the only factor predicting medium-high levels of emotional exhaustion was temporal demand ($\chi 2(5)$ = 16.89, p =.005; B =.040, OR = 1.041 [95% CI: 1.003 – 1.081]. Temporal demand predicts perceived fatigue through emotional exhaustion. Advanced interventions for flight personnel's time management can be used as a proactive tool in preventing fatigue.

Keywords: FSS, MBI, NASA-TLX, fatigue, burnout, pilots

Figure 1. Flight personnel's operations based on IATA flight length



The International Air Transport Association (IATA)

Table 1. Variables that predict medium-high levels of perceived fatigue

						95% C.I.for EXP(B)	95% C.I.for EXP(B)
	B	S.E.	Wald	P value	Exp(B)	Lower	Upper
Emotional exhaustion	,258	,126	4,196	,041	1,294	1,011	1,656
Mental demand	,158	,104	2,298	,130	1,171	,955	1,437
Pyhsical demand	-,080	,104	,591	,442	,923	,753	1,132
Temporal demand	-,080	,079	1,014	,314	,924	,791	1,078
Frustration	,023	,066	,122	,727	1,023	,900	1,164

Table 2. Variables predicting medium-high levels of perceived emotional exhaustion

						95% C.I.for EXP(B)	95% C.I.for EXP(B)
	B	S.E.	Wald	P value	Exp(B)	Lower	Upper
Fatigue severity	,060	,040	2,250	,134	1,062	,982	1,148
Mental demand	,026	,015	2,792	,095	1,026	,996	1,058
Temporal demand	,040	,019	4,484	,034	1,041	1,003	1,081
Frustration	-,008	,020	,153	,696	,992	,955	1,032
Effort	-,010	,019	,257	,612	,990	,953	1,029

[Abstract:0058]

From Underwater to Altitude: Translating Closed-Circuit Oxygen Rebreather Principles for Hypobaric Aerospace Operations

Maria Vittoria Carminati
C2Space Tech LLC

Background
Decompression sickness remains a persistent operational risk in high-altitude aviation, extravehicular activity, and future lunar surface operations, where humans may transition between habitat, vehicle, and suit pressure environments. Current countermeasures rely heavily on oxygen prebreathe, pressure staging, and procedural mitigation of inert gas burden. These approaches reduce risk but create operational delays, logistical constraints, and mission-planning limitations. Closed-circuit oxygen rebreathers are mature in underwater and industrial environments, where they support portable oxygen delivery, carbon dioxide removal, and extended-duration breathing-gas management. However, direct translation to aerospace environments requires a distinct safety framework because hypobaria, pressure transitions, suit integration, oxygen partial pressure behavior, carbon dioxide retention, and human-factor demands differ substantially from underwater use.

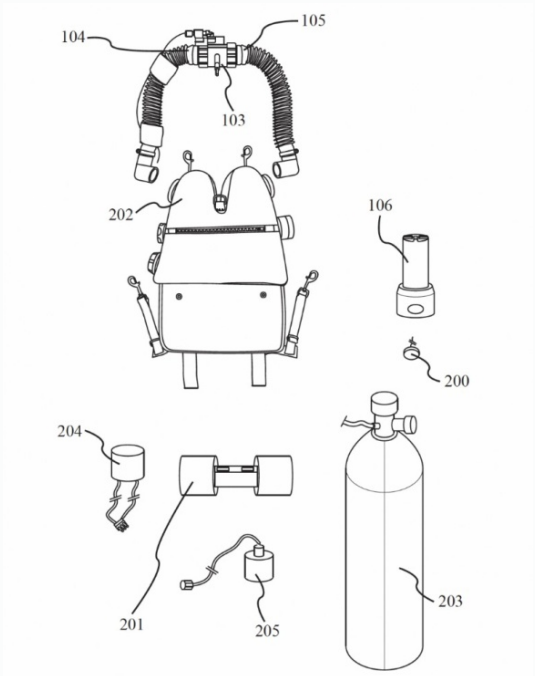
Description
We describe a translational framework for adapting closed-circuit oxygen rebreather principles to hypobaric aerospace operations. The framework identifies design and testing considerations for oxygen delivery, carbon dioxide scrubbing, inspired and expired gas monitoring, intermediate pressure behavior, sensor redundancy, alarm logic, work of breathing, failure modes, user training, and emergency procedures. It also proposes a staged evaluation pathway beginning with bench testing and progressing through hypobaric chamber testing and human-in-the-loop safety assessment. Candidate endpoints include oxygen saturation, inspired oxygen, inspired and expired carbon dioxide, scrubber duration, neurological status, symptoms, venous gas emboli surveillance, workload, alarm response, and post-exposure adverse events.

Discussion
Underwater closed-circuit systems provide a useful operational model for portable life support, but aerospace adaptation should not be treated as a simple equipment transfer. A hypobaric rebreather must be evaluated as an integrated medical, engineering, and human-performance system. This framework supports future development of compact oxygen life-support technologies that may reduce prebreathe burden, improve operational flexibility, and support decompression-risk mitigation during high-altitude, EVA, and lunar missions. The work is presented as a design and testing framework, not as completed validation of a production device.

Keywords: rebreather, hypoxia, decompression sickness, prebreathe, medical oxygen

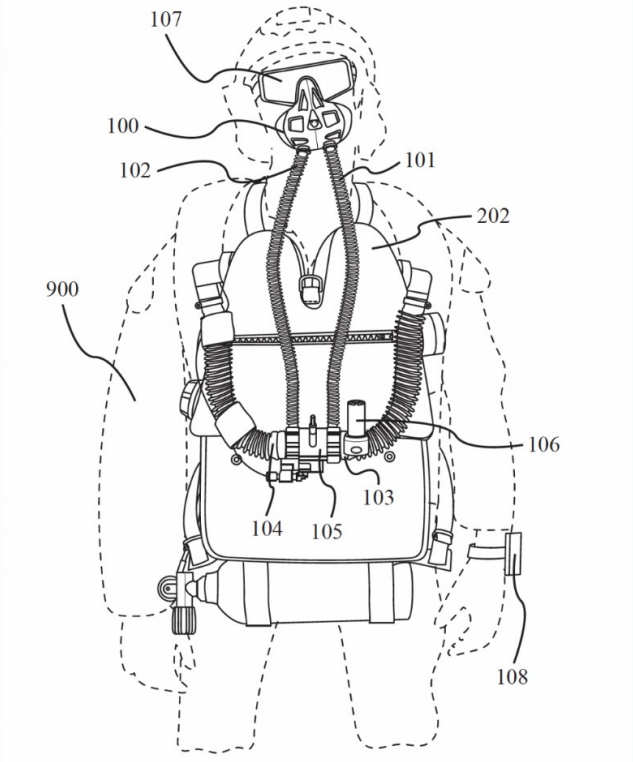
Conceptual Closed-Circuit Oxygen Rebreather System Adapted for Hypobaric Aerospace Operations

Poster Presentations



Conceptual configuration of a wearable closed-circuit oxygen rebreather adapted from underwater life-support principles for high-altitude and EVA-adjacent aerospace operations. The system integrates a breathing interface, counterlung/back-mounted breathing loop, oxygen supply, gas-routing components, carbon dioxide removal architecture, monitoring elements, and user-worn support hardware. The design illustrates a translational framework for portable oxygen delivery and CO_2 management during hypobaric exposure, with potential application to decompression-risk mitigation, prebreathe support, and operational flexibility during altitude, lunar, or extravehicular-activity scenarios. The figure is presented as a design concept and testing framework, not as a validated production device.

Wearable closed-circuit oxygen rebreather concept for hypobaric aerospace operations.



The system adapts underwater rebreather principles—portable oxygen supply, recirculating breathing loop, CO_2 removal, and physiologic monitoring—to altitude/EVA-relevant environments where decompression risk, oxygenation, and operational mobility are central safety concerns.

[Abstract:0063]

The Fascinating Story of Meryem el-İcliyye (Maryam al-İcliyya)

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Meryem el-İcliyye, was a 10th-century Muslim woman astronomer and astrolabe maker from Aleppo in present-day northern Syria. She came from a family of instrument makers; her father was also an astrolabe craftsman, and both apprenticed under the Baghdad-based astrolabe maker Nastūlus. Historical records, primarily from Ibn al-Nadim, do not confirm her first name as "Maryam," and "al-Usturlabi" simply means "the astrolabe maker," a descriptor of her profession rather than a proper name. Maryam al-Usturlabi was the daughter of Qushyar al-Fli'in. Her father was a renowned astrolabe maker in Baghdad and an apprentice to Bastulus, a scientist who is recorded as having invented the world's oldest surviving astrolabe. From childhood, she became interested in astrolabe making alongside her father. After her father's death, Maryam al-İcliyya, influenced by his profession, continued to manufacture astrolabes. However, this was not an easy task, as it required a good knowledge of mathematics and astronomy. Being both a diligent and curious student, Maryam learned these sciences and improved the astrolabe. Now, with the help of the astrolabe, the altitude of celestial bodies, the times of sunrise and sunset could be measured, and direction could be determined on land. This instrument, likened to a modern smartwatch, was highly appreciated for its importance in setting times and finding direction. Maryam "al-Usturlabi" al-İlciyya made significant contributions to the design of astrolabes.An astrolabe is an astronomical instrument used to solve problems related to the positions of the sun and stars, and to time. It is used in the mathematical calculations necessary for solving many astronomical problems. Its name comes from the Greek words "Aster," meaning star, and "Lambonein," meaning to take, measure, catch, hold, understand, and comprehend, and today it means "star catcher" or "star holder." Developed by various civilizations and used in the Mediterranean basin for about 2000 years, the astrolabe was known to the Greeks in the 2nd or perhaps 4th century BC. An astrolabe is a portable instrument used vertically for observation, mounted on a type of quadrant suspension system; in other words, it is a plane representation of the celestial sphere. It consists of circular disks, each with its own function. In its common form, the astrolabe, or plane sphere, has inner disks with latitude degrees and horizontal coordinates engraved on the metal.In this paper,we will present the fascinating and inspiring life story of Meryem el-İcliyye.

Keywords: history, woman astronomer, astrolabe, Meryem el-İcliyye

[Abstract:0064]

The development of space physiology in space research

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Space physiology research investigates how the human body adapts to microgravity, radiation, and isolation, shifting from early survival studies to long-term health maintenance for missions to Mars. Key developments include understanding cardiovascular deconditioning, bone density loss, neuro-vestibular shifts, and creating advanced exercise countermeasures to sustain astronaut health.Studies show significant bone and muscle loss due to reduced weight-bearing loads, driving the need for intense resistance exercise protocols. Headward fluid shifts occur immediately, reducing plasma volume and causing orthostatic intolerance upon return to Earth. Exposure to microgravity causes spatial disorientation, motion sickness, and changes in balance control, requiring neuro-vestibular training. Research into high-dose radiation exposure is crucial for deep space exploration, with studies focusing on DNA damage, mitochondrial dysfunction, and telomere changes. Long-term missions affect astronaut nutrition and immune function, necessitating specialized diets and medical monitoring. Development of advanced equipment on the International Space Station (ISS) has reduced muscle atrophy significantly. An emerging field using AI and data modeling to understand how bodily systems adapt in an integrated manner rather than in isolation.Use of head-down bed rest studies to simulate spaceflight effects on Earth. The future of space physiology focuses on autonomous medical care, genomics, and artificial intelligence to manage health on long-duration interplanetary missions. Space medicine and space physiology are often viewed as two aspects of space life sciences, with the former being more operational, and the latter being more investigational. Space medicine tries to solve medical problems encountered during space missions. These problems include some adaptive changes to the space environment, including weightlessness, radiation, the absence of the 24-hour day/night cycle; as well as some non-pathologic changes that become maladaptive on return to Earth, such as muscle atrophy and bone demineralization. Space physiology tries to characterize body responses to space, especially weightlessness, reduced activity, and stress. It provides the necessary knowledge required for an efficient space medicine. Physiological adaptations to spaceflight involve several multisystemic responses on human health and function that require a deeper understanding given the increasing duration of space missions. Indeed, preserving astronauts' health and their physical and cognitive ability to perform the tasks during spaceflight is mandatory. In this paper, we will describe an overview of the milestones in the development of physiology in space research.

Keywords: Physiology, space physiology, space medicine, history of space physiology

[Abstract:0067]

Prevalence and factors associated with poor sleep complaints among airline pilots operating from Belgium

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INTRODUCTION: Given their potential negative impact, the aim of this study was to investigate the factors associated with complaints of poor sleep among airline pilots.

METHOD: A prospective, cross-sectional study was conducted among 124 airline pilots during their periodic occupational health visits using a sociodemographic questionnaire, a flight activity questionnaire, and specialized questionnaires on sleep disorders. Statistical analyses were performed to identify factors associated with the occurrence of complaints of poor sleep among airline pilots.

RESULTS: 25.8% of airline pilots presented complaints of poor sleep. Factors significantly associated with the occurrence of complaints of poor sleep were age, parenthood, number of flight hours, number of flights per month, presence of sleep disorders or chronic illness, chronic medication, occasional use of melatonin, caffeine consumption, and self-reported sleep duration.

CONCLUSION: Complaints of poor sleep are common among airline pilots, which justifies better screening of complaints and associated factors in occupational health consultations in order to more systematically refer affected pilots to specialized sleep medicine consultations. Future studies seem necessary to confirm our results and allow the development of more targeted interventions for this particular subpopulation.

Keywords: airline pilots, sleep disorders, prevalence, occupational medicine

[Abstract:0070]

Ophthalmological Evaluation in Pilots and Co-pilots: Implications for Operational Safety and Occupational Health in Brazil

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INTRODUCTION: Vision is the primary sensory input for pilots, accounting for approximately 80% of the information required for safe flight operations. In Brazil, the RBAC 67 regulation establishes rigorous ophthalmological standards for the Aeronautical Medical Certificate (CMA). However, cockpit-specific occupational hazards often exceed the scope of periodic regulatory screenings. OBJECTIVE: This study analyzes the ophthalmological requirements for Class 1 pilots in Brazil and investigates the impact of cockpit occupational risks on visual health and operational safety. METHODOLOGY: A systematic literature review was conducted across PubMed, SciELO, and regulatory databases (ANAC, FAA, EASA, ICAO), focusing on Brazilian civil aviation standards and prevalent occupational pathologies. RESULTS: The analysis confirms that the Brazilian regulatory framework is largely harmonized with international ICAO standards. Nevertheless, significant occupational risks were identified, including Dry Eye Syndrome (due to low humidity and reduced blink rates), Digital Eye Strain (from glass cockpits and blue light), and cumulative UV radiation exposure. These conditions can degrade functional vision, leading to increased human error and potential safety incidents. The study also highlights a gap in Brazilian research regarding large-scale epidemiological data on pilots' long-term eye health. CONCLUSION: While periodic regulatory exams are essential, they are insufficient to address the evolving technological and environmental challenges of the modern cockpit. Proactive eye health management is critical. Recommendations include updating ANAC protocols to incorporate more functional vision testing, implementing ergonomic improvements and blue light protection by airlines, and enhancing personalized counseling by occupational physicians. Future research should prioritize longitudinal studies to better understand the long-term effects of digital cockpits and high-altitude radiation on the visual apparatus of flight crews. This integrated approach is vital for maintaining high standards of operational safety and pilot well-being in the Brazilian aerospace sector.

Keywords: Aviation Medicine, Ophthalmology, Occupational Health, Pilots

[Abstract:0073]

Misperceptions, Postures, and Aberrant Physiological adaptations on Earth, Microgravity, Space, and the Extraterrestrial-A Review

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Background. The physiological bases of early Flight in Gliding was easy by the 'seat of your pants' with the airplane's attitude relative to its own frame of reference and the G-force vector directly downwards, not toward the nearest point below the plane on the ground, resulting in erroneous responses of the vertical, in helicopters, and Glide slopes of landing an aircraft. Self-motion perception as evolved in the biped, is better retained in the Z-axis, when pilots align their head and eyes toward the horizon, rather than the cockpit vertical axis. Natural orientation depends on Image Phase Congruency (IPC) of the human visual systems to process spatial frequency information, as by early basic spatial vector-cardiograms of the images of Lissajous. Discomfort in 'the pit of your stomach' indicating a visual-graviceptor-vestibulo-collic biodynamic to vibration resonance(4to6Hz). Body-Kinesthetic, Autonomic and Systemic responses, extending to diaphragmatic and cardiorespiratory kinematics, chest wall mechanics, and body fluid shifts result in 'the puffy faces and chicken legs' of astronauts. Vestibular-cervical reflexes with hearing inputs from the saccule modulate movements, as elucidated in dancers, and mind-body-yogic practitioners, retain wave forms and fluid postures, with sharp physiological body awareness, and body ownership. Body ownership illusions result from a multisensory integration of information and visuo-tactile or visuo-kinesthetic-visceral sensory conflict resolution, (as in projected Avatars), and illusory proprioceptive movement sensations, with kinesthetic responses.
Description. Terrestrial Evolutionary Postural Adaptations from the buoyant Fetal, to a Bipedal Stance and upright posture, is a unique species dependent configuration, that facilitates sensorimotor transformations, prevents drift in path orientation in microgravity, with a reflexive lowered tone of gravity-bearing extensor muscles and increased axial foot and hip support. In microgravity, rats adopt a bipedal forelimb locomotion with the hindlimbs relegated to grasping activities inspiring the designs of foot support surface inputs, with variable stiffness of Gecko-Inspired Foot and Adhesion Performance on Flexible Surfaces for other celestial bodies.
Discussion Man is still the epitome of having adapted the terrestrial Milieu Interieur (Claude Bernard 1813-78) with organized transitions from cells to organs in complex functional finite order, over time, unto Aging. In Extraterrestrial Environments hallmarks of Perception and Locomotion from the Milieu Exterieur, are now the bases of a unique Intellect and Intelligence for designed tools, engineered modalities, automation, and robotics, with Innovative re-foldable soft origami grippers and actuators and origami-based vacuum pneumatic artificial muscle (OV-PAM). Such bioinspired musculoskeletal systems could recognize newer Kinesthetic and Physiological modalities of Postural adaptations.

Keywords: Flight, Posture, Kinesthesia, Body-Illusions, Space, Extraterrestrial Physiological Adaptation.

[Abstract:0075]

Circadian patterns of medical emergencies resulting in flight diversion: a single-centre experience

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BACKGROUND: Circadian rhythms in sympathetic tone, cortisol, and blood pressure coincide with peak incidence of acute cardiovascular events in the general population. Commercial air travel introduces additional physiological stressors, including relative hypoxia, dehydration, reduced food intake, and travel-related fatigue, which may further modulate the temporal pattern of medical conditions during flights. The diurnal distribution of flight diversions due to medical emergencies has not been systematically described in the literature. The aim of this study was to determine whether a predictable time-of-day distribution existed across a 24-hour period.

METHODS: We retrospectively analyzed all patients assessed by airport-based emergency medical services following flight diversions to Zagreb International Airport from January 2015 to February 2026. We analyzed the time of medical interventions in 119 consecutive flight diversions and categorized each case into one of four time-of-day periods: night (00:00–06:00), morning (06:00–12:00), afternoon (12:00–18:00), and evening (18:00–24:00). Descriptive statistics were used to analyse the data.

RESULTS: Medical emergencies were similarly distributed across all parts of the day, with morning (06:00–12:00h, n = 40, 33.6%), afternoon (12:00–18:00h, n = 36, 30.3%), and evening (18:00–24:00h, n = 35, 29.4%) periods showing comparable frequency, while the nocturnal period (00:00–06:00h) accounted for a smaller portion of events (n = 8; 6.7%). Two peaks were observed at 11:00h and 21:00h. Cardiac arrest cases (n = 16) were distributed equally across all four time-of-day periods. Syncope (n = 23) demonstrated the morning predominance, with 47.8% of events occurring between 06:00 and 12:00h. Chest pain (n = 17) followed a similar morning pattern, with 55.6% recorded in the morning period. Neurological cases (n = 26) represented the most frequently recorded diagnosis across all time-of-day periods, with a relatively uniform distribution throughout the 24-hour period. Psychiatric emergencies showed a markedly inverse distribution compared to syncope and chest pain, with all cases (n = 8) occurring between 12:00 and 01:00h.

CONCLUSION: While overall event frequency was comparable across daytime hours, diagnosis-specific patterns emerged: syncope and chest pain clustered in the morning, consistent with known circadian cardiovascular physiology, whereas cardiac arrest showed no time-of-day predilection. Moreover, cumulative travel-related stressors, rather than circadian physiology, drove psychiatric emergencies in the later hours. The nocturnal nadir likely reflects reduced flight operations rather than a true circadian effect. These findings suggest that diurnal patterns of in-flight medical emergencies resulting in diversions are partly driven by modifiable factors, although the majority of events remain difficult to prevent.

Keywords: Emergency Medical Services, Air Travel, Travel Medicine, Circadian Rhythm

Figure 1. Flight diversions to Zagreb International Airport

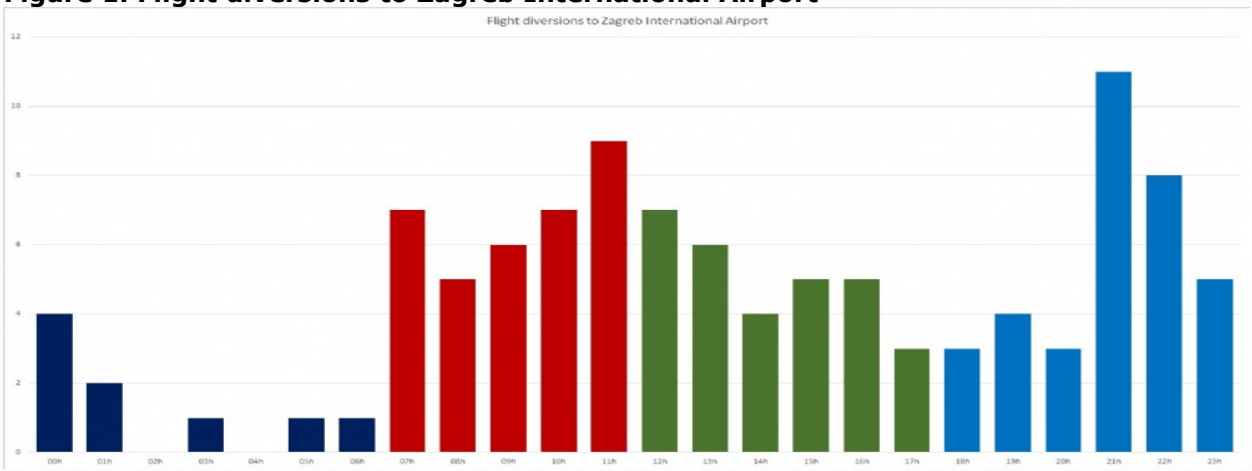

Figure 1. Hourly distribution of flight diversions to Zagreb International Airport. Two peaks were observed at 11:00h and 21:00h, with the nocturnal period (00:00–06:00h) accounting for the fewest events.

[Abstract:0087]

Fatigue Risk Factors, Circadian Disruption, and Cognitive Performance Among Libyan Flight Crew Members: A Cross-Sectional Questionnaire-Based Study

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BACKGROUND

Fatigue is a major human factors concern in aviation and represents a significant threat to operational safety. Flight crew members, including pilots and cabin crew, are frequently exposed to irregular schedules, night duties, extended duty periods, and disrupted sleep patterns. These factors may contribute to circadian rhythm disturbances, reduced alertness, impaired decision-making, and decreased cognitive performance. Despite the importance of fatigue risk management in aviation, limited evidence is available regarding fatigue-related risk factors among Libyan flight crew members. This study aims to assess fatigue risk factors, circadian disruption, and their potential impact on cognitive performance among Libyan flight crew personnel.

METHODS

A cross-sectional questionnaire-based study was conducted among Libyan flight crew members, including pilots and cabin crew. Participants were recruited through both electronic distribution of a structured questionnaire and direct recruitment at Al-Salam Medical Center, Tripoli, Libya. The questionnaire was available in both Arabic and English. Professional eligibility was verified using participants' aviation license numbers to ensure that only licensed flight crew members were included in the study. The survey collected demographic data, occupational characteristics, work schedules, sleep patterns, fatigue symptoms, circadian disruption indicators, and self-reported cognitive performance measures. Statistical analyses will be performed to determine the prevalence of fatigue-related factors and evaluate associations between fatigue, circadian disruption, and cognitive performance indicators.

RESULTS

Data collection is currently ongoing. The final analysis will determine the prevalence of fatigue symptoms, sleep disturbances, and circadian rhythm disruption among Libyan flight crew members. Associations between fatigue-related factors and cognitive performance measures will be evaluated following completion of data collection and statistical analysis.

CONCLUSION

This study is expected to provide valuable insights into fatigue-related risk factors affecting Libyan flight crew members and their potential influence on cognitive performance. The findings may support evidence-based fatigue mitigation strategies, fatigue risk management programs, and operational policies aimed at enhancing crew well-being and improving aviation safety.

Keywords: Fatigue, Flight Crew, Aviation Safety, Circadian Rhythm, Cognitive Performance, Fatigue Risk Management

[Abstract:0094]

No Sex Differences in the Distribution of G Tolerance, Anti-G Straining Maneuver Effectiveness, and High-G Training Success: A Large-Sample Retrospective Study

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BACKGROUND: High-G training is mandatory before military flight cadets progress to advanced fighter aircraft to ensure adequate G tolerance and effective anti-G straining maneuver (AGSM) performance, thereby reducing the risk of G-induced loss of consciousness. Although previous studies have reported similar G tolerance between males and females, evidence from large female cadets remains limited. Moreover, sex-specific distributions of relaxed G tolerance (RGT), straining G tolerance (SGT), AGSM effectiveness, and high-G training outcomes have not been well characterized. This study compared these measures between male and female military flight cadets.
METHODS: This retrospective study analyzed the first high-G training records of Air Force flight cadets over a 7-year period. Training included a gradual-onset rate (0.1G/s) profile to determine RGT and SGT, with AGSM effectiveness calculated as the difference between SGT and RGT, followed by three rapid-onset rate (3G/s) profiles: 6G for 10 s, 7.5G for 15 s in the neutral seated position, and 6G for 10 s in the check-six posture. Successful completion of all profiles was defined as passing the training. RGT, SGT, AGSM effectiveness, percentile distributions, and training success rates were compared between the sexes.
RESULTS: A total of 783 training records (711 males and 72 females; mean age approximately 23 years) were analyzed. Despite these anthropometric differences, RGT, SGT, AGSM effectiveness, and training success were comparable between the sexes. Mean RGT was identical (4.9G; P = 0.738), whereas mean SGT (7.8 ± 1.0 vs. 7.6 ± 1.0G; P = 0.132) and AGSM effectiveness (2.9 ± 1.0 vs. 2.8 ± 1.0G; P = 0.265) also showed no significant sex differences. The 25th, 50th, and 75th percentile distributions of RGT, SGT, and AGSM effectiveness were nearly identical between the sexes. Although a greater proportion of male cadets achieved an SGT ≥8.0 G (48.6% vs. 40.8%) and an AGSM effectiveness ≥3.0 G (48.2% vs. 42.3%), neither difference reached statistical significance. Overall training success rates were similarly high in males and females (96.1% vs. 97.2%; P = 0.868).
CONCLUSIONS: Male and female military flight cadets demonstrated comparable G tolerance, AGSM effectiveness, percentile distributions, and high-G training success despite marked differences in anthropometric characteristics. These findings support the use of uniform high-G training standards regardless of sex while providing sex-specific normative reference data for G tolerance and AGSM performance. Future studies integrating body composition or cardiovascular characteristics may further elucidate the physiological determinants of G tolerance.

Keywords: Sex Differences, Relaxed G Tolerance, Straining G Tolerance, Anti-G Straining Maneuver Effectiveness

[Abstract:0095]

Sex differences in AI-derived ECG heart age responses and their association with G tolerance

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BACKGROUND: Artificial intelligence (AI)-derived heart age (HA), estimated from electrocardiogram (ECG) data, has emerged as a novel marker of cardiovascular health and future cardiovascular risk. Anticipated stress before high-G training can activate the autonomic nervous system and increase heart rate (HR). Previous study has suggested that smaller changes in HA may be associated with better G-tolerance. This study investigated the relationships among HA, HR responses, and relaxed G-tolerance (RGT) and further explored potential sex differences in these associations.

METHODS: A total of 96 flight cadets who underwent high-G training between 2023 and 2024 were enrolled. Single-lead ECG recordings were obtained using the Apple Watch Series 9 during registration and immediately before training. HA was estimated using a previously developed AI model based on ECG signals. RGT was assessed during a gradual-onset-rate profile (onset rate: 0.1 G/s) and defined as the G level at which cadets experienced either complete peripheral vision loss or 50% central vision loss without performing an anti-G straining maneuver. Participants were stratified by RGT performance, and sex-specific analyses were performed.

RESULTS: The study included 76 males and 20 females with a mean age of 25.7 ± 1.4 years. Mean RGT was 4.9 ± 1.0 G, and approximately 20% of participants achieved RGT > 5.5 G, with no significant sex differences in G-tolerance. Compared with registration measurements, HA and HR increased by 4.0 ± 9.2 years and 20.1 ± 14.3 beats/min, respectively, before training. Cadets with RGT > 5.5 G exhibited smaller increases in both HA and HR than those with lower RGT. Males demonstrated a slight increase in HA before training, whereas females showed a slight decrease. Among males, an HA increase >7 years and an HR increase > 10% were associated with a significantly lower chance of achieving RGT > 5.5 G ($P = 0.008$ and $P < 0.001$, respectively). Similar trends were observed in females but did not reach statistical significance.

CONCLUSIONS: This study demonstrates that smaller HA and HR variations significantly correlate with higher RGT only in males, indirectly suggesting that cardiovascular responses induced by anticipated stress before high-G training may be associated with G-tolerance. While these findings are not observed in females, suggesting potential sex differences, the female sample size should be increased to assess the consistency of results.

Keywords: Artificial intelligence, Electrocardiography, Heart age, High-G training, Relaxed G tolerance, Sex differences

[Abstract:0102]

Precision space health: an autonomous biosensing and clinical decision-support framework for long-duration space missions

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Background
Long-duration space missions expose astronauts to unique health risks, including microgravity-induced physiological changes, radiation exposure, circadian rhythm disruption, and limited access to conventional medical care. As future exploration missions extend beyond low Earth orbit, communication delays and the impossibility of rapid medical evacuation necessitate greater medical autonomy. Recent advances in wearable biosensors, artificial intelligence (AI), and point-of-care diagnostics have enabled continuous health monitoring and early detection of medical conditions in space. This review outlines a structured process framework for autonomous health monitoring, risk assessment, and clinical decision support during long-duration space missions.
Description
The Precision Space Health framework consists of five sequential steps. First, physiological data acquisition is performed using wearable and portable biosensors that continuously monitor cardiovascular parameters, metabolic biomarkers, sleep patterns, radiation exposure, and neuromuscular performance. Second, multimodal data integration combines information from multiple sensors into a unified health profile. Third, AI-based risk stratification analyses trends, identifies deviations from individual baselines, and predicts potential health concerns. Fourth, clinical decision-support systems generate alerts and recommend diagnostic or therapeutic actions when abnormalities are detected. Finally, relevant health data are transmitted to ground-based medical teams for asynchronous consultation and mission support when communication permits. Recent developments supporting this framework include flexible multi-analyte biosensors, optical biomarker detection platforms, metabolomic monitoring, CRISPR-based diagnostic technologies, and telemedicine-enabled decision-support systems. Together, these innovations facilitate early disease detection and reduce dependence on immediate terrestrial medical intervention.
Discussion
Autonomous biosensing offers a practical framework for maintaining astronaut health during long-duration missions. Continuous monitoring improves situational awareness, supports preventive medicine, and enables timely intervention in resource-limited environments. The framework supports increasing medical autonomy during deep-space missions where communication delays and the absence of medical evacuation limit conventional healthcare delivery. Challenges remain regarding sensor calibration in microgravity, biological sample handling, regulatory approval, cybersecurity, and long-term validation of AI-supported diagnostic systems. Future development should focus on closed-loop monitoring systems capable of integrating diagnostics, risk assessment, and clinical decision support into a single operational platform. Such innovations may improve mission safety while simultaneously advancing terrestrial applications in remote healthcare, telemedicine, and digital health technologies.

Keywords: Aerospace Medicine, Biosensors, Artificial Intelligence, Space Health, Autonomous Diagnostics

[Abstract:0107]

Sex and G-Tolerance Differences in Heart Rate Variability during Mild Exercise among Military Flight Cadets

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BACKGROUND: Mild exercise-induced cardiovascular responses have been proposed as potential physiological markers of G tolerance. Previous studies in male flight cadets demonstrated that individuals with superior relaxed G tolerance (RGT) exhibited lower walking-phase heart rate variability (HRV), as reflected by the standard deviation of normal-to-normal intervals (SDNN). However, whether this relationship is similarly observed in female cadets remains unclear, given known sex-related differences in autonomic and cardiovascular regulation. This study aimed to investigate sex differences in HRV responses during mild exercise and to examine their association with G tolerance among military flight cadets.

METHODS: Forty-five Air Force flight cadets (38 males and 7 females) were enrolled. Before high-G training, resting and walking-phase heart rate (HR) and SDNN were measured using the BioHarness 3.0 wearable monitoring system. RGT was subsequently assessed during a gradual-onset-rate centrifuge profile (0.1 G/s). Participants were categorized into high-G tolerance (HGT; RGT ≥ 5.5G) and low-G tolerance (LGT; RGT < 5.5G) groups. HR and SDNN parameters were compared according to sex and G-tolerance status.

RESULTS: The mean age of participants was 24.3±3.2 years. Male cadets were significantly taller, heavier, and had higher body mass index values than female cadets. Mean RGT was slightly lower in males than in females (4.9±0.9 G vs. 5.3±0.8 G). Ten cadets (7 males and 3 females) were classified as HGT. No significant differences in resting HR or resting SDNN were observed between sexes or G-tolerance groups. In contrast, walking-phase SDNN was significantly lower in HGT males than in LGT males (56.2±19.7 ms vs. 90.4±30.5 ms, p = 0.024). Female cadets also demonstrated higher walking-phase SDNN values than HGT males (76.9±17.1 ms vs. 56.2±19.7 ms), although this difference reached borderline non-statistical significance (p = 0.073).

CONCLUSIONS: Male cadets with superior G tolerance exhibited lower walking-phase SDNN values than both LGT males and female cadets. These findings support the potential utility of exercise-induced HRV as a marker of G tolerance and suggest possible sex-related differences in autonomic regulation before high-G exposure. Due to limited number of female participants, larger prospective studies should clarify sex-specific autonomic mechanisms and to determine whether males and females exhibit distinct physiological adaptations during different phases of high-G training.

Keywords: G tolerance, high-G training, heart rate variability, standard deviation of normal-to-normal intervals

[Abstract:0108]

Competence and Readiness of Physicians in Saudi Arabia in Managing In-Flight Medical Emergencies: A Systematic Review

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INTRODUCTION: As air travel in Saudi Arabia continues to grow rapidly, ensuring that physicians are prepared to manage in-flight medical emergencies (IMEs) is of increasing importance. Despite growing awareness within the Saudi healthcare system, evidence regarding physicians' competence and preparedness in this specific context remains limited. This review aims to assess physicians' competence encompassing knowledge, awareness, and clinical skills and readiness including confidence, preparedness, and willingness to assist in managing IMEs, as well as their attitudes, practices, and awareness of aviation physiology and onboard medical resources, and to identify key gaps and predictors of performance.

METHODS: A systematic search of PubMed, Scopus, Web of Science, and Google Scholar was conducted for studies published up to 15 May 2026. Cross-sectional studies involving licensed physicians in Saudi Arabia were included. Outcome measures included knowledge, attitudes, confidence, preparedness, and practices regarding IMEs. Risk of bias was assessed using the Joanna Briggs Institute (JBI) critical appraisal tool for cross-sectional studies. This systematic review was conducted in accordance with the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review followed predefined protocol registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number CRD420261328551, to ensure methodological rigor and transparency.

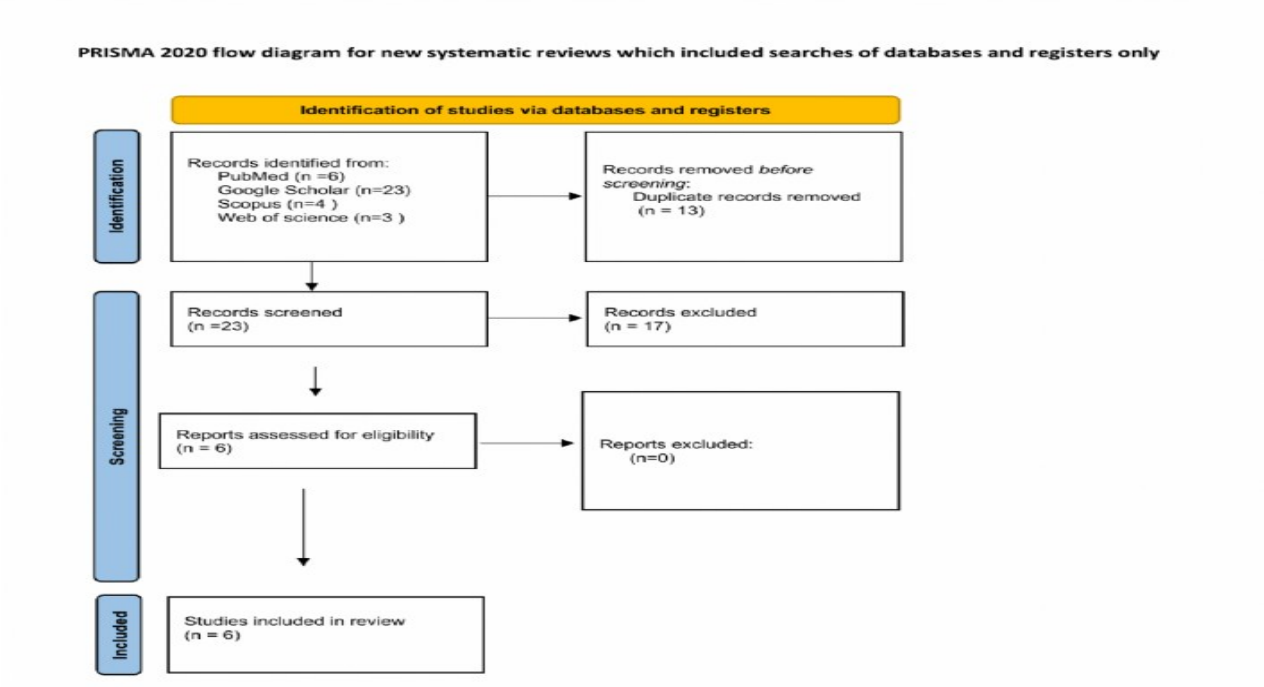
RESULTS: Six cross-sectional studies from different regions of Saudi Arabia were included. Approximately half of the study populations demonstrated adequate knowledge of aviation physiology, onboard equipment, and emergency protocols; however, considerable variability was observed across studies. Most physicians expressed a positive attitude toward volunteering during IMEs, yet many lacked confidence in their abilities due to the absence of targeted aviation medicine training, concerns about medicolegal liability, and general unfamiliarity with airline procedures. Physicians who had previously encountered an IME were more likely to have completed life-support training, to have traveled more frequently, and to have demonstrated higher competence and willingness to assist. Systemic barriers, including ambiguous legal frameworks and the lack of formal aviation medicine training, further hindered effective emergency response.

CONCLUSIONS:
Despite a high willingness to assist during IMEs, physicians in Saudi Arabia demonstrated significant gaps in knowledge, confidence, and preparedness. Implementing structured simulation-based training programs, strengthening relevant legal frameworks, and fostering interprofessional collaboration are recommended to address these deficiencies. The development of a nationally unified emergency response framework and the integration of aviation medicine training into medical education curricula are strongly recommended.

Keywords: Knowledge, Attitudes, Practices, Competence, Preparedness, in-flight emergencies.

Poster Presentations

Prisma Flowchart



Poster Presentations

Summary of the included studies

Table 1: The summary characteristics of the included studies.

Domain	AlShamlan et al. (2021) BMC Emerg Med	Alarifi & ALRowais (2023) Cureus	Khalil Hussien et al. (2024) Cureus	Almadhyan et al. (2025) WJEM	Hawati et al. (2025) Cureus	Almutairi & Sulaiman (2025) Cureus
Country / Region	Saudi Arabia – multi-region	Saudi Arabia – Riyadh	Saudi Arabia – multi-region	Saudi Arabia – 5 regions	Saudi Arabia – multi-region	Saudi Arabia – Qassim region
Study Design	Cross-sectional online survey	Cross-sectional survey	Cross-sectional online survey	Cross-sectional study	Cross-sectional web-based survey	Descriptive cross-sectional study
Study Period	January 2021	January 2023	Not specified	March – September 2024	June – October 2024	2024
Data Collection Tool	Self-administered online questionnaire; 11 Likert items; adapted from Katzer et al. & Ng et al.	Self-administered questionnaire; adapted from Katzer et al. & Ng et al.; pilot tested	Structured online questionnaire; 14 items; adapted from AlShamlan et al.; Cronbach α ≥ 0.70	Self-administered questionnaire; pre-validated (Ng et al.); Google Forms / Qualtrics	Comprehensive online survey (Google Forms); clinical scenarios + aviation physiology + Likert scale	Self-administered online questionnaire; developed from literature review; pilot tested on 20 participants
Sampling Method	Online link via SCFHS registered emails; no duplicate responses allowed	Online Google Form via SCFHS emails distributed to all FM residents across 8 programs	Stratified convenience sampling across regions and specialties via electronic medical communities	Randomised sampling from MOH & SCHS directories; online link (no duplicates)	Online survey distributed via email and face-to-face by data collectors	Simple random sampling of PHCCs; convenient non-probability sampling

Summary of the included studies 2

			ies			

Table 2: The baseline characteristics of the included studies.

Domain	AlShamlan et al. (2021) BMC Emerg Med	Alarifi & ALRowais (2023) Cureus	Khalil Hussien et al. (2024) Cureus	Almadhyan et al. (2025) WJEM	Hawati et al. (2025) Cureus	Almutairi & Sulaiman (2025) Cureus
Target Population	All physicians in KSA (all specialties)	Family medicine (FM) residents in Riyadh	Medical interns & postgraduate physicians in KSA	Licensed physicians across 5 regions of KSA	Emergency medicine, family medicine & ICU doctors in KSA hospitals	FM residents & primary healthcare (PHC) physicians in Qassim
Sample Size	n = 4,558	n = 189	n = 368	n = 359	n = 5,000	n = 155
Mean Age	54.6% aged < 30 years	Mean 27.25 years (SD 2.58)	42.4% aged 30–39 years	75.8% aged 25–34 years	Mean 45.23 years (SD 12.12)	Mean 29.85 years (SD 5.32)
Gender	Male 56.1%, Female 43.9%	Male 51.3%, Female 48.7%	Male 55.2%, Female 44.8%	Male 69.6%, Female 30.4%	Male 65.2%, Female 34.8%	Male 51.0%, Female 49.0%
Specialty / Professional Level	Medical interns 27.3%, residents 30.5%, specialists 15.9%, consultants 16.6%; all specialties included	FM residents only: PGY-1 27%, PGY-2 35.4%, PGY-3 37.6%	Medical interns 13.3%, residents 38.9%, GPs 26.1%, specialists 13.0%, consultants 8.7%	FM 16.7%, internal medicine 16.4%, EM 14.2%, paediatrics 9.7%; < 5 years practice 66.3%	EM 30.6%, FM 39.6%, ICU 29.8%; residents 10.7%, board certified 42.5%, consultants 26.4%	FM consultants 5.2%, FM specialists 35.5%, FM residents 44.5%, PHC physicians 14.8%

[Abstract:0115]

Overcoming the Noise Barrier: A Hybrid Acoustic Digital Stethoscope Ecosystem for Helicopter Emergency Medical Transport

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BACKGROUND: Ambient cabin noise frequently exceeding 90 dB and severe airframe vibration render standard stethoscopes unusable during helicopter emergency medical evacuation (MEDEVAC). While digital stethoscopes mitigate some interference, rotor noise still penetrates the chestpiece, overlapping the diagnostic range of heart and lung sounds. This study presents a compact acoustic insulation attachment that encapsulates an FDA-approved digital stethoscope (Eko Core 500), passive insulation (combining several layers of different acoustic materials to maximize passive attenuation while remaining lightweight and portable) with digital noise cancellation for high-noise aeromedical transport.

METHODS: We developed a multi-layered, easily attachable and detachable housing providing 360° acoustic sealing around the Eko Core 500 bell, with a soft silicone membrane for patient skin contact. The encapsulated stethoscope transmits cardiopulmonary sounds via Bluetooth to the Eko application (iOS/Android), which records and acts as a digital pass-through; a hardwired cable then relays live audio into the clinician's Active Noise Reduction (ANR) helicopter headset. A pilot study enrolled 10 adult volunteers under live HEMS flight conditions Heart and lung sounds were captured with the encapsulated device and, for comparison, with the bare device under identical conditions, with audibility rated on a 5-point Likert scale (1 = inaudible, 5 = clearly audible).

RESULTS: Median audibility rose from 2 to 5 for heart sounds and from 1 to 3 for lung sounds with the housing versus the bare device. The system layered three tiers of suppression: 360° passive reduction, digital active noise cancellation, and aviation-grade headset isolation. The wired app-to-headset relay delivered continuous audio without the Bluetooth-to-headset dropouts characteristic of rotary cabins. The silicone membrane maintained stable acoustic coupling, and rapid attachment and detachment did not disrupt flight staging or interfere with crew radio communications.

CONCLUSION: Pairing a modular 360° passive housing with digital active noise cancellation and a hardwired app-to-headset pass-through demonstrates the feasibility of in-flight auscultation without modifying aircraft avionics. This provides aeromedical crews with a rapid, recordable diagnostic aid for triage. A formal validation study is pending approval by the Portuguese National Institute of Medical Emergency (INEM).

LIMITATIONS: This pilot enrolled 10 healthy adults, capturing only normal sounds; performance on pathological findings remains unproven and is the validation study's central aim. Audibility was subjective and unblinded, introducing observer bias. Lung-sound capture remained limited, indicating low- and mid-frequency rotor noise is not fully overcome; nonetheless, the audibility achieved may suffice for binary judgements such as confirming bilateral lung insufflation after intubation.

Keywords: MEDEVAC, Prehospital Emergency Care, Noise Reduction, In-Flight Triage, Cardiopulmonary Assessment; Critical Care Transport

Photo

Poster Presentations



[Abstract:0122]

Cardiovascular risk stratification in civil aviation pilots: the role of coronary calcium score

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BACKGROUND. Cardiovascular disease (CVD) is the leading cause of flight disqualification among civil aviation pilots. In aviation medicine, cardiovascular risk (CVR) assessment serves not only to improve individual prognosis but also to prevent sudden incapacitation in flight due to CVD — a factor of critical importance for aviation safety. Despite the existence of regulatory frameworks in Russia, the USA, and Europe, risk stratification tools applicable to younger pilots (aged 40–50) remain limited, necessitating the use of additional non-invasive markers.
DESCRIPTION. A review of Russian (Order No. 437), international (ICAO), American (FAA), and European (EASA, CAA) regulatory documents was conducted, alongside a review of scientific publications on CVR assessment in civil aviation pilots. Current risk stratification scales include SCORE (Russia, pilots over 40), SCORE 2/SCORE OP (Europe), and the Reynolds Risk Score (USA). High and very high risk levels require additional cardiological evaluation and pharmacological prevention. However, these scales demonstrate limited discriminative value in pilots aged 40–50, where calculated CVR rarely exceeds moderate even in the presence of significant risk factors. Emerging non-invasive markers include high-sensitivity C-reactive protein (hsCRP > 3 mg/L) and lipoprotein(a) (Lp(a) > 50 mg/dL). The strongest predictor of cardiovascular events is the Coronary Calcium Score (CCS) — a quantitative assessment of coronary artery calcification using the Agatston scale, incorporated into the MESA (Multi-Ethnic Study of Atherosclerosis) calculator for precise risk quantification. CCS correlates linearly with CVR: 0 units — very low risk; 1–10 — moderate (primary prevention indicated); 11–100 — high (lipid-lowering therapy advisable); 101–400 — high to very high (stress echocardiography, myocardial scintigraphy, or CT coronary angiography additionally required); >400 — very high (selective coronary angiography may be warranted even with negative ischemia testing).
DISCUSSION. CVR assessment in civil aviation pilots requires a specialized approach that goes beyond conventional risk scales. Active implementation of CCS measurement is particularly essential in pilots under 50 years of age, where standard algorithms have limited informative value. CCS enables timely detection of subclinical atherosclerosis, objective risk stratification, and early initiation of preventive strategies — including non-pharmacological interventions and pharmacological treatment with statins and ezetimibe — thereby directly contributing to flight safety and the professional longevity of pilots. Wider integration of CCS into aviation medical examination protocols warrants consideration at both national and international regulatory levels.

Keywords: coronary calcium score, cardiovascular risk, civil aviation pilots, risk stratification, aviation Medicine

[Abstract:0124]

Effects of a Physical Therapy Program on Surface Electromyographic Activity of Erector Spinal Muscles in an Air Force Patient with Non-Specific Low Back Pain: A Case Report

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BACKGROUND: Non-specific low back pain (NSLBP) is a prevalent condition that can impair neuromuscular function and operational readiness in military personnel. In Air Force personnel, biomechanical stress resulting from prolonged sitting, vibration, or heavy lifting during duty represents a frequent trigger. Building upon a previous methodology validated in an athletic case report (Marsocci et al. 2025), this study aimed to evaluate the impact of a tailored physiotherapy intervention on pain levels, neuromuscular control assessed through surface electromyography (sEMG), and occupational performance in an Air Force military member with NSLBP.
Case Presentation: A 30-year-old male Air Force service member reported NSLBP following heavy lifting and postural strain during operational training. Following the framework of the reference case study, the physiotherapy intervention included education, manual therapy, therapeutic exercises, and motor control training, progressing to the gradual reintroduction of previously painful occupational movements.
RESULTS: Patient-reported outcome measures (PROMs) demonstrated significant improvements, mirroring the athletic data from the reference study: the Örebro Musculoskeletal Pain Questionnaire (OMPQ) score decreased from 74 to 47, the SF-36 Physical Functioning (PF) score increased from 68 to 85. Pain levels, measured by the Numeric Pain Rating Scale (NPRS), decreased from 8/10 to 3/10. Furthermore, sEMG analysis revealed an improved flexion relaxation ratio (FRR), indicating enhanced neuromuscular control, particularly in the eccentric activity of the spinal erectors.
CONCLUSION: This case highlights the importance of tailored physiotherapy interventions for Air Force personnel with NSLBP. Adapting objective sEMG measures and PROMs from sports physiotherapy to a military setting provides valuable insights, emphasizing the relevance of addressing neuromuscular deficits to restore operational performance and prevent recurrence.

Keywords: surface electromyography, non-specific low back pain, military physiotherapy, air force, military pilot.

[Abstract:0125]

Accidental Ground Exposure to Electromagnetic Chaff in Four Military Personnel: Risk Assessment and Medical Management

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BACKGROUND: Electromagnetic chaff is composed of aluminized continuous glass fibers released by military aircraft as radar countermeasures. Although extensively used operationally, human data regarding accidental occupational exposure remain scarce, often leading to uncertainty and unnecessary concern among exposed personnel.

METHODS: We report an accidental exposure involving four military ground personnel following the landing of a Mirage 2000-5 aircraft after in-flight chaff deployment. A launcher hatch remained partially open, resulting in environmental contamination during post-flight operations. Exposure occurred outdoors in a non-confined environment for approximately 30 minutes at an estimated distance of 10 meters, with brief close-range exposure (<1 minute at approximately 1 meter). All individuals underwent immediate clinical assessment including targeted history, physical examination and spirometry.

RESULTS: None of the exposed personnel developed respiratory, ocular or cutaneous symptoms. Physical examination and spirometry were normal in all cases. Risk assessment incorporated exposure characteristics together with the physicochemical properties of the fibers. Continuous glass filaments used in modern chaff typically measure ≥20–40 µm in diameter, making alveolar deposition highly unlikely. Current toxicological and regulatory data classify these fibers as not classifiable regarding carcinogenicity in humans (IARC Group 3) and indicate mainly transient mechanical irritation rather than systemic toxicity. Consequently, no systematic imaging or additional investigations were considered necessary.

CONCLUSION: In this case, brief outdoor accidental exposure to electromagnetic chaff was not associated with acute clinical effects. Medical management should rely on exposure assessment, simple decontamination, targeted clinical evaluation and symptom-based follow-up rather than systematic complementary investigations. Improved education of military personnel regarding the actual health risks of modern aluminized glass-fiber chaff may reduce unnecessary anxiety while maintaining appropriate occupational safety measures. This report contributes rare clinical data to guide aerospace and military physicians confronted with similar incidents.

Keywords: Electromagnetic chaff, Occupational exposure, Glass fibers, Aerospace medicine, Military Medicine

[Abstract:0128]

Study on color perception under hypobaric hypoxia conditions at high altitude

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The purpose of this study is to present the findings of the high-altitude research, conducted by the Italian Air Force during the ARTEMIS 4554 scientific mission on Monte Rosa.
Visual color perception is a complex process, starting from retinal photoreceptors up to cortical signal processing. This system, like all neurological ones, is highly sensitive to the reduction of the oxygen partial pressure.
The participants underwent psychophysical fitness evaluation for suborbital flight according to the protocols defined by the Italian Air Force. They were also tested using Ishihara pseudoisochromatic plates and the Farnsworth-Munsell 100 Hue test under standardized lighting at three different altitudes: 0 m ASL during the pre-mission phase (T0), 3,647 m ASL (T1), and 4,554 m ASL (T2).
All personnel were evaluated at T0 and T1, consisting of 27 subjects (24 males, 3 females); of these, only 10 (9 males, 1 female) were also tested at T2. Age range was 32–70 years, with a mean of 48.7 and a standard deviation of 8.44.
At altitude T0, no patient made any errors. At T1, the plate errors were: VII (8 errors), IX (5 errors), XII (18 errors), XVII (10 errors), for a total of 41 errors. At T2, only 2 errors were reported on plate XVII.
The high number of errors at T1 could be explained by the hypoxic effect at 3,647 m ASL, whereas the lower error rate from T1 to T2 might correspond to an adaptation phase to the reduced oxygen partial pressure.
For the Farnsworth test, three parameters were analyzed: Total Error Score (TES), C-Index (Confusion Index), and S-Index (Selectivity Index).
The mean TES value showed an increase of approximately 20 points during the ascent from T0 to T1, remaining substantially stable from T1 to T2.
The C-Index (normal range 1-1,78) showed low values, between 1.3 and 1.35, indicating a mild, generalized deficit across all altitudes.
The S-Index (normal range 1,09-1,38) revealed values, between 1.25 and 1.4, signifying the absence of a specific axis of deficit.
Hypobaric hypoxia can reduce visual color perception, which worsens at an altitude of 3,647 m ASL and tends to stabilize at 4,554 m ASL, supporting the concept of the activation of high-altitude acclimatization mechanisms. The deficit is generalized rather than related to a specific color axis, indicating a partial and random reduction in the perception system.

Keywords: Color perception, Hypobaric hypoxia, High altitude, Acclimatization, Italian Air Force

Poster Presentations

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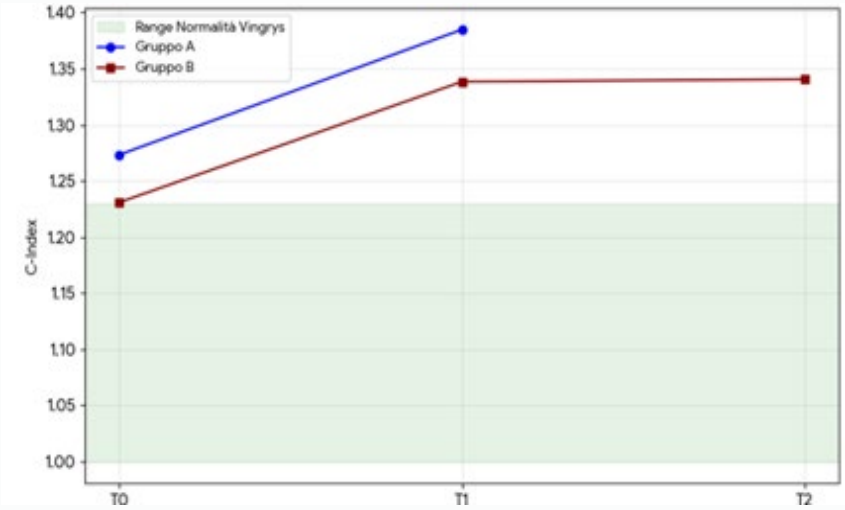

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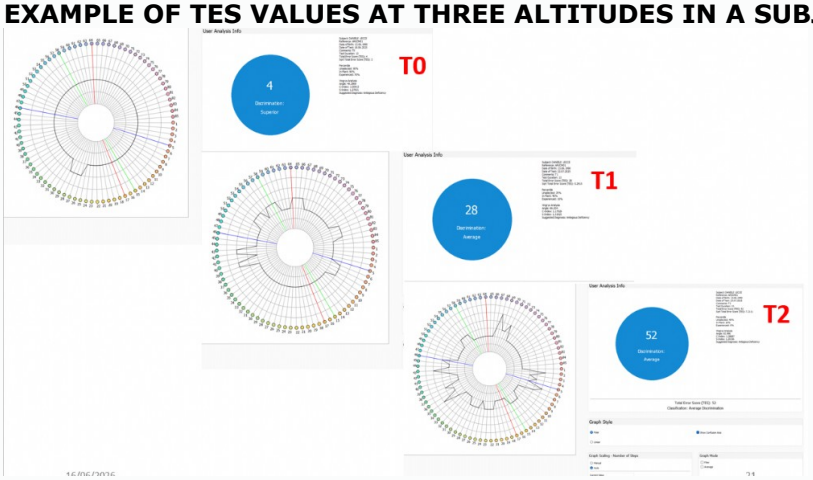

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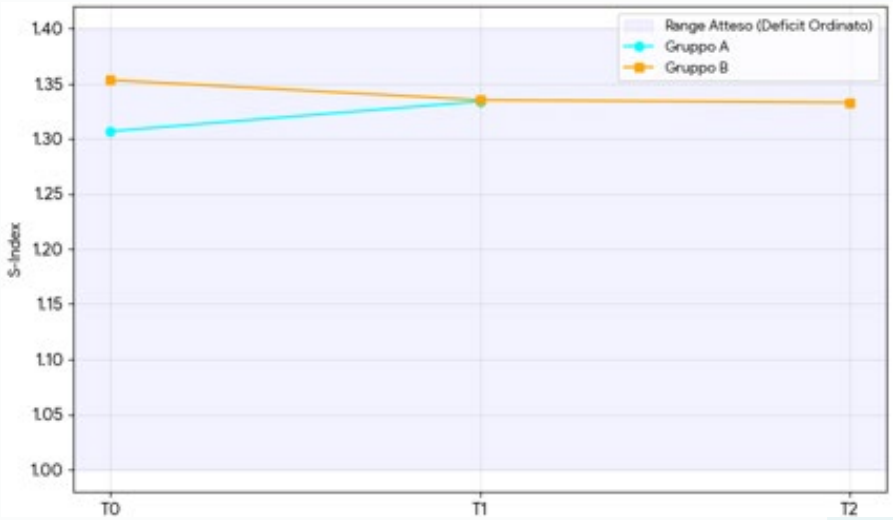

[Abstract:0130]

Cervical Muscle Activation and Vestibular Function in Italian Air Force Aircrew with Non-Specific Neck Pain

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BACKGROUND: Military aircrew are exposed to severe accelerative and biomechanical cervical stressors that lead to a high prevalence of non-specific neck pain. Building upon our previous exploratory work on the cervico-vestibular network, this study investigates the interaction between the vestibulo-collic reflex (VCR) and phase-specific cervical motor control through an interdisciplinary otoneurological and rehabilitative framework.
OBJECTIVES: To evaluate the statistical correlation between VCR integrity, muscle activation parameters expressed as Root Mean Square (RMS) across four distinct phases of head movement, and clinical indices of pain and disability in Italian Air Force aircrew with neck pain.
METHODS: 20 aircrew members from the Italian Air Force with clinically diagnosed non-specific neck pain underwent a sequential diagnostic protocol. Initially, otorhinolaryngology specialists quantified clinical status using the Numeric Pain Rating Scale (NPRS) and the Neck Disability Index (NDI), and recorded cervical Vestibular Evoked Myogenic Potentials (cVEMPs) from the sternocleidomastoid (SCM) muscle to analyze peak-to-peak amplitude and the interaural asymmetry ratio. Subsequently, physiotherapists conducted a kinematic and surface electromyography (sEMG) assessment of the SCM and upper trapezius muscles during a complete head flexion-extension cycle. The motor cycle was fractionated into four distinct phases: 1) flexion, 2) return to upright posture, 3) extension, and 4) return to upright posture, extracting a single RMS value for each phase.
RESULTS: Aircrew members with higher clinical disability (elevated NDI) demonstrated a significant cVEMPs interaural asymmetry (>30\%) and baseline hypertonia. Correlation analysis revealed that lower cVEMPs amplitude (reflecting VCR deficit) significantly correlated with increased, inefficient sEMG RMS values. This compensatory muscle hyperactivation was selectively localized during the return to upright posture phases following both flexion (Phase 2) and extension (Phase 4), demonstrating a strong negative correlation ($r = -0.62$; $p < 0.01$).
CONCLUSIONS: Neck pain in military aircrew is driven by a sensorimotor mismatch. A vestibular reflex deficit compromises automatic head stabilization, forcing the central nervous system to overload the SCM and upper trapezius muscles during postural repositioning phases. This integrated cVEMPs-sEMG protocol offers an objective gold standard for screening and targeted rehabilitation in aviation medicine.

Keywords: cervical muscle, non-specific neck pain, surface electromyography

[Abstract:0136]

Operational Countermeasures for Microgravity-Induced Gut Dysbiosis and Host Metabolic Shifts

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BACKGROUND:
It has been observed that when humans undergo long-duration spaceflight, the combination of environmental stressors results in the disruption of their systemic homeostasis. Available data from the International Space Station and ground based analogs - specifically the 14-day and 60-day Head Down Bed Rest (HDBR) models, show that prolonged gravitational unloading causes a state of gut dysbiosis. This microbial destabilization in turn results in altered host metabolic pathways, immune deconditioning, and heightened vulnerability to opportunistic pathogens, posing a threat to the health of future astronauts in inter-planetary missions.

DESCRIPTION:
This study synthesizes genomic and metagenomic data to map out a biological diversity signature in the gut exposed to microgravity. Re Metagenomic profiling shows dramatic down-regulations of key homeostatic phyla, including the immunomodulatory genus *Lactobacillus* and the anti-inflammatory short-chain fatty acid (SCFA) producer *Faecalibacterium prausnitzii*. We also observe considerable structural variability of *Bacteroides*. At the same time, there are sharp spikes in microbial antibiotic resistance (eg, *tetQ* encoding tetracycline resistance and the *evgS* regulatory system) alongside virulence factors such as VF0044 which relate to lipopolysaccharide phase variation. These shifts and variations break down intestinal barrier integrity, evident from the host's plasma and urine metabolite profiles.

DISCUSSION:
To address these microgravity-induced gut microbial alterations, a highly structured operational framework/protocol is needed demanding rigorous implementation. Prophylactic countermeasure protocols must evolve past broad dietary interventions into targeted biotherapeutic regimens. We suggest incorporating precision postbiotics and personalized pre-flight screening to handle the massive variance seen between the individuals in orbital environments. Administering targeted, strain-specific *Lactobacillus* probiotics alongside specialized prebiotic fiber matrices designed to feed *Faecalibacterium prausnitzii* metabolism can preserve SCFA production, stabilize host metabolic pathways, and reinforce mucosal immunity. Mitigating this specific dysbiosis is an essential medical countermeasure to protect astronaut health and sustain human performance during extended exploratory spaceflight.

Keywords: Microgravity, Gut microbiome, Dysbiosis, Spaceflight, Probiotics, Prebiotics

[Abstract:0151]

Microgravity and venous thrombosis in astronauts: a systematic review

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Human spaceflight exposes astronauts to weightlessness,headward fluid shift,and constrained medical resources.Over the past several years, venous thrombosis has emerged as a clinically relevant concern after the incidental detection of internal jugular vein (IJV) thrombosis during an ISS mission and the subsequent finding of abnormal venous flow patterns in astronauts under microgravity conditions.The pathophysiological rationale is grounded in Virchow's triad,especially venous stasis.In microgravity,the IJV may enlarge, flow may become stagnant or retrograde, and shear stress may decrease,creating a plausible substrate for thrombosis.Although several reviews have discussed the topic,the underlying human evidence base remains small and consists mainly of one prospective cohort, surveillance data,and case-based reports.This work was designed as a systematic review of the astronaut-specific evidence on microgravity and venous thrombosis.The review question was framed according to the PICOS framework, and the reporting structure was aligned with PRISMA principles.Original studies involving astronauts or cosmonauts were included if they provided data from the preflight, inflight, or postflight phases and reported at least one of the following outcomes: clinically documented venous thrombosis,IJV thrombosis, venous stasis,retrograde flow,reduced flow velocity, spontaneous echo contrast, or hemostatic biomarkers.Technical reports and narrative reviews were used exclusively to provide background context and for citation chaining,not as primary sources of evidence.The available evidence indicates that spaceflight is associated with clinically relevant venous flow abnormalities and,in rare cases,thrombosis.In a prospective ISS cohort, astronauts exhibited IJV dilation,flow stasis or reversal and one confirmed case of occlusive thrombosis.A subsequent NASA surveillance study showed significant reductions in peak IJV flow velocity during flight accompanied by frequent stagnant or retrograde flow and spontaneous echo contrast.Overall,venous thrombosis in space appears to be a rare but plausible event,and the evidence remains limited to small,highly selected astronaut cohorts.The available evidence supports a biologically plausible association between microgravity and thrombotic risk,primarily driven by venous stasis and flow abnormalities.Although overt venous thrombosis appears rare,recurrent findings of internal jugular vein distension, stagnant or retrograde flow,and spontaneous echo contrast suggest that spaceflight may promote a prothrombotic milieu.Current data remain limited by small sample sizes, heterogeneous endpoints, and the absence of robust clinical event rates,underscoring the need for continued surveillance and operational countermeasures.Microgravity appears to create a venous environment in astronauts that promotes stasis and clinically significant thrombosis.The available evidence is sufficient to support a systematic review, but remains inadequate for a robust quantitative meta-analysis.Future studies should standardize ultrasound endpoints,expand monitored astronaut cohorts, and clarify which individual risk factors warrant personalized prevention strategies.

Keywords: Microgravity,venous thrombosis,astronauts,systematic review

[Abstract:0155]

Pilot Mental Health Monitoring Program in Commercial Aviation: Process Description

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BACKGROUND: Mental health disorders among airline pilots may adversely affect not only quality of life but also professional performance and operational safety. In civil aviation, return to flight following mental health-related medical leave requires a structured, confidential, and multidisciplinary approach consistent with the Brazilian Civil Aviation Regulation (RBAC 67) and ICAO Doc 8984. To address this need, Azul Linhas Aéreas developed a Pilot Mental Health Monitoring Program designed to encourage early help-seeking, support pilots throughout treatment and recovery, facilitate a safe return to flight duties, reduce the risk of relapse, and enhance operational safety.

DESCRIPTION: The program includes multiple referral pathways, including a 24-hour psychosocial support hotline, referrals from Occupational Health, Flight Operations, Training and Simulator departments, the Safety Management System (SMS), the Pilot Peer Support Program (PPSP), and voluntary self-referral. Following the initial identification of a mental health concern, the pilot is temporarily removed from flight duties and scheduled for evaluation by a psychiatrist experienced in aviation medicine. The assessment includes a comprehensive review of psychiatric and medical history, fatigue, sleep quality, lifestyle factors, occupational and personal stressors, substance use, and validated screening instruments for depression and anxiety. Based on the clinical evaluation, recommendations are made regarding medical leave and referral for psychiatric and/or psychological treatment with healthcare professionals independently chosen by the pilot. After completion of treatment and medical clearance from the treating physician, the pilot undergoes a reassessment by the airline psychiatrist. If considered clinically fit, the pilot is referred for aeromedical certification in accordance with RBAC 67 requirements. Following aeromedical clearance and return to flight duties, follow-up evaluations are conducted after one month, every three months during the first year, and every four months thereafter. Monitoring continues for six months after clinical discharge and discontinuation of psychotropic medication. Pilots managed without medication are reassessed after one, three, and six months and may then be discharged from the monitoring program. Medical confidentiality is maintained throughout all stages, and a structured scheduling and tracking process ensures continuity of care and adherence to follow-up.

DISCUSSION: By standardizing referral pathways, clinical assessment, return-to-flight criteria, and follow-up intervals, this program aims to reduce barriers to seeking mental health care, promote early identification of relapse, and support the safe reintegration of pilots into operational duties. This experience provides a practical framework that may assist other air operators in developing standardized mental health monitoring and return-to-flight programs for flight crew.

Keywords: Mental Health, airline pilots, civil aviation

[Abstract:0158]

Relationship Between Exercise Performance, Spirometric Respiratory Parameters, and TUC in Pilot Candidates: An Observational Study

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INTRODUCTION: This study was planned to investigate whether there is a relationship between sports performance components measured by the Wingate Test (WT) and cardiopulmonary exercise (CPE) testing, with periodic examination spirometric parameters and the time of useful consciousness (TUC) measured during low-pressure hypoxia training, in pilot candidates with different physical fitness levels.
METHODS: A total of 24 healthy young male pilot candidates (23.75 ± 0.98 years) participated in the study. After standart spirometric pulmonary function testing was performed in all participants, Wingate power performance and treadmill cardiopulmonary exercise tests were conducted. One day later, TUC duration (seconds) was measured during low-pressure chamber training at an altitude of 25,000 feet. Statistical analyses were performed using SPSS software. Correlation relationships were calculated using linear regression analysis.
RESULTS: A significant positive correlation was found between spirometric and WT power parameters; among WT variables, peak power (PP) and mean power (MP) were significantly positively correlated with forced vital capacity (FVC) ($r = 0.563$, $p = 0.004$ and $r=0.491$, $p=0.015$ respectively) and anaerobik treshold (AT) ($r=0.447$, $p=0.029$). A significant positive correlation was also found between spirometric and CPE parameters; exercise capacity (mL/min/kg) was positively correlated with maximal voluntary ventilation (MVV) ($r = 0.468$, $p = 0.021$). No significant correlation was found between TUC durations and exercise capacity or spirometry.
CONCLUSIONS: FVC may be associated with anaerobic performance, as individuals with higher anaerobic capacity may be expected to have greater forced vital capacity. In addition, the correlation between exercise capacity and MVV suggests that MVV, as a parameter evaluating the respiratory system as a whole, may also be an important indicator in assessing an individual's exercise capacity. Exercise capacity or spirometric parameters are not seem to be an indicator of TUC.

Keywords: Pilot candidates; Wingate test, cardiopulmonary exercise test; spirometry; forced vital capacity; maximal voluntary ventilation; time of useful consciousness, TUC

CORRELATIONS OF PARAMETRS

	FORCED VITAL CAPACITY (FVC)	ANAEROBIC TRESHOLD (AT)	MEAN VOLUNTARY VOLUME (MVV)	TIME OF USEFUL CONSCIOUSNESS (TUC)
PEAK POWER (PP)	+	+	n/s	n/s
MEAN POWER (MP)	+	+	n/s	n/s
EXERCISE CAPACITY(EC)	n/s	n/s	+	n/s

+: positive correlation n/s: not significant

[Abstract:0159]

A New Field in Space Medicine: The Conceptual Need for Space Physical Therapy and Rehabilitation

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The increasing duration of crewed space missions demonstrates that changes caused by microgravity profoundly affect not only the musculoskeletal system but also locomotor biomechanics, neuromuscular control, and sensorimotor adaptation. Although the countermeasures currently in use make significant contributions to reducing physiological losses, a common conceptual framework for the movement-focused assessment of space adaptations, the maintenance of functional performance, and the clinical management of rehabilitation processes has not yet been clearly defined. This situation creates a significant conceptual gap in the management of musculoskeletal, neuromuscular, and neurovestibular changes through a holistic rehabilitation approach.

This study aims to address this gap from an interdisciplinary perspective by establishing the theoretical foundation of the concepts of Space Physical Therapy and Space Rehabilitation and defining the potential scope of this field within space medicine. In this context, Space Physical Therapy is defined as a movement-focused clinical specialty encompassing movement analysis, functional assessment, neuromuscular and vestibular rehabilitation, as well as pre-mission preparation, in-mission movement support, and post-mission functional recovery. In contrast, Space Rehabilitation is proposed as a conceptual model that addresses these processes within a continuum of holistic care and intervention, systematically integrating the rehabilitation process from pre-mission to post-mission.

This conceptual approach aims not only to establish a common academic language for movement-focused health management in long-duration crewed space missions but also to provide a theoretical foundation for future clinical protocols, training programs, and interdisciplinary research. Furthermore, it is believed that the knowledge gained from space missions could contribute to the rehabilitation of individuals on Earth who experience immobilization, neurological diseases, and prolonged inactivity.

Keywords: Space Medicine, Space Physiotherapy, Space Rehabilitation

[Abstract:0160]

The Role of Flight Instructors in Student Pilot Mental Health Support: A Process Review

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BACKGROUND: The international aviation community has increasingly promoted the "pilots helping pilots" peer support concept in recent years. The Civil Aviation Administration of China (CAAC), in its 2025 "Measures for the Management of Mental Health Work for Flight Students," also encourages flight instructors to participate in student mental health services. However, in current flight school practice, mental health work is typically undertaken by aviation medical officers and student administrators, while flight instructors—who have the closest and most frequent contact with students—remain marginalized. Flight instructors possess unique and irreplaceable advantages in the early identification of maladaptive signs and the alleviation of career-related distress among student pilots.
DESCRIPTION: This paper reviews the practical process of flight instructor involvement in mental health support implemented at a general aviation flight school in China (with an annual training capacity of approximately 300 students). The selection process for the program prioritizes three criteria: recognition of and commitment to psychological work, frequency of daily contact with students, and the instructor's own mental health status, without emphasis on technical qualifications. The training process is structured in two phases. The first phase focuses on foundational psychological knowledge and mindset development through a blended online-offline approach. During this period, flight instructors do not directly engage in student mental health work but accumulate experience through observation and discussion, while also contributing to the refinement of the school's psychological assessment and counseling protocols. The second phase emphasizes practical skill enhancement, during which instructors, under the supervision of professional psychologists, conduct supportive counseling sessions with students. Over two years, this process has cultivated ten flight instructors capable of conducting initial psychological counseling, and has established a collaborative mechanism centered on flight instructors.
DISCUSSION: This process has achieved initial success in breaking down departmental barriers and leveraging instructors' front-line role in early identification. However, three challenges remain: the role boundaries of flight instructors need further clarification to prevent ethical risks; the systematic nature of specialized psychological training for instructors requires strengthening; and the tendency of students to avoid seeking help due to stigmatization must be addressed through ongoing cultural development. This process may serve as a reference for similar flight schools in constructing an integrated "training & psychological support" system.

Keywords: Pilot Training, Peer Support, MENTAL HEALTH

[Abstract:0167]

Participatory Ergonomics for Preventing Musculoskeletal Disorders in Flight Attendants

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BACKGROUND: Musculoskeletal disorders (MSDs) are among the most common occupational health problems affecting flight attendants due to repetitive manual handling, awkward postures, and physically demanding in-flight tasks. Despite the high burden of MSDs, evidence on effective workplace interventions for aviation personnel remains limited. This study evaluated the effectiveness of a participatory ergonomics programme in reducing MSDs among flight attendants.

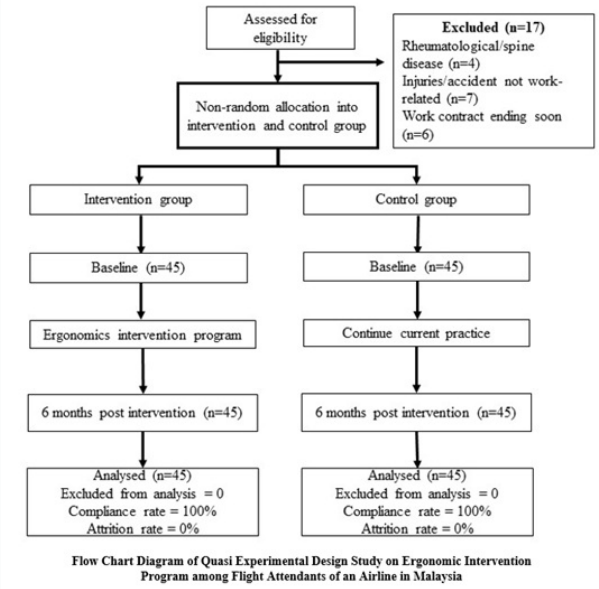
METHODS: A quasi-experimental pre-post study with a control group was conducted among 90 Malaysian flight attendants. Participants were assigned into two equal-sized groups (n=45 each), with one group receiving a participatory ergonomics programme and the other serving as the control. The participatory ergonomics programme was developed collaboratively with an ergonomics committee comprising management, occupational health professionals, flight attendant representatives, and ergonomics specialists. The intervention included ergonomics education, body mechanics training, manual handling techniques, educational materials, and six months of reinforcement through workplace reminders and online resources. Primary outcome was MSD prevalence, while secondary outcomes included perceived physical demands and psychosocial work factors using validated instruments. Generalized Estimating Equations were used to evaluate intervention effects after adjustment for relevant covariates.

RESULTS: All participants completed the six-month follow-up. Six months after the intervention, the participatory ergonomics programme significantly increased the odds of remaining free from MSDs compared with the control group (adjusted OR 6.45, 95% CI 2.13–9.76; p=0.005). Significant improvements were also observed in perceived physical demands during aircraft door operation and cabin baggage handling, as well as workplace predictability (all $p<0.05$).

CONCLUSIONS: Participatory ergonomics significantly reduced MSDs and improved selected physical and psychosocial work outcomes among flight attendants. These findings demonstrate the potential of participatory ergonomics as a practical, sustainable workplace strategy for preventing MSDs in the aviation industry and support its wider implementation to improve occupational health among aviation personnel.

Keywords: Flight attendants, Musculoskeletal disorders, Participatory ergonomics, Occupational health, Aviation medicine, Workplace intervention

Flow Chart Diagram of Quasi Experimental Design Study



Flow Chart Diagram of Quasi Experimental Design Study on Ergonomic Intervention Program among Flight Attendants of an Airline in Malaysia

A total of 107 flight attendants were screened for eligibility, of whom 17 were excluded for not meeting the inclusion criteria. The remaining 90 participants provided informed consent and were equally allocated into two study groups (n=45 each). All participants completed the six-month follow-up and were included in the final analysis, resulting in a 100% retention rate.

Proportion of 'No MSDs' Among Respondents between Intervention and Control Groups at Baseline and 6-month Post Intervention

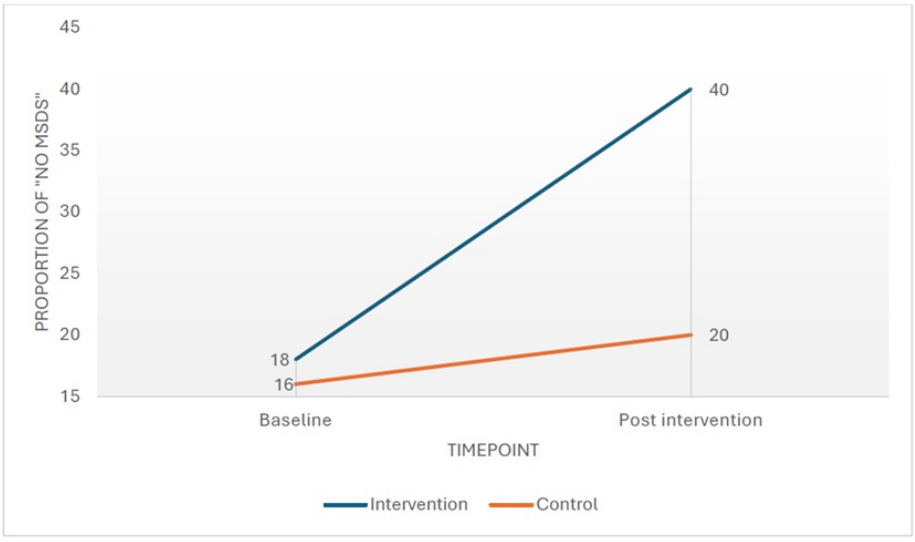


Figure 1. Proportion of 'No MSDs' Among Respondents between Intervention and Control Groups at Baseline and 6-month Post Intervention

The intervention group demonstrated a substantial increase in the number of participants without musculoskeletal disorders (No MSDs), rising from 18 at baseline to 40 at six months post-intervention. In contrast, the control group showed only a slight increase, from 16 to 20 participants over the same period.

[Abstract:0171]

HIF-1α/HMOX1 Axis Mediates Ferroptotic Air–Blood Barrier Injury in Hypobaric Hypoxia-Induced High-Altitude Pulmonary Edema

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BACKGROUND: Aviation and aerospace medicine confronts persistent physiological challenges from hypobaric hypoxia (HH) during high-altitude flight, cabin decompression events, and extended operations at elevated altitudes, placing pilots, aircrew, and astronauts at risk of high-altitude pulmonary edema (HAPE). Despite its operational significance, the dominant mode of cell death driving alveolar–capillary barrier disruption remains incompletely defined. This study investigates whether ferroptosis of alveolar epithelial cells (AECs) and pulmonary microvascular endothelial cells (PMVECs), driven by a HIF-1α/HMOX1 axis, underlies HH-induced lung injury.
METHODS: Transcriptomic datasets from hypoxia-exposed murine lungs (GEO) were intersected with the FerrDb ferroptosis driver database, complemented by KEGG/GO enrichment and single-cell RNA-seq deconvolution. C57BL/6 mice were exposed to simulated 5000 m HH for 3 days, with or without intraperitoneal ferrostatin-1 (Fer-1) or intratracheal AAV-mediated HMOX1 knockdown. MLE-12 and HPMEC cells were cultured under 1% O_2 with inhibitors of ferroptosis (Fer-1), apoptosis (Z-VAD-FMK), and necroptosis (Nec-1). A Transwell air–blood barrier model assessed TEER and FITC-dextran permeability. Mechanistic dissection used siRNA silencing, FG-4592-induced HIF-1α stabilization, ChIP-qPCR, and dual-luciferase reporter assays.
RESULTS: Bioinformatics identified ferroptosis as a top enriched pathway under hypoxia, with HMOX1 upregulated in AECs and PMVECs. HH induced pulmonary edema (elevated W/D ratio), alveolar septal thickening, and hemorrhage, with ferroptotic hallmarks: shrunken mitochondria on TEM, iron deposition, elevated MDA and 4-HNE, upregulated HIF-1α/HMOX1/ACSL4, and suppressed GPX4/SLC7A11. Fer-1 attenuated injury, reduced Evans Blue and BALF protein leakage, and restored redox balance. In vitro, Fer-1 rescued hypoxia-induced viability loss, lipid ROS accumulation, labile iron overload, TEER decline, and paracellular leakage. HIF-1α silencing abolished HMOX1 induction and ferroptosis, whereas FG-4592 recapitulated the phenotype under normoxia in a Fer-1-reversible manner.
CONCLUSION: Hypobaric hypoxia drives HAPE through HIF-1α-mediated transcriptional activation of HMOX1, precipitating labile iron overload, lipid peroxidation, and ferroptosis in alveolar epithelial and pulmonary microvascular endothelial cells, culminating in air–blood barrier disruption. These findings carry direct implications for aviation and aerospace medicine, offering a mechanistic framework and pharmacological countermeasure to protect aircrew, high-altitude pilots, and astronauts from hypoxia-related pulmonary injury during flight operations, sudden cabin depressurization, and prolonged space missions. Targeting the HIF-1α/HMOX1 axis represents a promising aeromedical strategy for preventing high-altitude pulmonary injury.

Keywords: hypobaric hypoxia, high-altitude pulmonary edema, ferroptosis, HIF-1α, HMOX1

[Abstract:0178]

Design and Implementation of a Structured Well-Being Program for Cockpit and Cabin Crew: The Dakka Route as a Pilot Application

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Crew are exposed to a range of occupational health challenges, including circadian rhythm disruption, irregular nutritional patterns, chronic dehydration, and insufficient recovery opportunities. These factors are particularly pronounced in long-haul and multi-sector operations, where flight schedules intersect with multiple time zones and extended duty periods. Despite a growing body of literature documenting the health burden associated with aviation work, structured, operationally integrated well-being programs that provide actionable guidance remain scarce in airline settings.There is a recognized gap between scientific recommendations and practical implementation tools accessible to crew members during active operations.

A route-specific well-being framework was developed for crew as part of a broader organizational well-being initiative. The framework integrates evidence-based principles from nutrition, sleep, and behavioral health into a practical,step-by-step guidance system. The design process involved three sequential phases: (1) operational analysis —mapping route-specific parameters including flight duration, departure and arrival times, layover conditions, and time zone transitions; (2) content development —translating scientific evidence into actionable recommendations across pre-flight, in-flight, and post-flight; and (3) material design —producing user-friendly tools, including checklists, meal timing guides, hydration protocols, and sleep preparation strategies, formatted for real-world operational use.

The Dakka route was selected as the initial implementation case to develop and refine the framework, given its distinct operational characteristics —including a significant time zone difference, nocturnal outbound flight, and limited layover duration —which collectively represent a relevant example of the challenges common to long-haul aviation operations. The resulting guide covers nutrition planning, hydration management, sleep preparation, in-flight movement, and post-flight recovery, incorporating both general evidence-based recommendations and destination-specific contextual information.

This project demonstrates that well-being support in aviation can be made more effective when scientific knowledge is translated into structured, operationally integrated tools rather than delivered as general health messaging. By addressing nutrition, hydration, and rest within a unified, route-specific framework, the program offers a practical model that accommodates real operational constraints while supporting informed decision-making by crew members throughout the flight cycle. The phased design methodology —from operational analysis to material development —provides a replicable process applicable to other operational contexts. The Dakka implementation serves as a proof of concept for the feasibility of tailored well-being programs within airline operations. Future steps will focus on assessing crew engagement and behavioral outcomes, and on expanding the framework to additional destinations. This initiative also reflects a broader organizational commitment to transitioning well-being from an individual responsibility to a systematically supported institutional practice.

Keywords: Well-being, Nutrition, Sleep Hygiene, Flight Crew, Long-Haul Operations, Program Development

[Abstract:0179]

Space Anemia in Long-Duration Spaceflight: A Review of Hemolysis and Hemoglobin Dynamics

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Space anemia is a recurrent hematologic finding in astronauts exposed to prolonged microgravity and becomes more evident with increasing mission duration. Recent evidence indicates that long-duration spaceflight is associated with decreased hemoglobin concentration, increased anemia prevalence, and delayed hematologic recovery after return to Earth. Mechanistic studies suggest that hemolysis is a major contributor to this condition, with astronauts demonstrating elevated markers of hemoglobin degradation and persistent signs of red blood cell destruction during spaceflight.

Earlier explanations emphasized plasma volume shifts and physiologic adaptation to microgravity; however, more recent studies support a stronger role for altered red blood cell turnover and hemolytic processes. Observational data also show a duration-dependent decline in hemoglobin, suggesting a dose-response relationship between time spent in space and the severity of anemia. At the same time, some literature argues that the precise pathophysiology remains incompletely defined and that erythrocytes may be relatively resistant to direct microgravity injury, highlighting the complexity of the phenomenon.

Taken together, the current literature supports space anemia as a clinically relevant, duration-dependent consequence of human spaceflight. Understanding its mechanisms is important for astronaut monitoring, mission planning, and the development of preventive strategies for future long-duration missions beyond low Earth orbit.

Keywords: Space anemia, hemolysis, hemoglobin, spaceflight

[Abstract:0183]

Aeromedical decision to fly After traumatic brain injury

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INTRODUCTION: Traumatic brain injury (TBI) is a major cause of death and disability in adults. It's caused in our country in 70% by road accidents that are steadily increasing. TBI is a cause of neurologic sequelae with socio-professional reintegration problems and thus of significant concern for aircrew. Considering the potential risk to flight safety, the flying status after TBI should be determined. This paper aims to describe the waiver process following TBI, reviewing the risk associated with each aviation occupation.

METHODS: We conducted a 3-year retrospective study in the Aeromedical Expertise Center of all derogation requests established by civilian or military aviators, and we analyzed cases that recovered from a TBI during this period and requested a waiver, with a review of the aeromedical decision.

RESULTS: We identified 4 cases. TBI represented 1, 56 % of all medical reasons for requesting a waiver. The average age was 34, 2 years. TBI was severe in three cases. The delay in requesting a waiver was 3,25 years. Because of favorable reasons, all waiver requests were accepted with limitations.

CONCLUSION: The waiver process following TBI is stringent, through assessing fixed neurologic deficit; neurocognitive impairment; seizure risk, and removing aircrew with elevated risk for sudden incapacitation. Aircrew must be asymptomatic after a delay. The risk factors for TBI in aircrew and the risk of seizures are increased by some specific aviation constraints, which justify case law on the resumption of flight duties.

Keywords: flight safety, aeromedical waiver, aircrew licensing, post-traumatic seizure risk factors, sudden incapacitation.

[Abstract:0188]

A Rare Case of Morganella morganii Nasal Abscess Possibly Associated with an Insect Bite in the Crew Rest Compartment During Flight: An Aviation Medicine Perspective and Fitness-to-Fly Assessment

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INTRODUCTION: Morganella morganii is an opportunistic Gram-negative pathogen typically found in the gastrointestinal flora; sinonasal involvement is exceedingly rare in the literature. Infections acquired during duty require a distinct management approach given the cabin exposure profile and the need for fitness-to-fly evaluation in unusual cases.
CASE DESCRIPTION
A healthy 32-year-old male flight attendant awoke with a sudden stinging sensation at the tip of his nose while sleeping in the crew rest compartment during a transatlantic flight; no insect was seen at the time. Redness noticed during deboarding was mistaken for a pimple; when swelling increased over the following days he was referred to hospital. During four months of Dermatology/ENT follow-up, topical and oral empirical treatments were administered, accumulated fluid was drained four times, and Morganella morganii was isolated from wound culture. Definitive surgical drainage was delayed, and the infection became chronic, leading to a 13×32 mm abscess and significant destruction of the alar cartilage. The patient underwent surgery under intratracheal general anesthesia on 01.12.2023; the abscess, resulting from an insect bite just above the left nasal ala, was explored internally, purulent material was drained, and the cartilage was repaired. Following postoperative flight surgeon evaluation, he returned to duty on 06.01.2024. Return to duty was assessed by an Authorized Aeromedical Examiner (AME) in accordance with the Turkish Directorate General of Civil Aviation's (SHGM) SHT-MED regulations [Annex MED.C.025(a)(2)(iv), AMC15 MED.C.025], through three separate follow-up examinations on 12.12.2023, 22.12.2023, and 29.12.2023. At the final examination, the nasal cavity was clear, edema had fully resolved, and no defect was found at the operative site; based on clinical findings, the cabin crew member was declared "Fit to Fly" without restriction.
DISCUSSION
This case demonstrates that environmental exposures such as insect bites encountered during flight duty, while not directly or indirectly threatening flight safety in the first instance, can, as in this case, lead to prolonged loss of working capacity and extensive aviation medicine evaluation when infections develop with atypical, treatment-resistant pathogens such as Morganella morganii. Atypical pathogens should be considered in the differential diagnosis of abscess formation resistant to empirical treatment; given that delays in diagnosis and definitive treatment can lead to complications and consequent temporary unfitness, early culture-and-antibiogram-guided management and prompt surgical drainage are recommended. The findings also draw attention to the importance of, and the need to review, vector control standards on board aircraft.

Keywords: Morganella morganii, nasal abscess, insect bite, alar cartilage destruction, aviation medicine, fitness to fly

[Abstract:0195]

Artificial Intelligence's Expanding Role in Ultrasound for Space Medicine

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BACKGROUND: Spaceflight exposes crew members to microgravity-induced physiological changes and restricts access to standard diagnostic imaging. Ultrasound has emerged as the primary imaging modality available in orbit due to its portability and versatility, but its diagnostic value depends heavily on operator skill and, historically, on real-time guidance from experts on the ground, guidance that becomes impractical as communication delays grow with distance from Earth. Artificial intelligence (AI) offers a path toward reducing this dependency by assisting with image acquisition, interpretation, and remote guidance.

OBJECTIVE: To identify the current literature on the integration of artificial intelligence with ultrasound in the context of space medicine, characterize how this intersection has evolved, and highlight recent applications tested in actual spaceflight.

METHODS: A structured literature search was conducted using PubMed, Embase, and Web of Science, originally performed in December 2024 and updated in July 2026, using search terms including "ultrasound," "artificial intelligence," and "space." This was supplemented by hand-searching of space agency communications (NASA, ESA, CNES) given the fast-moving nature of the field with advances that have not been formally published yet.

KEY FINDINGS: Twenty-three studies met inclusion criteria, spanning 2001 to 2026; only three substantively addressed ultrasound, artificial intelligence, and space simultaneously, reflecting how novel this specific intersection is. Most studies applied AI to ultrasound image acquisition or interpretation generally, without a specific space application. Two European Space Agency-affiliated systems illustrate the field's trajectory: ALISSE, trained on more than 50,000 images per organ, enabled entirely untrained users to obtain clinically acceptable kidney and bladder images in 9 of 10 attempts, and EchoFinder-2, combining augmented-reality probe guidance with AI-based organ identification, was tested aboard the International Space Station in 2026. Commercially available AI-ultrasound products for cardiac, pulmonary, and trauma applications may offer near-term translational pathways. Key challenges include the scarcity of space-specific training datasets, regulatory hurdles, and uncertainty around AI performance on microgravity-altered anatomy.

CONCLUSIONS: Artificial intelligence-integrated ultrasound has the potential to reduce operator dependency and mitigate communication-delay limitations central to long-duration spaceflight, but the evidence base remains sparse and concentrated in the last five years. Continued investment in space-specific datasets and validation, particularly as in-orbit systems such as EchoFinder-2 mature, will be necessary to support autonomous diagnostic capability for lunar and Mars-class missions.

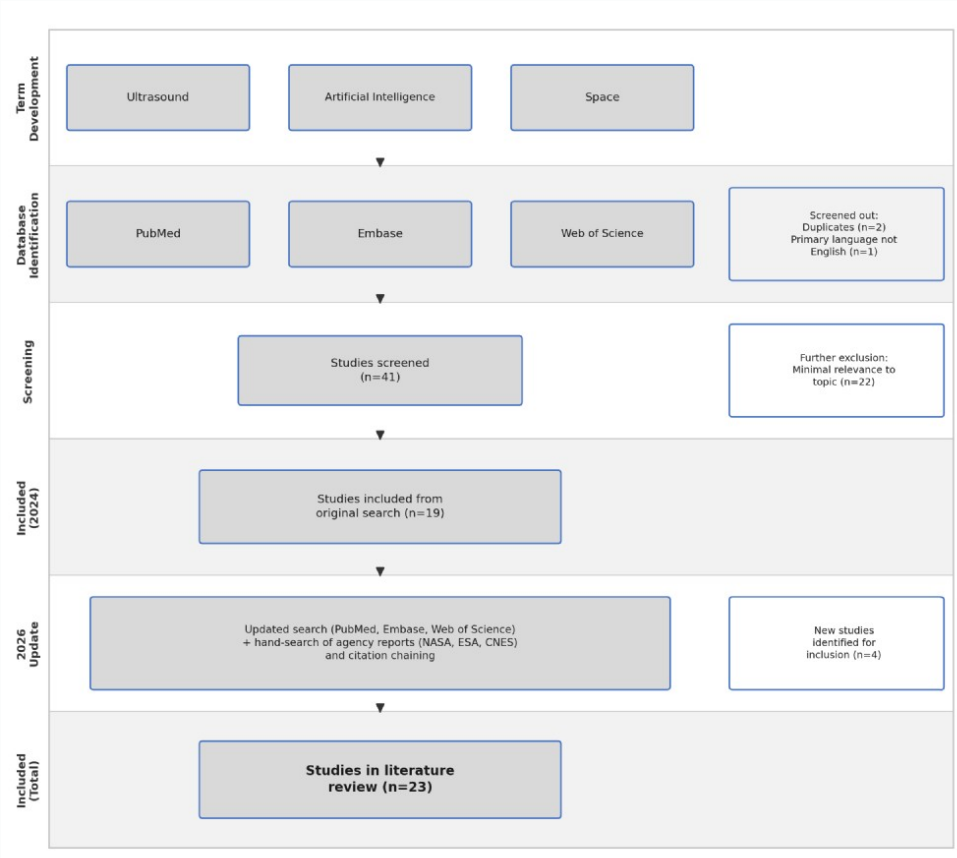
Keywords: Space medicine, ultrasound, artificial intelligence

EchoFinder



ESA astronaut Sophie Adenot is seen preparing for an EchoFinder session. Photo: ESA.

Flowchart



Study identification and selection process, combining the original December 2024 database search (PubMed, Embase, Web of Science; n=19 included) with a July 2026 update.

[Abstract:0196]

A Comparative Analysis of Aeromedical Certification Standards for Psychiatric Conditions - Use of Antidepressant Medications Among FAA, TCCA, CAA, EASA, and CASA

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BACKGROUND: Psychiatric disorders are among the most challenging issues in aeromedical decision-making due to their potential impact on flight safety. Aeromedical practice has increasingly shifted from diagnosis-based exclusion toward individualized risk assessment, a shift pioneered in Australia in 1987 when aviation personnel with successfully treated depression were first permitted to return to operational duties following sustained clinical stability on antidepressant treatment. Since then, several aviation regulatory authorities have adopted similar risk-based approaches, though implementation remains non-uniform.
OBJECTİVES: The objective of this study is to compare aeromedical certification standards for psychiatric conditions among five aviation regulatory authorities: the Federal Aviation Administration (FAA), the Transport Canada Civil Aviation (TCCA), the UK Civil Aviation Authority (CAA), the European Union Aviation Safety Agency (EASA), the Civil Aviation Safety Authority of Australia (CASA) with respect to two domains: (1) the acceptability and rule-out criteria for underlying psychiatric conditions, and (2) the certification requirements associated with antidepressant medication use. Psychoactive substance use disorders fall outside the scope of this study.
METHODS: A comparative review was conducted using aeromedical certification guidance accessible through the official websites of the FAA, TCCA, CAA, EASA and CASA, supplemented where necessary by consultancy literature (e.g., the EASA-commissioned MESAFE project report), which was clearly distinguished from binding regulatory text. Data were extracted on (1) the eligibility of psychiatric conditions for certification, including accepted and excluded/rule-out conditions, and (2) certification requirements associated with antidepressant treatment, including eligibility, acceptable antidepressants, eligibility of multiple psychiatric medications, stabilization period and evaluation periods, necessity for evaluation by a psychiatrist, assessment tools, operational restrictions, certificate issuance time after treatment ends and follow-up protocols. Findings were tabulated into two comparative tables.
RESULTS: All five authorities permit aeromedical certification with psychiatric conditions and antidepressant treatment through individualized, risk-based assessment. Psychosis and suicidal ideation/behavior are universally excluded, while mild-moderate depression is acceptable, scope beyond this varies with CASA narrowest and TCCA/EASA-CAA broadest. There are differences among regulatory authorities regarding the accepted antidepressants, stabilization periods, assessment tools, psychiatrist evaluation requirement, operational restrictions and follow-up protocols.
CONCLUSIONS: Although all five authorities have shifted toward individualized, risk-based certification for antidepressant-treated aviation personnel, considerable variability persists in acceptable medications, stabilization periods, follow-up requirements, which may produce inconsistent safety thresholds and complicate cross-authority licensing recognition. The study is limited to five regulatory systems and does not address Future research should extend this framework to other countries like Japan, China, Russia.

Keywords: Aeromedical psychiatric certification, antidepressant treatment, depression, medication policy

[Abstract:0199]

Hidden Cardiovascular Disease in Commercial Pilots Aged 60 Years and Older: A Cross-Sectional Study of 448 Pilots

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BACKGROUND: Cardiovascular disease is of critical importance in aviation medicine because of its potential to cause sudden inflight incapacitation. Although advanced age is a well-established risk factor for cardiovascular disease, pilots may underreport symptoms or health concerns due to fears of aeromedical restrictions or loss of medical certification. This study aimed to evaluate the contribution of specialist cardiology assessment incorporated into routine periodic aeromedical examinations in detecting previously unrecognized cardiovascular disease among commercial pilots aged 60 years and older.

METHODS: In this cross-sectional study conducted between 2024 and 2026, 448 commercial pilots aged 60 and older were enrolled. All included participants had no prior diagnosis of cardiovascular disease during their regular aeromedical examinations and were free of any flight restrictions due to cardiovascular reasons. In addition to their routine periodic aeromedical examinations, these pilots underwent evaluation by a cardiologist. Advanced cardiological investigations were performed on pilots where clinically indicated based on the initial specialist assessment.

FİNDİNGS: Previously undiagnosed cardiovascular disease was detected in 34 out of the 448 evaluated pilots (7.5\%). Consequent aeromedical certification restrictions or limitations were applied to 31 of these pilots. Ischemic heart disease was diagnosed in 17 pilots; of these, 10 underwent percutaneous coronary intervention (PCI) and one underwent coronary artery bypass grafting (CABG). Furthermore, aortic aneurysm was diagnosed in 8 pilots, cardiac arrhythmia in 2 pilots, and primary hypertension in 2 pilots, with appropriate treatments initiated. Three pilots diagnosed with cardiovascular disease without any operational flight restrictions.

CONCLUSION: Clinically significant cardiovascular disease was detected in 7.5\% of commercial pilots aged 60 and older who had no prior cardiovascular history or flight restrictions. Considering that pilots may be reluctant to report symptoms due to the fear of license loss or operational restrictions, comprehensive cardiovascular evaluation during periodic aeromedical examinations—and utilizing advanced cardiological testing when necessary—is crucial for advanced age pilots.

Keywords: Cardiovascular disease, aviation medicine, safety, medical certification

[Abstract:0209]

Space Musculoskeletal Risk Stratification (SMRS): A Literature-Derived Framework for Future Explainable AI-Assisted Clinical Decision Support in Human Spaceflight

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INTRODUCTION: Musculoskeletal deconditioning is a mission-limiting risk during long-duration human spaceflight. Head-down bed rest (HDBR) and prolonged bed rest provide the principal terrestrial analogues for studying unloading-induced muscle loss, yet their findings are difficult to translate into individualized risk assessment because exposure duration, muscle selection, imaging methods, countermeasure protocols, and outcome reporting are highly heterogeneous. We therefore developed the Space Musculoskeletal Risk Stratification (SMRS) framework to organize analogue evidence into a clinically oriented architecture for future explainable artificial intelligence-assisted decision support.

METHODS: A literature-derived registry was assembled from 13 published bed-rest/HDBR reports (1992–2025). Known cohort overlap was reviewed, yielding an estimated 153 non-duplicated participants. Extracted variables included unloading duration, participant characteristics, muscle group, imaging modality, reported atrophy, countermeasure status, and study methodology. A focused control-group subset comprised six studies, 46 participants, and 24 MRI/CT-derived lower-limb muscle outcomes. Evidence gaps and sources of heterogeneity were mapped to design a three-layer SMRS architecture: (1) a standardized data layer integrating analogue studies, future astronaut datasets, imaging, wearables, biomarkers, physiological monitoring, and Lower Body Negative Pressure responses; (2) an explainable AI layer for harmonization, longitudinal modelling, interpretability, and uncertainty estimation; and (3) a physician-guided clinical decision-support layer. A preliminary conceptual risk matrix was constructed across exposure, atrophy, anatomical distribution, imaging findings, countermeasure status, and physiological monitoring.

RESULTS: Unloading duration ranged from 14 to 119 days. Substantial between-study heterogeneity was identified in anatomical targets, measurement methods, participant characteristics, intervention protocols, and outcome definitions, while most evidence remained group-level rather than individual-level. SMRS converts these limitations into explicit data domains and a traceable workflow linking standardized evidence acquisition to interpretable risk stratification and personalized countermeasure planning. The framework is intended to support, not replace, flight-surgeon judgement.

CONCLUSIONS: Current analogue evidence is insufficient for a clinically validated AI prediction system, but it is sufficient to define the data architecture, clinical domains, and validation pathway required for one. SMRS provides a structured foundation for future individualized musculoskeletal surveillance, exercise and nutritional planning, imaging follow-up, and evaluation of LBNP-based countermeasures during long-duration missions. Prospective validation using standardized longitudinal analogue and astronaut datasets is required before clinical implementation.

Keywords: Space Medicine, Head-Down Bed Rest, Musculoskeletal Deconditioning, Risk Stratification, Explainable Artificial Intelligence, Clinical Decision Support

Conceptual Workflow of the Space Musculoskeletal Risk Stratification (SMRS) Framework

Poster Presentations

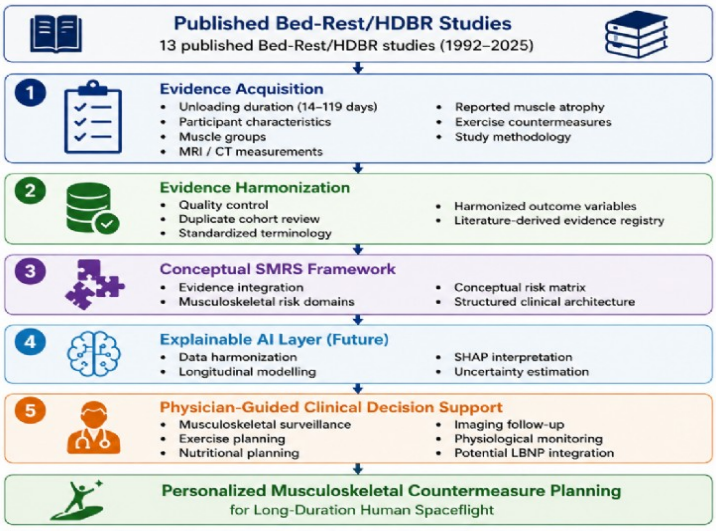

Figure 1. Conceptual workflow of the Space Musculoskeletal Risk Stratification (SMRS) framework integrating literature-derived analogue evidence, evidence harmonization, future explainable artificial intelligence, and physician-guided clinical decision support to enable personalized countermeasure planning for long-duration human spaceflight.

Conceptual workflow of the Space Musculoskeletal Risk Stratification (SMRS) framework integrating literature-derived analogue evidence, evidence harmonization, future explainable artificial intelligence, and physician-guided clinical decision support to enable personalized countermeasure planning for long-duration human spaceflight.

Proposed Architecture of the Space Musculoskeletal Risk Stratification (SMRS) Framework

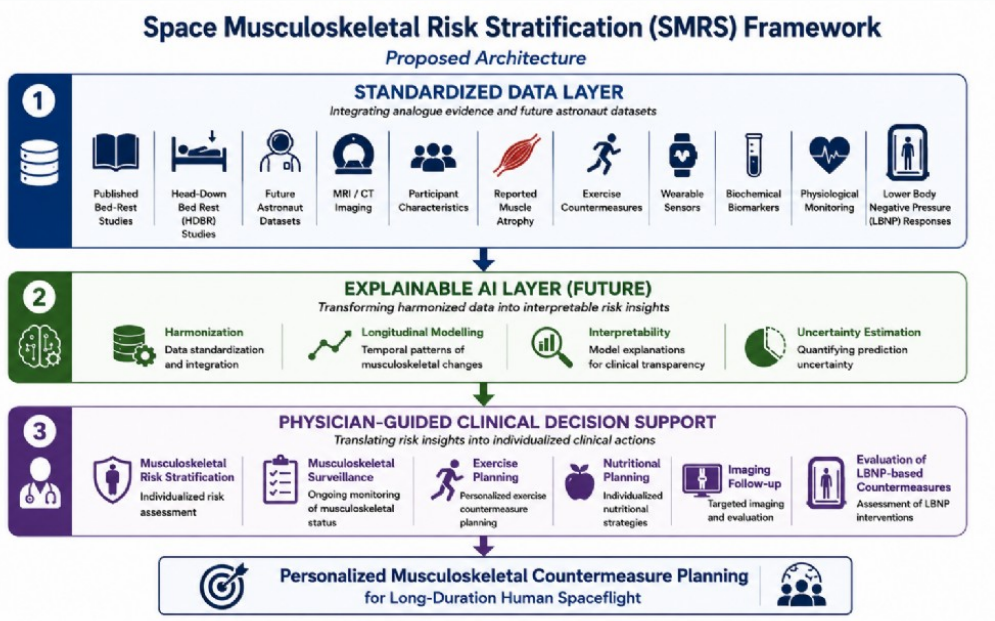

Figure 2. Proposed architecture of the Space Musculoskeletal Risk Stratification (SMRS) framework integrating literature-derived analogue evidence, future astronaut datasets, explainable artificial intelligence, and physician-guided clinical decision support for personalized musculoskeletal countermeasure planning during long-duration human spaceflight.

Proposed architecture of the Space Musculoskeletal Risk Stratification (SMRS) framework illustrating the standardized data layer, future explainable artificial intelligence layer, and physician-guided clinical decision-support layer for personalized musculoskeletal countermeasure planning during long-duration human spaceflight.

[Abstract:0212]

Beyond Evacuation: Operational Decision Frameworks for Autonomous Deep-Space Medicine

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Background
Long-duration space exploration and isolated operational environments fundamentally challenge conventional aerospace medicine, where care relies on rapid evacuation to tertiary facilities. When deep-space missions make evacuation logistically impossible, high-consequence medical emergencies threaten individual survival, crew safety, and mission success.

Description
This study evaluates the necessary paradigm shift from patient-centered clinical care to a mission-centered, systems-based model of operational risk management. Grounded in risk models like NASA's Integrated Medical Model and empirical analogue data (submarine, Antarctic, and spaceflight), we examine clinical decision-making constrained by deep communication latency, strict consumable resource limits (oxygen, power, fluids), and profound diagnostic uncertainty. To navigate these constraints, we synthesize two proven high-risk decision frameworks: Naturalistic Decision Making (Recognition-Primed Decision Model) and the OODA Loop. We demonstrate how integrating pattern recognition and continuous cognitive adaptation enables clinicians and Crew Medical Officers to make rapid, defensible clinical decisions without real-time Earth support or advanced terrestrial diagnostics.

Discussion
As human spaceflight expands beyond low Earth orbit, flight safety depends on re-engineering medical capabilities for total autonomy. By integrating operational decision frameworks, cross-disciplinary systems engineering, and advanced simulation into flight surgeon training, this work establishes a novel blueprint for managing critical health events when external support does not exist. Ultimately, this framework provides a practical strategy for mitigating human-factor risks, thereby safeguarding both near-Earth flight safety and the future of human deep-space exploration.

Keywords: Aerospace Medicine, Operational Risk Management, Autonomous Healthcare, Human Factors, Deep-Space Exploration

[Abstract:0216]

Beyond the Airlock: Does EVA Exposure Impact Long-Term Survival in Career Astronauts?

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INTRODUCTION: Extravehicular activity (EVA) is a physically demanding component of human spaceflight, exposing astronauts to unique physiologic stressors including increased radiation, thermal stress, and prolonged exertion. While the long-term health effects of spaceflight have been investigated, the relationship between EVA exposure and mortality remains poorly understood. Our objective was to evaluate the association between EVA exposure and survival time among career astronauts.
METHODS: We performed a retrospective cohort study using publicly available biographical and mortality data for astronauts from NASA, Roscosmos, ESA, CSA, and JAXA. Mission specialists who flew on space shuttle flights but were not career astronauts were excluded, as were astronauts who had not yet flown. Survival time was defined as the interval between astronaut selection and death or 6/17/2026 if still alive. Kaplan-Meier survival analysis was performed to compare survival between those with EVA exposure and those without.
RESULTS: The study cohort consisted of 524 astronauts (322 NASA, 141 Roscosmos, 30 ESA, 10 CSA, 11 JAXA). EVA experience was documented in 240 astronauts (45.8%), and 125 astronauts (23.9%) were deceased at the time of analysis. The mean number of EVAs was 1.49 ± 2.38 and mean age at death was 68.64 ± 17.55 years. Across all astronauts studied, average survival time from selection was 34.49 ± 15.49 years. Kaplan-Meier survival analysis showed a significantly longer survival time in those who had performed EVAs (log-rank chi-square=18.7, $p<0.001$). At 20 years after selection the EVA group had an estimated survival rate of 99.1% (confidence interval (CI) [97.9, 100]) versus the non-EVA group at 91.1% (CI [87.9, 94.5]). At 40 years the EVA group had an estimated survival of 92.7% (CI [88.4, 97.2]) versus 76.1% (CI [70.4, 82.2]) in the non-EVA group.
CONCLUSIONS: Overall, analysis showed prolonged survival in the EVA cohort, likely reflecting the healthy worker effect, whereby astronauts selected for EVAs represent an exceptionally healthy sub-cohort. With projected increases in EVA frequency for lunar missions and beyond, more crew members will likely be exposed. Continuous long-term monitoring remains critical as deep space missions pose higher environmental risks than Low Earth Orbit. Limitations to this study include the immortal time bias whereby astronauts have to survive long enough to complete the necessary training to perform an EVA.

Keywords: Extravehicular activity, survival, Kaplan-Meier

[Abstract:0231]

Communication Channels Used for Reporting Infectious Diseases in Commercial Air Transport: An Evaluation Under the International Health Regulations (IHR-2005) - A Retrospective Analysis of 225 Events from 2015-2020

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OBJECTIVE: In addition to the central mechanism operating through National Focal Points (NFPs) for notifying public health events of international concern, the International Health Regulations (IHR-2005) also provide, under Annex 1B and Articles 19-22, for direct coordination between local/regional health authorities and carrier operators (airlines) at designated Points of Entry (PoE). However, there is no systematic field data on which channels are actually used to report infectious diseases in commercial air transport. This study aims to identify these channels and to evaluate the place of NFP use in operational practice.

METHODS: A total of 225 infectious disease notifications (310 flights) concerning internationally travelling passengers, received by our Health Unit between 2015 and 2020, were retrospectively reviewed. Notifications were classified by communication channel as either via NFPs or via non-NFP operational channels (between the airport health authority at the point of departure/arrival and our relevant station). The routine period (2015-2019) was compared with the first year of the pandemic (2020).

RESULTS: Notifications originated from 52 countries and 9 different diseases, with COVID-19 being the most common (n=181). Overall, 26.2% (59/225) of notifications were received via the NFP channel, 59.1% (133/225) via airline stations or operations units, and 14.7% (33/225) via other channels. NFP use rose from 13.9% (6/43) in 2015-2019 to 29.1% (53/182) in 2020; the overall channel distribution differed significantly between the two periods (chi-square = 18.43, df = 2, $p < 0.001$).

CONCLUSION: Infectious disease notifications in commercial air transport are conducted through a variety of communication channels. When notifications fall outside the main framework defined by IHR-2005 (the NFP), this is thought to bring a range of data management and public health surveillance problems, which may include failure to ensure compliance with personal data protection legislation, failure to systematically record case and contact information in national health systems, and the inability to holistically capture the geographic/temporal pattern among events outside the NFP line. However, given the speed advantage provided by operational communication and the fact that the large majority of notifications actually flow through these channels, as well as the statistical weight of the data collected particularly under Annex 1B and Articles 19-22, this data should also be incorporated into the national surveillance systems of the countries of departure and arrival. The development of a standardized, digital, and integrated reporting infrastructure led by WHO, IATA, and ICAO is of critical importance for strengthening future surveillance capacity.

Keywords: International Health Regulations, National Focal Point, commercial aviation, infectious disease notification, aviation Medicine

[Abstract:0236]

Charting a Course into Aerospace Medicine: An International Roadmap for Doctors and Medical Students

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[2]NHS

Aerospace medicine remains a small, highly specialised field, and doctors and medical students outside existing military or airline-industry networks often find the routes into it unclear. Professional societies, mentorship schemes, courses, and certification pathways all exist internationally, but information is scattered and requirements differ between countries, which can make entry appear more opaque to newcomers than it actually is.
This poster presents a practical, internationally-oriented roadmap for doctors and medical students seeking to enter aerospace medicine. It draws on the authors' complementary positions (one early in the journey into the field, the other with a more established trajectory within it) together with published guidance from professional societies and training institutions worldwide. Guidance from international bodies including the Aerospace Medical Association (AsMA), the International Academy of Aviation and Space Medicine (IAASM), and the European Society of Aerospace Medicine (ESAM), alongside their national constituent societies, is synthesised into a single visual framework spanning the career continuum: medical school (interest groups, taster courses, electives); early postgraduate training (society membership, conference attendance, mentorship, scholarships); formal and informal specialisation (diplomas and masters programmes, structured training, and board or equivalent certification); and established practice (civil, military, regulatory, research, or space-medicine tracks). At each stage, concrete next steps are highlighted: which societies to join, which courses to consider, and which meetings to attend.
By consolidating this into one accessible reference, the poster aims to lower the barrier to entry internationally, particularly for those without a pre-existing mentor, institutional pathway, or national training programme. Viewers should leave able to identify their current position on the roadmap and the specific next step available to them. It is intended as a practical companion for students and doctors attending ICAM 2026, and as a prompt for discussion about how the specialty recruits and supports its next generation

Keywords: Aerospace medicine, Career Mobility, Medical education, Mentoring, Specialization, Professional Societies

[Abstract:0238]

Preparing for the Skies: In-Flight Medical Emergency Simulations for Medical Students

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INTRODUCTION: With a frequency of one medical event per 212 flights, trainees may encounter in-flight medical emergencies while in medical school. It is appropriate for medical students to respond; however, unlike hospital settings, trainees rely on remote ground consultation amidst limited resources, loud environments, and spatial constraints. Our in-flight emergency simulations aimed to familiarize medical students with the resources and procedures onboard an aircraft and increase confidence in providing care outside of a clinical setting.

METHODS: Twenty first through third year medical students from a single medical school participated in the event. Pre- and post-participation surveys were distributed. The first hour featured a local pilot leading a didactic about airline policies and global regulations. Then, students participated in four simulations of common chief complaints in an in-flight emergency including: (1) anaphylaxis in an adult patient; (2) syncope in an adult patient; (3) hypoglycemia in a pediatric patient; and (4) anxiety in a pregnant patient. Participants were assessed in willingness to respond to an in-flight medical emergency using a binary scale with 1 being willing and 0 being unwilling. They also rated their confidence in medical diagnosis, treatment, and communication using a Likert scale of 1 through 5 (with 5 being extremely confident), and 95% confidence intervals were used for analysis. Pre and post simulation confidence intervals that did not overlap were identified as significant.

RESULTS: Of 20 participants, 17 completed the post-survey (attrition rate 15%). Survey data collected before and after the simulations showed an increased willingness to respond to an in-flight medical emergency from 55% before to 94% after. Self-reported confidence in diagnosis increased from [1.249, 1.851] to [2.936, 4.005], confidence in treatment increased from [1.093, 1.607] to [2.690, 3.780], and confidence in communication increased from [1.349, 2.051] to [3.286, 4.361]. These increases in confidence in diagnosis, treatment, and communication were all significant.

CONCLUSION: This pilot study demonstrates that a single simulation significantly improves medical student confidence in managing in-flight medical emergencies. Future directions include expansion of simulations to other community settings to further broaden medical students' skillsets, such as wilderness medicine. Modification of these simulations for use at different levels of training may be beneficial, specifically for residents outside of emergency medicine who lack exposure to field medicine.

Keywords: In-flight medical emergency, Simulation, Medical Education

[Abstract:0248]

Real-world queries to a generative AI medical assistant reveal physician information needs in aviation and travel medicine across four European countries

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Tonic Easy Medical

INTRODUCTION: Generative artificial intelligence (genAI) assistants are increasingly used by physicians for point-of-care information. Aviation and travel medicine spans heterogeneous, low-frequency clinical scenarios, from fitness-to-fly assessment to tropical disease prophylaxis, that often generate uncertainty in daily practice. Analysing real-world queries (prompts) submitted to a genAI assistant offers a novel window into physicians' information needs and knowledge gaps. This study characterised the volume, topics, and geographic distribution of aviation and travel medicine queries submitted to Tonic AI by physicians across four European countries.

METHODS: Prompts were first extracted from the Tonic AI log (23/07/2025 - 23/07/2026) using a broad keyword pre-filter for travel- and aviation-related terms, yielding 35,429 candidate prompts. Multilingual (PT/IT/ES/FR) regex-based detection with contextual disambiguation then confirmed 10,113 (28.5% of candidates) as genuine travel or aviation medicine queries, flagged into seven non-mutually-exclusive categories: malaria/tropical diseases, fitness-to-fly/aviation medicine, travel consultation and vaccination, altitude medicine, fear of flying, motion sickness, and jet lag. Manual sampling validated over 90% precision per theme. Beyond descriptive statistics, the authors used a chi-square test, a two-proportion chi-square test and linear regression.

RESULTS: Of 35,429 prompts analyzed, 10,113 (28.5%) addressed aviation or travel medicine. Malaria and tropical diseases predominated (6,279; 62.1% of travel-related prompts), led by malaria (56.6%) and yellow fever (21.6%). Fitness-to-fly/aviation medicine accounted for 2,211 prompts (21.9%), followed by travel consultation and vaccination (19.4%); altitude medicine, fear of flying, motion sickness, and jet lag together represented under 5%. Portugal generated the most prompts (4,027; 39.8%), followed by Italy (3,305; 32.7%), Spain (1,704; 16.8%), and France (1,077; 10.6%). Thematic distribution differed significantly across countries ($\chi^2=766.6$, df=18, $p<0.001$): fitness-to-fly queries represented 32.8% of Italy's travel prompts versus 16.6% for the other three markets combined ($\chi^2=342.7$, df=1, $p<0.001$). Monthly prompt volume rose significantly over 11 complete months (linear regression, slope +38 prompts/month, $R^2=0.63$, $p=0.003$). Specialist physicians authored 68.3% of prompts, medical residents 30.7%.

CONCLUSIONS: Real-world genAI logs across four European countries confirm that aviation and travel medicine, particularly tropical disease prophylaxis and fitness-to-fly evaluation, is the most prevalent topic queried by physicians, and prompt volume grew significantly over the study period. Thematic patterns varied significantly by country, notably Italy's higher share of aviation-medicine queries, indicating market-specific rather than uniform information needs. These statistically supported patterns, drawn mainly from specialist and resident physicians, position genAI logs as a scalable tool for surveillance of physician information needs and could inform country-tailored continuing medical education in aviation/travel medicine.

Keywords: aviation medicine, travel medicine, generative artificial intelligence, fitness to fly, digital health

[Abstract:0250]

Global Scientific Output in Aerospace Medicine and Space Physiology (1970–2026): A Comprehensive Bibliometric Analysis

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Universidad de Guadalajara

BACKGROUND: Human space exploration subjects the human body to unique environmental hazards, including microgravity, space radiation, and altered circadian rhythms. As international space agencies target long-duration missions to the Moon and Mars, evaluating the evolution of space medicine research and analog mission studies is critical. This study performs a quantitative bibliometric analysis of the global scientific literature on aerospace medicine, space physiology, and spaceflight analogs from 1970 to 2026.

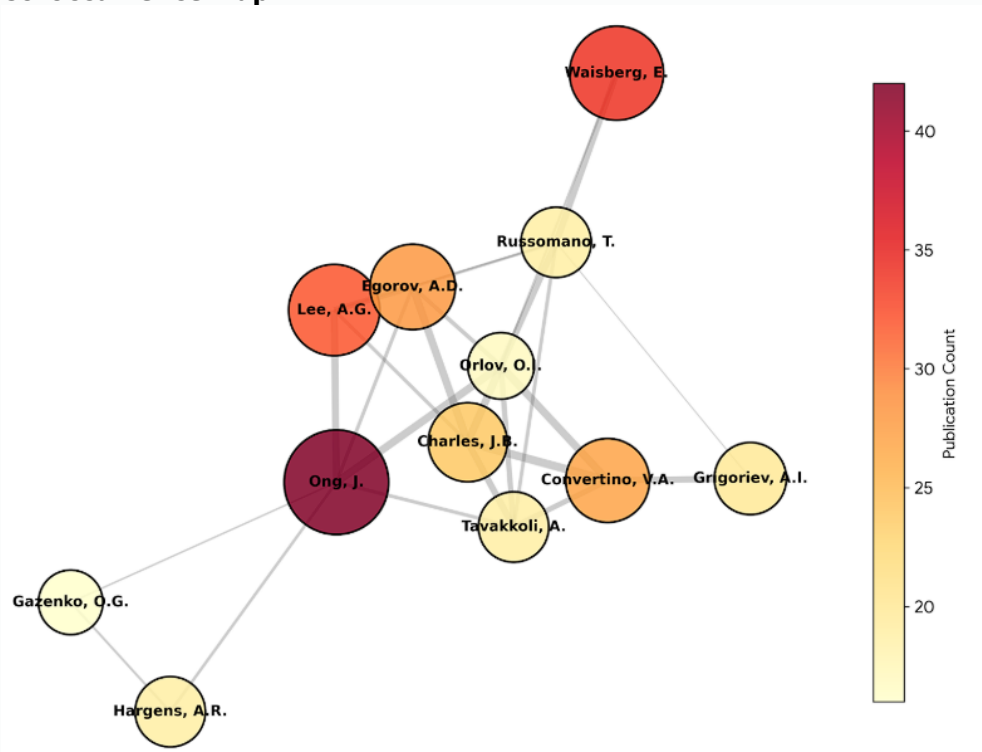
METHODS: A comprehensive literature search was executed in the Scopus database using a Boolean strategy combining Medical Subject Headings (MeSH) and search terms for space medicine, microgravity, spaceflight analogs, astronaut health, and multi-system physiological adaptations (cardiovascular, neurovestibular, musculoskeletal, neuro-ocular, and immunological). Publications in English from 1970 to 2026 were retrieved. Bibliometric indicators analyzed included publication output trends, document types, subject domains, source journals, institutional affiliations, prolific authors, and funding agencies.

RESULTS: A total of 2276 publications met the inclusion criteria. Publication output showed an upward trajectory, reaching historical peaks in 2025 (n = 149, 6.5%) and 2024 (n = 88, 3.9%). Original research articles constituted the primary document type (n = 1393, 61.2%), followed by reviews (n = 366, 16.1%) and conference papers (n = 301, 13.2%). Medicine (n = 1116, 31.5%) and Engineering (n = 642, 18.1%) were the predominant subject areas. Acta Astronautica (n = 237) and Aviation, Space, and Environmental Medicine / Aerospace Medicine and Human Performance (n = 271 combined) were the primary publishing outlets. Institutional productivity was led by NASA Johnson Space Center (n = 200) and the Institute for Biomedical Problems of the Russian Academy of Sciences (n = 168). Leading individual contributors included Ong, J. (n = 42), Waisberg, E. (n = 34), Lee, A.G. (n = 32), and Egorov, A.D. (n = 28). NASA (n = 130) and NIH (n = 35) were the main funding sponsors.

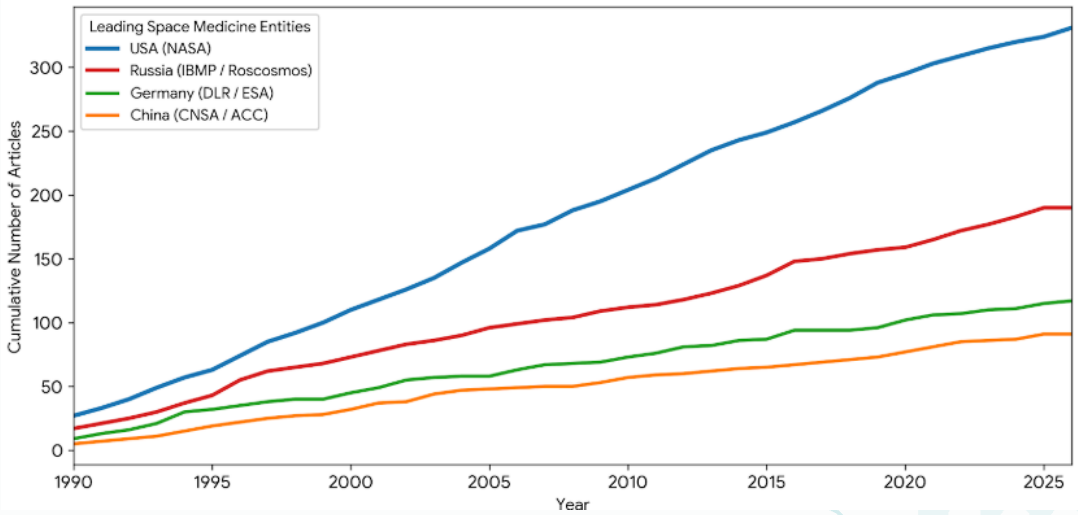
CONCLUSION: Research in aerospace medicine has advanced from early observational studies to specialized, multi-system pathophysiological investigations and ground-based analogs (e.g., Spaceflight Associated Neuro-ocular Syndrome - SANS, bone/muscle deconditioning). The strong presence of specialized space agencies highlights the centralized structure of this field. Identifying these publication patterns helps pinpoint critical gaps to guide future operational space medicine and interplanetary crew health management.

Keywords: medicine, physiology, Spaceflight, Bibliometry, SANS, space

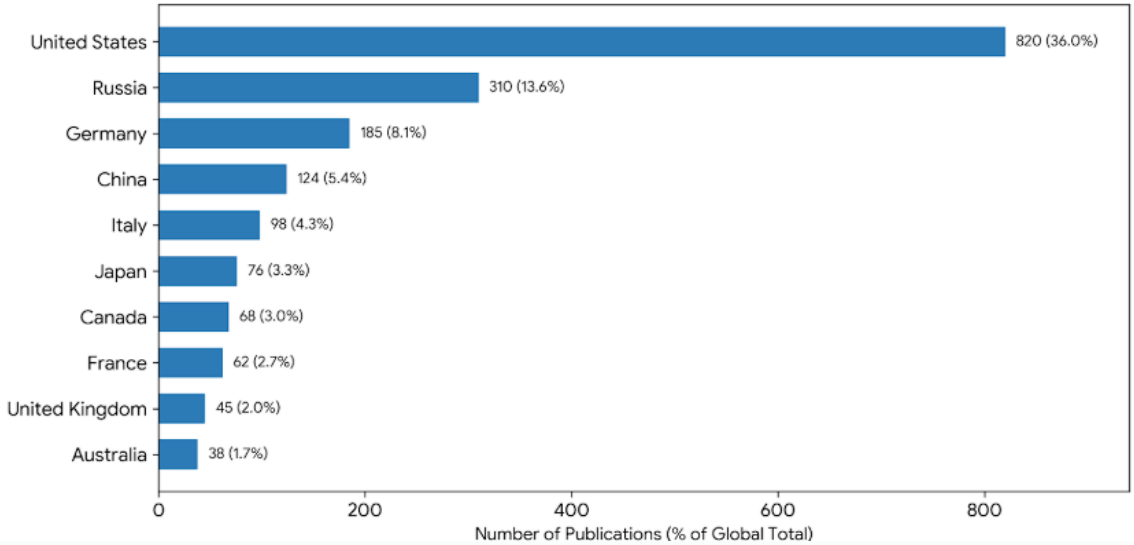
Co-occurrence Map



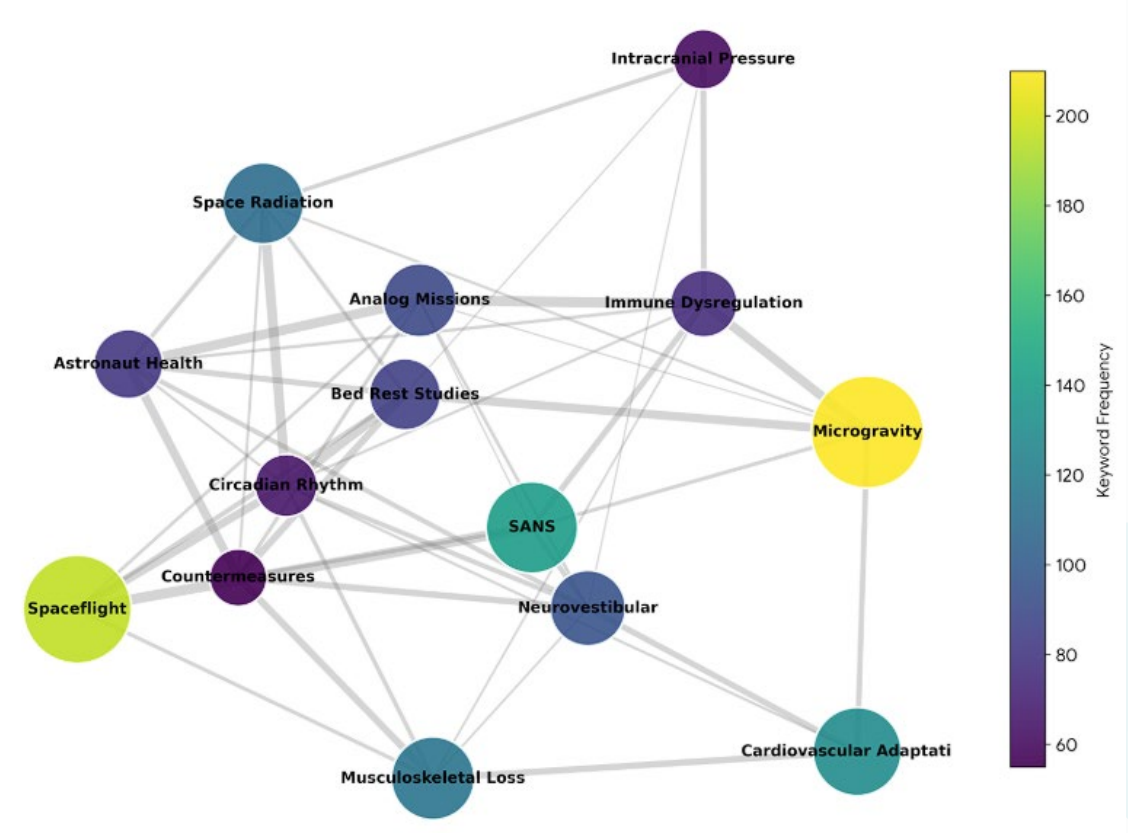
Cumulative Production Trajectories over Time (1990–2026)



Geographical Distribution of Output by Country



Term Co-occurrence Map



[Abstract:0255]

Female Fertility Preservation Before Long-Duration Spaceflight: Is Oocyte Cryopreservation Part of Astronaut Medical Planning?

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BACKGROUND:
Long-duration missions beyond low Earth orbit will expose astronauts to prolonged spaceflight-associated hazards, including ionizing radiation and altered gravity. Evidence regarding female reproductive health in space remains limited, with human reproductive outcomes largely uncharacterized. This raises an important clinical question: should fertility preservation be considered within pre-flight medical planning for women undertaking exploration-class missions?
DESCRIPTION:
A structured literature review was conducted using PubMed, NASA life-science resources, aerospace medicine literature, astronaut health guidance, and evidence from experimental spaceflight and radiation models. Evidence concerning ovarian reserve, follicular depletion, reproductive ageing, female reproductive function, and fertility-preservation strategies was evaluated. Current evidence for oocyte cryopreservation was considered in the context of established reproductive medicine practice and its potential application to astronaut health.
DISCUSSION:
Preclinical and radiation-based evidence indicates that ovarian follicles are vulnerable to ionizing radiation, while animal spaceflight studies have demonstrated disruption of ovarian function and folliculogenesis. However, direct evidence linking spaceflight exposure with reduced ovarian reserve, accelerated reproductive ageing, or impaired fertility in human astronauts remains insufficient. Oocyte cryopreservation is an established fertility-preservation technique in clinical practice, with evidence supporting its effectiveness in appropriately selected women. Nevertheless, its specific role in astronaut medical planning has not been established. A potential pre-flight framework could incorporate reproductive goals, age, ovarian reserve assessment, anticipated mission duration, estimated radiation exposure, and post-flight reproductive plans. Such counseling should remain individualized rather than constitute a universal recommendation for female astronauts.
CONCLUSION:
Fertility preservation represents a potentially relevant but currently evidence-limited component of women's reproductive health planning for long-duration spaceflight. Prospective research should establish reproductive risk estimates, clinically meaningful monitoring endpoints, and criteria for considering oocyte or other fertility-preservation strategies before exploration-class missions.

Keywords: female fertility, fertility preservation, ovarian reserve

[Abstract:0260]

Empathy for Take-off: Nonviolent Communication as a Supportive CRM Tool

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INTRODUCTION: Although the Human-Factors and Crew-Resource-Management(CRM) literature extensively covers non-compliant passenger behavior,there's insufficient data regarding effective communication models,particularly for the pediatric population(1).Nevertheless,the communicative proficiency of the flight crew serves as a critical determinant of flight safety.This case report examines the significance of empathetic communication in ensuring aviation safety—specifically regarding a pediatric passenger who adamantly refused to fasten their seatbelt—within the framework of the Nonviolent-Communication(NVC) model developed by Marshall-Rosenberg(2).

CASE: The researcher observed a case during an intercity flight involving a 2.5-year-old(55-month-old) male traveling with his mother.During pre-takeoff safety checks,the child refused to fasten his seatbelt,exhibiting physical resistance and intense vocalized distress.As both a flight surgeon and a communication expert seated in close proximity,the researcher observed both the mother and the flight crew;the mother's body language indicated tension,embarrassment,and helplessness.The cabin manager,after consulting with the flight deck,informed the mother that the aircraft could not depart until the child was secured.Other cabin crew members exhibited signs of stress due to the operational delay.Initial communication strategies employed by the mother and crew included distraction,bargaining,attempted physical restraint,intimidation,and reward-punishment rhetoric;however,these methods failed to achieve the required cooperation.At the 13th minute of the delay, the researcher intervened with the consent of the crew and the mother.Utilizing an empathetic approach based on NVC,a secure connection was established first with the mother and then with the child.The child's screams of anger and fear-stemming from a lack of recognition of his underlying needs and the pressure to comply-transitioned into a mournful cry as it was revealed that his resistance was rooted in the distress of being separated from his father.Following emotional regulation,facilitated by the-mother's physical contact,the child voluntarily cooperated in fastening the seatbelt.This empathetic intervention lasted approximately 3-4 minutes and adhered to the four steps of the-NVC model:observation,feelings,needs,and requests.This approach resolved the operational crisis without the need for physical restraint,pharmacological agents,or security intervention,resulting in sustained voluntary compliance throughout the flight

DISCISSION&CONCLUSION: While limited to a single case,this study suggests that focusing solely on behavior in human factors management can lead to escalation,whereas addressing underlying emotions and needs facilitates voluntary compliance,particularly in pediatric populations.Empathy should be regarded not merely as a communicative skill but as a non-technical operational tool for flight safety.Furthermore,flight surgeons can provide vital support to flight crews within the-CRM context by intervening in both physiological and psychosocial dimensions.It's anticipated that the-NVC model can offer functional tools for flight crews to enhance skills in communication management,emotional regulation,and de-escalation within the-CRM framework(3,4,5).

Keywords: Nonviolent Communication - NVC, Crew Resource Management - CRM, Human Factors, Pediatric Passenger, De-escalation, Non-compliant Passenger

[Abstract:0263]

Otosclerosis in Aviation Medicine

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INTRODUCTION: Otosclerosis is an inherited disease of the middle ear where abnormal bone growth fixes the stapes bone (the stirrup) in place. Otosclerosis gradually impedes the natural mobility of the stapes footplate resulting in a progressive conductive hearing loss caused by the increased stiffness of the sound transmission system.
CASE: The candidate presented for an initial Class 3 medical examination. As part of the initial examination, an ENT evaluation was performed. Pure-tone audiometry demonstrated normal hearing on the right and a conductive hearing loss in the low and mid frequencies on the left. Tympanometry findings indicated a slightly lower compliance bilaterally; stapedial reflexes upon ipsilateral stimulation were absent on the left and demonstrated lower amplitude on the right. The candidate reports no hearing difficulties, vertigo, or tinnitus. The ENT specialist diagnosed Left Conductive Hearing Loss (Suspected Left Otosclerosis). A CT scan of the temporal bones was performed, which showed no pathological changes in the mastoid bones. The CT scan cannot reliably evaluate stapes fixation in the oval window. The candidate consulted two additional ENT specialists at reference institutions, where one provided a diagnosis of Suspected Congenital Stapes Fixation, and the other diagnosed Left Stapedovestibular Tympanosclerosis. Given that this is an initial application, the medical assessor evaluated her as unfit for Class 3 according to regulation ATCO.MED.B.005(b). The candidate filed an appeal to the secondary medical board.
CONCLUSION: The Board concludes that a precise diagnosis of the cause of stapes fixation can be established through clinical follow-up over several years, but definitively via exploratory middle ear surgery and histopathological findings. There is a discrepancy in the diagnoses established by different ENT specialists; however, considering that both tympanosclerosis and congenital stapes fixation are relatively stable conditions that do not progress over the years unlike otosclerosis, which is a genetically and autoimmune-mediated progressive disease and given that the candidate has mild unilateral hearing loss of approximately 35 dB in the speech frequencies with no speech discrimination difficulties, she is assessed as fit for Class 3 with TML (6 months) and SIC limitations.

Keywords: otosclerosis, aviation medicine, class 3

[Abstract:0270]

Gender Dysphoria and Aeromedical Assessment

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INTRODUCTION: Gender dysphoria is the distress a person feels when their internal gender identity does not match the sex they were assigned at birth.
CASE: The applicant 24 years old, male sex, presenting for an initial Class 3 medical examination. Born as a male, and since birth there is gender dysphoria. States that he has been treated in the Cabinet for Transgender Conditions since 2019. A male name is entered in the documents, plans to change the documents in terms of sex and name after graduating from university. Since 2020 on hormone therapy. He is satisfied with the feminine changes (breast growth, voice change...) which occurred as he takes hormone therapy. Uses Neofolin amp 5 mg 1x1 amp every 7 days Utrogestan 1000 mg 1x1 the first 10 days of the month, and used Androcur which has been discontinued in the meantime. Currently not motivated for surgical sex change. Submits an endocrinologist report with information of current hormone replacement therapy and that the therapy will be lifelong with adequate annual follow-ups. Also submits a psychiatrist report where it is stated that current of satisfactory psychological status. Until now there has be no psychiatric pharmacotherapy or hospitalizacion. Report states that in beginning there was maladjustment in interpersonal relationships as an adaptive response. There was insufficient evidence that the transition has been completed and due to the possible impact of adverse effects of the therapy the assessment was unfit for class 3. The applicant filed an appeal for the secondary medical board
CONCLUSION: The Board notes a practically completed transition in the psychological and endocrinological sense. No adverse effects of the hormone replacement therapy have been registered, which makes them less likely in the future as well. Additional psychological exploration indicates the regression of previously registered difficulties related to neurotic depth, mature adaptation mechanisms, good family, social, and professional adjustment. Based of these facts, decision was: fit for class 3 with the limitation SIC (obligatory report of a psychiatrist and endocrinologist for the next regular examination), and TML(limitation on the validity of the certificate to 12 months).

Keywords: Gender dysphoria, aeromedical assessment, class 3

[Abstract:0271]

Beyond the Altitude Barrier: International Strategies to Engage the Next Generation in Aerospace Medicine

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BACKGROUND:
The future of aerospace medicine depends on attracting and retaining new physicians. A United States survey conducted in 2021 illustrates the scale of the awareness problem: among 1,244 medical students, 49.2% had never heard of aerospace medicine, 75.9% did not know it was an official medical specialty, and only 2.7% reported access to an elective or enrichment opportunity, although 85.3% said they would be interested in learning more if given the opportunity. These results cannot be generalised internationally, but they illustrate how interest may not lead to participation when trainees cannot see a credible route into the field. Perceptions that aerospace medicine is primarily military or United States-centred may create a barrier for international civilian trainees. Recruitment must therefore address awareness, access and progression while recognising differences between national training and regulatory systems.

DESCRIPTION:
Building on a framework presented at the 2026 Aerospace Medical Association meeting in Denver, we consider how its core elements can be adapted internationally. These include multilingual digital outreach and student interest groups; structured mentoring, webinars and conference participation; supervised electives, observerships and research projects where available; and clear information on entry requirements, accreditation and further training. AI-assisted retrieval tools grounded in ICAO, EASA and FAA guidance and peer-reviewed literature may improve access to reliable information, but require expert oversight and regular updating. Professional organisations also shape how the field is perceived. The Civil Aviation Medical Association (CAMA) provides a useful example: its existing Space Medicine Committee and planned transition to the Civil Aerospace Medical Association reflect the growing relevance of civil spaceflight while retaining the organisation's aviation medicine foundations. International organisations can share adaptable resources and mentoring capacity without assuming that one curriculum will suit every country.

DISCUSSION:
Digital visibility is useful only if it leads to credible education, supervised experience and achievable next steps. Programmes should be evaluated beyond online reach, using repeat engagement, mentoring uptake, completion of educational activities, participation in supervised opportunities and progression to further training or practice. This approach is consistent with ICAO's Next Generation of Aviation Professionals priorities and ESAM's educational remit while allowing regional adaptation. Combining targeted outreach, mentoring, practical exposure and clear training pathways offers a realistic route from initial curiosity to sustained involvement in aerospace medicine and a stronger future workforce.

Keywords: aerospace medicine, education; mentoring, digital engagement

[Abstract:0288]

Neurogenesis Beyond Earth: A Systematic Review of the Effects of Microgravity on Neural Regeneration

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BACKGROUND: Long-duration exposure to microgravity induces cellular and molecular adaptations involving oxidative stress, inflammation, cytoskeletal remodeling, and altered intracellular signaling. Emerging evidence suggests that these changes may affect neural stem and progenitor cells, potentially altering neurogenesis and neuronal regeneration. However, the effects of microgravity on neural regenerative processes remain incompletely characterized.

OBJECTIVE: To systematically evaluate the effects of microgravity and simulated microgravity on neural stem and progenitor cell proliferation, neurogenesis, neuronal differentiation, and neural regenerative processes.

METHODS: A systematic review will be conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. PubMed, Scopus, Web of Science, and Embase will be searched for experimental and observational studies involving neural stem cells, neuronal cultures, animal models, astronauts, spaceflight, or ground-based microgravity analogues. Outcomes will include neural progenitor proliferation, neuronal differentiation, cell survival, neurite outgrowth, neuroinflammatory signaling, and molecular markers of neurogenesis and neural regeneration. Findings will be analyzed according to experimental model and exposure characteristics, and meta-analysis will be performed when sufficient methodological and quantitative homogeneity is present.

Expected RESULTS: Identifying alterations in neural stem cell activity, neurogenesis, and regenerative pathways following microgravity exposure, with effects potentially varying according to cell type, experimental model, and duration of exposure.

CONCLUSION: Understanding how microgravity affects neural stem cells and regenerative processes may provide new insights into nervous system adaptation to spaceflight and identify potential targets for preserving neurological function during future long-duration missions..

Keywords: Microgravity, Spaceflight, Neurogenesis, Neural Stem Cells, Neural Regeneration, Neuroinflammation

[Abstract:0295]

Mathematical modeling and molecular dynamics of cellular stress responses: applications for space agriculture and life-support systems

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As human presence in space increases, the ability to cultivate biological systems and fresh food on the International Space Station (ISS) and future planetary colonies becomes a prerequisite for long-term missions. Plants and bio-systems grown in space face unique environmental stressors that exacerbate temperature fluctuations. This study investigates the molecular dynamics of the Heat Stress Response (HSR) network, utilizing computational modeling to predict cellular stress adaptation and thermotolerance, offering a blueprint for sustainable aerospace life-support systems.

We evaluated the thermotolerance capacity of *Solanum lycopersicum* through physiological hypocotyl elongation assays, real-time quantitative PCR (qPCR), and transient GUS reporter protoplast systems. To bridge macroscopic phenotypes with genetic effectors, advanced computational analyses were performed in Python. Unsupervised machine learning (Principal Component Analysis) evaluated global transcriptomic variance, while a supervised Random Forest classification algorithm was trained on the expression matrix to determine predictive feature importance.

Physiological data demonstrated that uninterrupted severe heat exhausts cellular plasticity, requiring nocturnal reset periods for recovery.
Transactivation assays revealed a strong synergistic promoter activation by the master regulator HSFA1a paired with co-activators HSFA2 and HSFA7, contrasting with repression by Class B factors. Computationally, PCA successfully captured 97.3% of total biological variance, cleanly isolating the continuous extreme stress condition into a distinct state of molecular exhaustion. Furthermore, the Random Forest model identified the downstream effector APX3 and the core regulator HSFA2 as the highest predictive drivers distinguishing control from stress states.

The integration of molecular biology with predictive machine learning models provides a robust framework for understanding cellular stress memory and adaptation. Decoding these highly coordinated transcriptional networks is crucial for engineering climate-resilient biological systems capable of thriving in the demanding, enclosed environments of future aerospace exploration missions.

Keywords: heat Stress Response, Solanum lycopersicum, Machine Learning, Space Agriculture

[Abstract:0296]

Cardiac arrest during spaceflight: challenges for resuscitation in microgravity

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Background
Cardiac arrest during spaceflight represents a rare but potentially mission-threatening medical emergency. Microgravity fundamentally alters cardiopulmonary resuscitation (CPR), as conventional Earth-based chest compressions cannot be performed effectively without stabilization or alternative rescuer positioning. With increasing mission duration and the expansion of commercial spaceflight, practical and reproducible resuscitation strategies are becoming increasingly relevant.

Description
Current guidance recommends adapting terrestrial basic and advanced life support principles to the microgravity environment. For immediate basic life support, the Evetts-Russomano method is recommended, with the reverse bear hug method as an alternative when adequate compressions cannot be achieved. After transfer and restraint on the Crew Medical Restraint System, the handstand method is preferred when spacecraft dimensions permit. Airway management should prioritize patient and rescuer stabilization, with supraglottic airway devices favored when tracheal intubation expertise is unavailable. Defibrillation should be performed on an electrically isolated, restrained patient. Mechanical chest compression represents an emerging alternative to technically demanding manual techniques. Recent parabolic-flight research demonstrated a median compression depth of 53 mm with a standard mechanical piston device compared with 34.5 mm using manual handstand CPR, with the piston device achieving guideline-compatible compression depth.

Discussion
The fundamental principles of terrestrial resuscitation remain applicable during spaceflight, but their delivery requires substantial adaptation to microgravity, limited crew capacity, restricted equipment, spacecraft geometry, and delayed or unavailable evacuation. Emerging evidence suggests that mechanical chest compression may overcome an important limitation of manual CPR, although device mass, volume, deployment time, training requirements, and reliability remain important operational considerations. Evidence concerning defibrillation, pharmacological therapy, and post-resuscitation care remains limited. Future protocols should integrate evolving microgravity-specific evidence and prioritize simple, reproducible interventions suitable for increasingly long and remote missions.

Keywords: cardiac arrest, space medicine, microgravity, cardiopulmonary resuscitation



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585	81	138	53
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