MHIF FEATURED STUDY:

KPL-301-C203

OPEN AND ENROLLING:

EPIC message: *Research MHIF Patient Referral*

CONDITION:	PI:	RESEARCH CONTACT:	SPONSOR:
Severe COVID-19 pneumonia and hyper-inflammation	Ramiro Saavedra-Romero, MD	Christine Majeski christine.majeski@allina.com | 612-396-5341	Kiniksa

DESCRIPTION:

Phase 2/3, randomized, double-blind, placebo-controlled study to evaluate the efficacy and safety of single IV dose of mavrilimumab in adult subjects hospitalized with severe COVID-19 pneumonia and hyper-inflammation to reduce progression to respiratory failure or death. Mavrilimumab targets the GM-CSF receptor, neutralizing overexpression of GM-CSF associated with inflammation. This may address severe cytokine storm syndrome seen in subjects with COVID-19 and the immediate need to reduce rising mortality.

CRITERIA LIST/ QUALIFICATIONS:

Inclusion:

- >18 years old
- Positive SARS-CoV-2 within 14 days
- Bilateral pneumonia on chest x-ray or CT
- Elevated ferritin, CRP, D-dimer, LDH, or history of fever <7 days
- Requiring non-invasive ventilation or oxygen supplementation to maintain SpO2 >92% (i.e. nasal cannula, face mask, BiPAP, CPAP) or invasive ventilation <48 hours

Exclusion:

- Onset of COVID-19 symptoms >14 days
- Hospitalized for SARS-CoV-2 >7 days
- Prior severe or concomitant illness (i.e. pulmonary alveolar proteinosis, severe and uncontrolled pulmonary disease other than COVID-19 pneumonia, pre-existing LVEF <35%, MI/stroke/ hemodynamic instability/cardiogenic or septic shock <30 days, concomitant uncontrolled systemic or bacterial infection)
- Recent cell-depleting biological therapies or immunosuppressants (except corticosteroids)
- Received hydroxychloroquine within last 3 months

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Trouble in Thin Air: In-Flight Medical Emergencies

Jared M Routh, MD
Cardiology Fellow
Minneapolis Heart Institute

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Outline/objectives

- Describe the physiologic changes of air travel.
- Identify the most common in-flight medical emergencies (IME).
- Understand why responding to an IME poses inherent challenges.
- Identify the contents of the emergency medical kit and other available resources.
- Understand the legal protections afforded to those who respond to IME and identify potential issues.
- Assess a patient's cardiovascular fitness to fly.

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Disclosures

- None

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Courtesy Google Images

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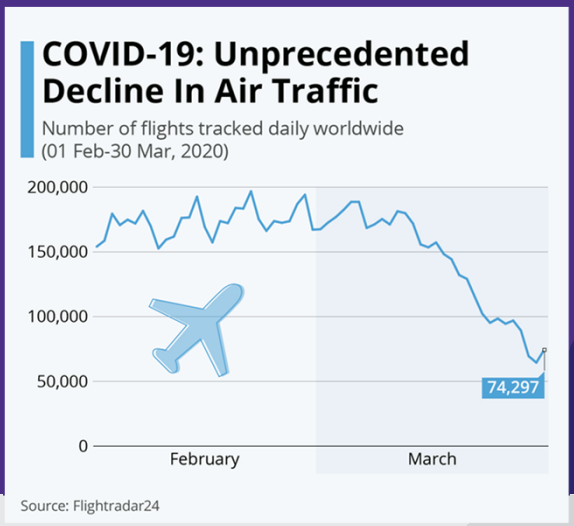
Air travel and the COVID-19 pandemic



6

Scope of the Topic

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Scope of the topic: Air travel worldwide

- Nearly 4 billion annual commercial air passengers worldwide.
- In the US,
  - 16.4 million flights annually
  - 45,000 flights/day carrying 2.9 million passengers
  - 5,400 flights in the sky simultaneously at peak times
- Aging worldwide population

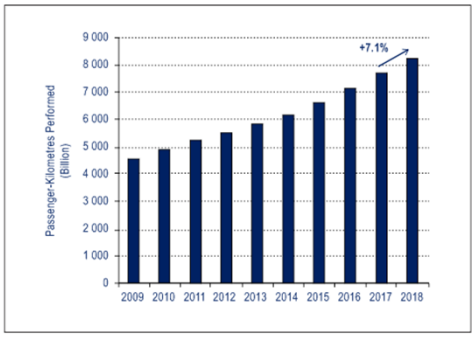

Figure 1. Passenger-Kilometres Performed
Total Scheduled Traffic, 2009-2018

https://www.faa.gov/air_traffic/by_the_numbers
https://www.icao.int/annual-report-2018

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Scope of the topic: In-flight medical emergencies

- 1 in 604 flights based on database review between 2008-2010
- 16 to 130 IME per 1 million passengers
- Estimate 44,000 IME occur worldwide per year

N Engl J Med. 2013; 368:2075-2083. CMAJ. 2018; 190:e217-222.
J R Soc Med. 2006: 99:628-631.

9

Epidemiology of IME

10

Epidemiology of IME

- Estimated IME
- Who responds?
- Most common IME
- Outcomes

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Outcomes of Medical Emergencies on Commercial Airline Flights

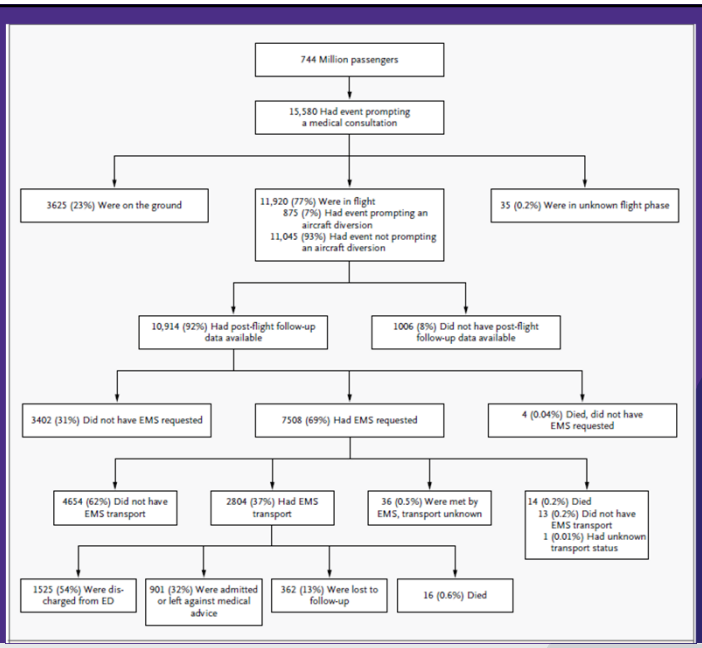
Drew C. Peterson, M.D., Christian Martin-Gill, M.D., M.P.H., Francis X. Guyette, M.D., M.P.H., Adam Z. Tobias, M.D., M.P.H., Catherine E. McCarthy, B.S., Scott T. Harrington, M.D., Theodore R. Delbridge, M.D., M.P.H., and Donald M. Yealy, M.D.

11

By the numbers

- 7+ million flights and 744 million passengers
- 1 IME per 604 flights
- 16 IME per 1 million passengers
- Who provides assistance?
  - Physicians 48.1%
  - Flight attendants 23.6%
  - Nurses 20.1%
  - EMS 4.4%
  - Other 3.7%

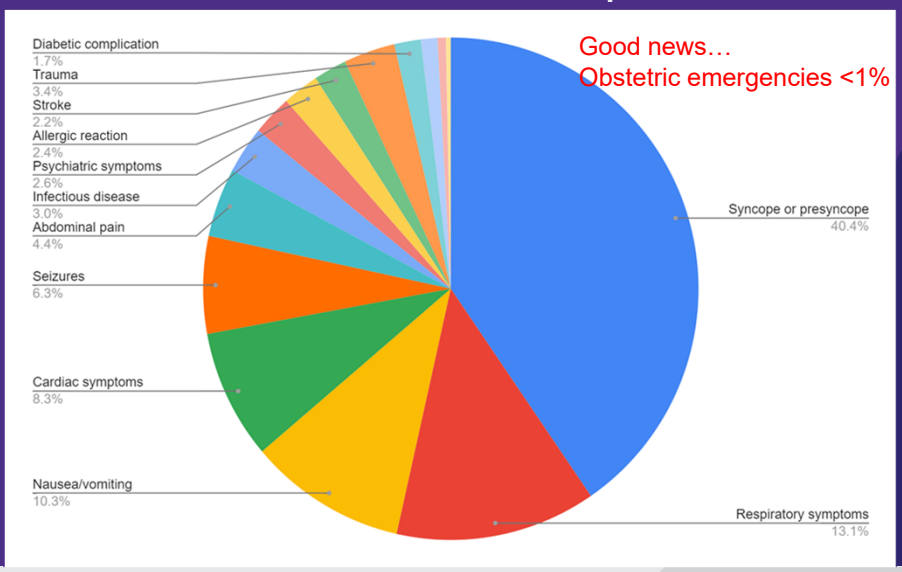
12



N Engl J Med 2013;368:2075-2083

13

Common chief complaints



14

Diagnostic accuracy?

- 79% agreement between on-flight and hospital diagnosis
- Passenger's condition improved in 60% prior to hospital arrival

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Common in-flight conditions

Table 4. Differential Diagnoses of Common In-Flight Medical Conditions

Medical Condition	Differential Diagnosis
Syncope or near-syncope	Vasovagal syncope, dehydration, hypoglycemia, toxic exposure, medication reaction, toxicity, acute coronary syndrome, arrhythmia, pulmonary thrombosis or air embolism, hypoxia
Chest pain	Acute coronary syndrome, pulmonary thrombosis or air embolism, pneumothorax, bronchospasm, aortic dissection, gastroesophageal reflux, musculoskeletal, anxiety
Shortness of breath	Chronic obstructive pulmonary disease, asthma, pneumonia, pulmonary thrombosis or air embolism, toxic exposure
Strokelike symptoms	Cerebrovascular accident, transient ischemic attack, hypoglycemia, seizure, syncope, intracranial mass, complex migraine
Seizure	Seizure, syncope, hypoglycemia, eclampsia, cardiac arrest
Gastrointestinal illness	Motion sickness, foodborne illness, gastritis, enteritis, gastroesophageal reflux, pancreatitis, medication/substance withdrawal
Obstetric emergency	Preterm labor, miscarriage, ectopic pregnancy, eclampsia
Allergic reaction	Allergic reaction, anaphylaxis, cellulitis, dermatitis
Cardiac arrest	Cardiac arrest (ventricular fibrillation, ventricular tachycardia, asystole, pulseless electrical activity), syncope or other cause of collapse (see above)
Substance abuse and misuse	Misuse of or withdrawal from opioid, alcohol, benzodiazepine, or stimulant
Psychiatric issue	Anxiety, depression, grief reaction, psychosis, posttraumatic stress disorder, personality disorders, somatization

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Table 2. Multivariable Analysis of Factors Associated with Selected Outcomes.*

Factor	Odds Ratio (95% CI)		
	Aircraft Diversion	Transport to a Hospital	Hospital Admission
Age	1.01 (1.006–1.014)	1.01 (1.008–1.013)	1.02 (1.016–1.026)
Medical problem			
Syncope	0.82 (0.63–1.06)	0.84 (0.73–0.97)	1.04 (0.77–1.42)
Respiratory symptoms	1.14 (0.82–1.58)	0.96 (0.80–1.15)	2.13 (1.48–3.06)
Cardiac symptoms	2.75 (2.07–3.66)	2.41 (1.99–2.91)	1.95 (1.37–2.77)
Abdominal pain, nausea, or vomiting	0.99 (0.72–1.35)	1.35 (1.14–1.60)	1.13 (0.79–1.62)
Seizures	2.07 (1.48–2.89)	1.90 (1.53–2.35)	1.57 (1.04–2.37)
Possible stroke	2.52 (1.61–3.96)	2.26 (1.64–3.10)	3.36 (1.88–6.03)
Type of aircraft			
Wide-body	1.02 (0.80–1.30)	0.68 (0.58–0.79)	1.56 (1.14–2.13)
Jumbo	1.23 (0.93–1.65)	0.73 (0.59–0.91)	1.62 (1.03–2.55)
AED used	3.02 (1.89–4.83)	3.89 (2.46–6.15)	1.79 (0.96–3.32)
Volunteer provider of medical assistance			
Physician	2.32 (1.76–3.04)	1.53 (1.35–1.75)	1.33 (1.01–1.75)
Nurse	1.86 (1.36–2.53)	1.47 (1.26–1.71)	1.09 (0.80–1.48)
EMS provider	2.82 (1.87–4.24)	1.83 (1.45–2.31)	1.52 (0.96–2.39)
Other	2.48 (1.53–4.03)	1.43 (1.08–1.90)	0.79 (0.43–1.44)
Patient was airline employee	1.87 (1.09–3.24)	1.97 (1.34–2.91)	—
Airline no.			
1	0.78 (0.60–1.02)	1.28 (1.12–1.46)	0.32 (0.24–0.42)
2	2.08 (1.66–2.61)	1.10 (0.96–1.26)	0.84 (0.64–1.09)
3	0.49 (0.32–0.74)	0.93 (0.79–1.09)	0.83 (0.61–1.13)
4	2.80 (2.05–3.83)	NA	NA
Flight distance			
2500–4999 km	1.26 (1.05–1.51)	—	—
5000–7499 km	1.23 (0.91–1.67)	—	—
7500–9999 km	1.09 (0.76–1.57)	—	—
≥10,000 km	0.25 (0.13–0.50)	—	—

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The Cabin Environment

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The cabin environment

- Pre-flight environment
- Pressurization/Oxygenation
- Air quality
- Limited space

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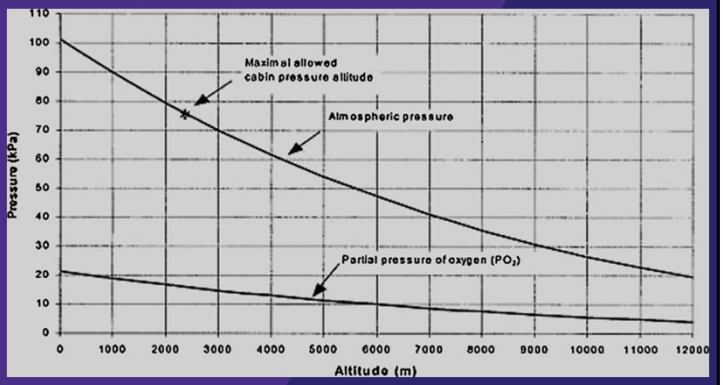
The cabin environment: Pre-flight environment

- Anxiety
- Security measures
- Increased activity

20

The cabin environment: Physiology of air travel

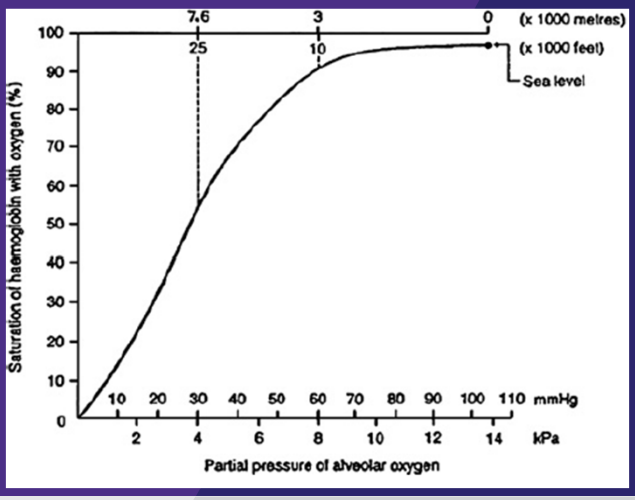
- Barometric pressure
  - 760 mmHg -> 565 mmHg
- Partial pressure of oxygen falls with increasing altitude
  - Dalton's Law



21

The cabin environment: Physiology of air travel

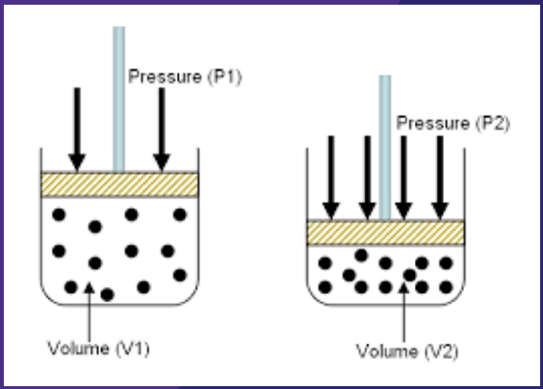
- Cabin typically pressurized to 5,000 to 8,000 ft
- PaO2
  - Drops from ~95 mmHg to ~60 mmHg
- Oxygen saturation
  - Drops from 97% to 90-93%
- At risk for hypobaric hypoxia



22

The cabin environment: Physiology of air travel

- Boyle's law ($P_1V_1 = P_2V_2$)
- Cabin pressure drops
- Volume expansion up to 30%
- Air trapped in enclosed spaces expands
  - Sinus, middle ear, gastrointestinal
  - Recent surgery - wound dehiscence
  - Feeding tubes, catheters
  - Spontaneous pneumothorax



23

The cabin environment: Cabin air quality

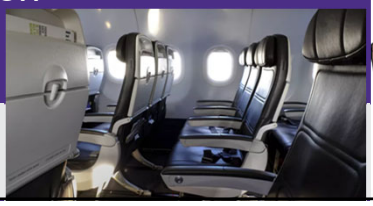
- Pressurized and dehumidified
- Cycled through the engine compartment
- Humidity between 5-25%
  - Leading to dehydration
  - Exacerbation of reactive airway diseases

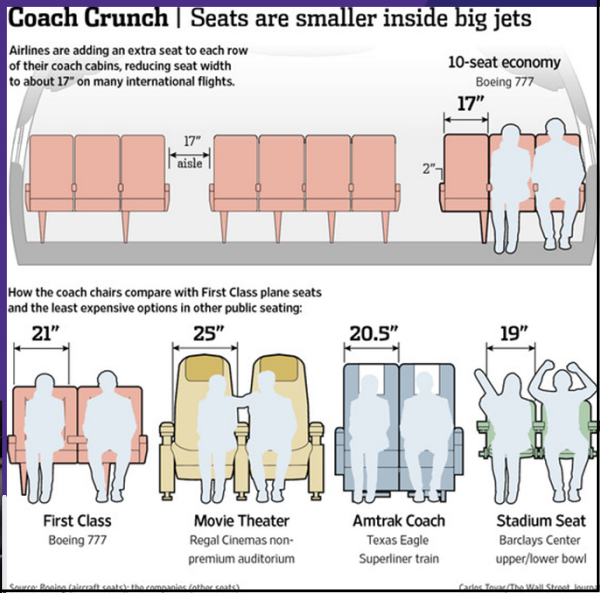
N Engl J Med. 2002; 346:1067-1073.
JAMA. 2018; 320:2580-2590.

24

The cabin environment: Space

- Tight, cramped space (and getting smaller)
  - Average seat width in 2000 18.5” to 17” today
- Physically makes responding to IME more difficult
- Noise/vibration





Ostrower J and Michaels. WSJ 2013.
Levin A.Bloomberg. 2018.

25

Responding to an IME

26

The medical volunteer role

- Gather information
- Assess the ill passenger
- Aid in communication with ground-based support
- Provide an assessment and recommendation
- Administer medications and/or perform procedures

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Available resources

- Flight attendants (FA)
  - Trained in CPR and the use of AEDs
  - Handle 25% of reported IME
- Ground-based medical consultation
- On-board medical kit
- Automatic external defibrillator (AED)
  - Mandated by the FAA in 2001
- Other passengers

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On-board medical kit

Required contents of EMK[1]

- Airways, oropharyngeal
- Adhesive tape, 1-inch
- Alcohol sponges
- CPR mask
- IV administration set
- Needles
- Protective gloves
- Sphygmomanometer
- Stethoscope
- Syringes
- Tape scissors
- Tourniquet
- Manual resuscitation device with
- Basic instructions on use of the ki

- Calcium chloride
- Diazepam
- Digoxin
- Glucose gel
- Furosemide
- Lorazepam
- Haloperidol
- Hydrocortisone
- Meclizine
- Methylprednisolone
- Metoprolol
- Morphine
- Nalbuphine
- Naloxone
- Promethazine
- Sodium bicarbonate

FAA.gov EMK Contents
N Eng J Med. 2013; 368:2075-83.
Aerospace medical association 2019 EMK update

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Ground-based medical consultation

MedAire
An International SOS Company

STAT-MD

AT THE GATE - IN THE AIR - AT DESINATION

- 24/7 ADVICE & ASSISTANCE
- ARRANGEMENT OF LOCAL EMERGENCY SERVICES
- REPORTING & ANALYSIS

Courtesy MedAire Medlink and STAT MD websites

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Flight diversion

- 2-7% of IME result in diversion
- Decision solely the captain's
- Ground-based medical support

Table 2. Multivariable Analysis of Factors Associated with Selected Outcomes.*

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	Aircraft Diversion	Transport to a Hospital	Hospital Admission
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≥10,000 km	0.25 (0.13–0.50)	—	—

Prehosp Emerg Care. 2010; 14:235-239 . Medaire internal data. 2018.
JAMA. 2018; 320:2580-2590. N Engl J Med 2013;368:2075-2083
Survey by the Air Transport Association.

31

Flight diversion

- Factors
  - Weather
  - Fuel load
  - Physical ability of aircraft to land
  - Medical resources at closest airport
  - Time
- Cost: $20,000 to $893,000

Prehosp Emerg Care. 2010; 14:235-239 . Medaire internal data. 2018.
JAMA. 2018; 320:2580-2590. N Engl J Med 2013;368:2075-2083
Survey by the Air Transport Association.

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The medical volunteer role

- Decide if your in proper condition to respond.
- Introduce yourself and state your medical qualifications.
- Ask the patient for consent to treat.
- Request the medical supply kit from the FA.
- Obtain vital signs, brief history and perform a physical examination.
- Identify high risk features.
- Inform the flight crew of your impression.
- Communicate and confer with airline provided ground-based medical resources.
  - Provide your recommendations for further care, diversion of the aircraft, and/or ground-based medical assistance.
- Administer available treatments with in the scope of your expertise.
- Document the encounter and keep a personal copy.
- Patient privacy rights remain unchanged.

Adapted from Aviat Space Environ Med 1997;68:1134-8;
N Engl J Med 2013;368:2075-2083

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Legal Ramifications

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Legal Ramifications: Am I legally responsible when responding to an emergency in-flight?

105TH CONGRESS 2d Session } HOUSE OF REPRESENTATIVES { REPORT 105–456

AVIATION MEDICAL ASSISTANCE ACT OF 1998

MARCH 20, 1998.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

(b) LIABILITY OF INDIVIDUALS.—An individual shall not be liable for damages in any action brought in a Federal or State court arising out of the acts or omissions of the individual in providing or attempting to provide assistance in the case of an in-flight medical emergency unless the individual, while rendering such assistance, is guilty of gross negligence or willful misconduct.

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Legal ramifications

Table 2. Features of the Aviation Medical Assistance Act (AMAA) of 1998.*

The protections of the AMAA apply only to care rendered for "medical emergencies" and do not cover care rendered or medical advice given for nonemergencies.
Providers do not have to be asked to provide assistance in order to receive the protections of the AMAA.
The AMAA does not give providers any legal authority over the plane or its crew; thus, they cannot be held liable if a pilot does not follow their recommendations (e.g., to divert the plane).
The AMAA does not make providers responsible if a patient is harmed because of the failure of the airline to have appropriate medical equipment available.
Providers are not absolved of their legal duties (e.g., to avoid "gross negligence") simply because they may use medical resources provided by the airlines.

NEJM 2015:373: 939-45.

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Legal ramifications: Common questions

- Am I legally obligated to respond?
  - In the US, UK, Canada - No.
  - Countries in Europe, Australia and others - Yes.
  - Moral and professional obligations

J R Soc Med. 2006; 99:628-631. N Engl J Med. 2002; 346:1067-1073.
Medical Law International. 2017; 17:65-98. N Engl J Med. 2015;373: 939-45.

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Legal ramifications: Common questions

- Do I need to provide my credentials?
  - Technically unclear. Some laws provide for “in good faith” provisions.
  - Carry a digital copy on your cell phone.

J R Soc Med. 2006; 99:628-631. N Engl J Med. 2002; 346:1067-1073.
Medical Law International. 2017; 17:65-98. N Engl J Med. 2015;373: 939-45.

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Legal ramifications: Common questions

- What about protections on international flights?
  - It can get tricky.
  - Liability is determined by the law of the country in which the aircraft is registered.
  - International law governed by complex inter-country agreements.

J R Soc Med. 2006; 99:628-631. N Engl J Med. 2002; 346:1067-1073.
Medical Law International. 2017; 17:65-98. N Engl J Med. 2015;373: 939-45.

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Legal ramifications: Common questions

- What if I've had a few drinks? Should I decline to provide assistance?
  - Probably. Remember, gross negligence and willful misconduct.
  - Any type of impairment.

J R Soc Med. 2006; 99:628-631. N Engl J Med. 2002; 346:1067-1073.
Medical Law International. 2017; 17:65-98. N Engl J Med. 2015;373: 939-45.

40

Legal ramifications: Common questions

- Does the AMAA provide full, unrestricted protection?
  - No, it protects the "good samaritan" from liability for actions taken by competent persons within the scope of his/her training (i.e. no heroics).

J R Soc Med. 2006; 99:628-631. N Engl J Med. 2002; 346:1067-1073.
Medical Law International. 2017; 17:65-98. N Engl J Med. 2015;373: 939-45.

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Legal ramifications: Common questions

- Can I accept money, upgrades, or vouchers for my assistance?
  - AMAA protections
    - Volunteer, care rendered in good faith, no monetary compensation.
  - Any compensation in return for providing aid may jeopardize protection. Conflicting literature.

J R Soc Med. 2006; 99:628-631. N Engl J Med. 2002; 346:1067-1073.
Medical Law International. 2017; 17:65-98. N Engl J Med. 2015;373: 939-45.

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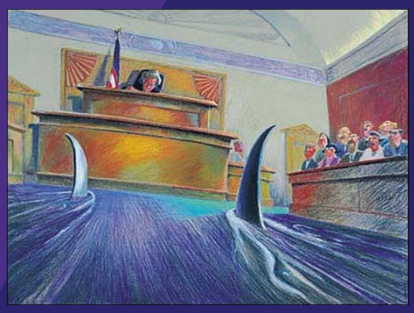
Legal ramifications: Common questions

- Has a physician ever been successfully sued for assisting in an IME?
  - Good samaritan laws do not stop a plaintiff from bringing a lawsuit (even if later dismissed).
  - Very little to no case law precedent to support this.



J R Soc Med. 2006; 99:628-631. N Engl J Med. 2002; 346:1067-1073.
Medical Law International. 2017; 17:65-98. N Engl J Med. 2015;373: 939-45.

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Legal ramifications: Common questions

- Can I bill for my services?
  - In 1997, a psychiatrist billed British Airways ~$750 for services rendered. He lost in court.
  - Negate protections under Good Samaritan laws.

BMJ. 1997; 317:701
J R Soc Med. 2006; 99:628-631

44

Fitness to Fly:
Pre-flight assessment of patients with cardiovascular disease

45

Fitness to fly: Contraindication to air travel

TABLE IV. CARDIOVASCULAR CONTRAINDICATIONS TO COMMERCIAL AIRLINE FLIGHT.

1. Uncomplicated myocardial infarction within 2–3 weeks
2. Complicated myocardial infarction within 6 weeks
3. Unstable angina
4. Congestive heart failure, severe, decompensated
5. Uncontrolled hypertension
6. CABG within 10–14 days
7. CVA within 2 weeks
8. Uncontrolled ventricular or supraventricular tachycardia
9. Eisenmenger syndrome
10. Severe symptomatic valvular heart disease

Aerospace medical association. 2003; 74:A1-A19.

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Fitness to fly: CAD/Recent ACS

Influence of Altitude Exposure on Coronary Flow Reserve

Christophe A. Wyss, MD*; Pascal Koepfli, MD*; Gregory Fretz, MD; Magdalena Seebauer, PhD; Christian Schirlo, MD; Philipp A. Kaufmann, MD

Background—Although no data exist on the effect of altitude exposure on coronary flow reserve (CFR), patients with coronary artery disease (CAD) are advised not to exceed moderate altitudes of ≈2500 m above sea level. We studied the influence of altitude on myocardial blood flow (MBF) in controls and CAD patients.

Methods and Results—In 10 healthy controls and 8 patients with CAD, MBF was measured by positron emission tomography and ^{15}O-labeled water at rest, during adenosine stress, and after supine bicycle exercise. This protocol was repeated during inhalation of a hypoxic gas mixture corresponding to an altitude of 4500 m (controls) and 2500 m (CAD). Workload was targeted to comparable heart rate–blood pressure products at normoxia and hypoxia. Resting MBF increased significantly in controls at 4500 m (+24%, $P<0.01$) and in CAD patients at 2500 m (+24%, $P<0.05$). Altitude had no influence on adenosine-induced hyperemia and CFR. Exercise-induced hyperemia increased significantly in controls (+38%, $P<0.01$) at 4500 m (despite a reduction in workload, −28%, $P<0.0001$) but not in CAD patients at 2500 m (moderate decrease in workload, −11%, $P<0.05$). Exercise-induced reserve was preserved in controls (+10%, P=NS) but decreased in CAD patients (−18%, $P<0.005$).

Conclusions—At 2500 m altitude, there is a significant decrease in exercise-induced reserve in CAD patients, indicating that compensatory mechanisms might be exhausted even at moderate altitudes, whereas healthy controls have preserved reserve up to 4500 m. Thus, patients with CAD and impaired CFR should be cautious when performing physical exercise even at moderate altitude. (***Circulation***. **2003;108:1202-1207.**)

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Fitness to fly: CAD/Recent ACS

- Stable CAD, stable angina, and prior MI
  - No contraindication to travel
  - Take medications normally
  - Bring copy of ECG
- Recent, uncomplicated MI
  - 2 weeks
- Complicated MI
  - 2 weeks after medically stable
  - Consider symptom limited GXT

ACC/AHA Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction)

Developed in Collaboration With the Canadian Cardiovascular Society

Administration regulation (1396). Therefore, air travel within the first 2 weeks of STEMI should be undertaken only if there is no angina or dyspnea at rest or fear of flying. The individual must have a companion, carry nitroglycerin, and request airport transportation to avoid rushing (personal communication, R.P. Gardner, PhD, November 2002). Air

JACC. 2004; e86-e292. Can J Cardiol. 2004; 20:1313-1323.
Heart. 2010; 96:ii1-ii16. JAMA. 2018; 320:2580-2590
Aerospace medical association. 2003; 74:A1-A19. Am J of Med. 2016; 129:1000e1-1000e6.

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Fitness to fly: Recent ACS

2010 BMJ Heart *Fitness to Fly Report*

- Very low risk (<65 yo, first event, successful reperfusion, EF>45%, uncomplicated)
  - 3 days
- Low risk (EF>40%, no symptoms of CHF, no ischemia or arrhythmia)
  - 10 days
- High risk (EF<40%, CHF symptoms, ischemia or arrhythmia)
  - Contraindicated

Heart. 2010; 96:ii1-ii16.

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doi:10.1093/eurjhf/hft003

Effects of reducing inspired oxygen concentration for one hour in patients with chronic heart failure: implications for air travel

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Fitness to fly: Heart failure

- Stable, chronic HF
  - No contraindication
- NYHA class III/IV symptoms*
  - O2 recommended with baseline SpO2<92%
  - Airport assistance
- Recent exacerbation
  - Some suggest waiting 6 weeks. Limited data.
- Severe, decompensated CHF
  - Absolutely contraindicated

JACC. 2004; e86-e292. Can J Cardiol. 2004; 20:1313-1323.
Heart. 2010; 96:ii1-ii16. JAMA. 2018; 320:2580-2590
Aerospace medical association. 2003; 74:A1-A19. Am J of Med. 2016; 129:1000e1-1000e6.

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Fitness to fly: Passengers with cardiac devices

- Airport metal detectors
  - Rarely set off, but carry information card
  - No evidence of device interaction
  - Can request hand search
- In-flight
  - EMI
  - Cosmic radiation
  - Vibration

Do Airport Metal Detectors Interfere With Implantable Pacemakers or Cardioverter-Defibrillators?

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Munich, Germany

OBJECTIVES The aim of this study was to determine whether airport metal detector gates (AMDGs) interfere with pacemakers (PMs) or implantable cardioverter-defibrillators (ICDs).

BACKGROUND It is currently unknown whether AMDGs interfere with implanted PMs or ICDs.

METHODS A total of 348 consecutive patients (200 PM and 148 ICD recipients) have been tested for the occurrence of electromagnetic interference (EMI) within the electromagnetic field of a worldwide-used airport metal detector.

RESULTS No interference, such as pacing or sensing abnormalities, was observed in any of the 200 PM and 148 ICD patients; also no reprogramming occurred.

CONCLUSIONS In vivo testing of PM and ICD systems showed no EMI with a standard AMDG. Clinically relevant interactions with implanted PMs or ICDs seem unlikely. (J Am Coll Cardiol 2003; 41:2054–9) © 2003 by the American College of Cardiology Foundation

JACC. 2004; e86-e292. Can J Cardiol. 2004; 20:1313-1323.
Heart. 2010; 96:ii1-ii16. JAMA. 2018; 320:2580-2590
Aerospace medical association. 2003; 74:A1-A19. Am J of Med. 2016; 129:1000e1-1000e6.

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Fitness to fly: DVT/PE

CHEST
AMERICAN COLLEGE of CHEST PHYSICIANS

Prevention of Venous Thromboembolism*

American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition)

William H. Geerts, MD, FCCP; David Bergqvist, MD, PhD; Graham F. Pineo, MD; John A. Heit, MD; Charles M. Samama, MD, PhD, FCCP; Michael R. Lassen, MD; and Clifford W. Colwell, MD

Recommendations: Long-Distance Travel

9.1. For travelers who are taking flights > 8 h, we recommend the following general measures: avoidance of constrictive clothing around the lower extremities or waist, maintenance of adequate hydration, and frequent calf muscle contraction (Grade 1C).

9.2. For long-distance travelers with additional risk factors for VTE, we recommend the general measures listed above. If active thromboprophylaxis is considered because of a perceived high risk of VTE, we suggest the use of properly fitted, below-knee GCS, providing 15 to 30 mm Hg of pressure at the ankle (Grade 2C), **or a single prophylactic dose of LMWH, injected prior to departure** (Grade 2C).

9.3. For long-distance travelers, we recommend against the use of aspirin for VTE prevention (Grade 1B).

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Fitness to fly: Travel after cardiac procedures

- Elective coronary angiography without PCI
  - The next day
- Uncomplicated, elective PCI
  - ~2 days
- CABG
  - 10-14 days (time for intrathoracic air to reabsorb)
- PPM/ICD
  - 1-2 days*
  - *2 weeks if complicated by PTX

JACC. 2004; e86-e292. Can J Cardiol. 2004; 20:1313-1323.
Heart. 2010; 96:ii1-ii16. JAMA. 2018; 320:2580-2590
Aerospace medical association. 2003; 74:A1-A19. Am J of Med. 2016; 129:1000e1-1000e6.

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Comprehensive pre-flight evaluation

- Assess for signs/symptoms of decompensation
- Recent/upcoming procedures or surgeries
- Presence of cardiac devices
- Vital signs including resting SpO2
- Recommend in-flight oxygen if:
  - Needed at rest
  - PaO2<70 mmHg or SpO2<92%
  - NYHA class III/IV symptoms
- Consider HAST or 50 m walk test
- Assess the need for DVT prophylaxis

JACC. 2004; e86-e292. Can J Cardiol. 2004; 20:1313-1323.
Heart. 2010; 96:ii1-ii16. JAMA. 2018; 320:2580-2590
Aerospace medical association. 2003; 74:A1-A19. Am J of Med. 2016; 129:1000e1-1000e6.

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Fitness to fly: Hypoxia altitude simulation test

- Gas mixture 51.1% oxygen with nitrogen
  - Replicates in-flight PaO2 at 8,000 ft
  - Oxygen recommended if
    - PaO2<50 mmHg
    - SpO2<85%
  - Can be paired with an exercise component

CHEST. 2008; 133:839-842.

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Comprehensive pre-flight evaluation

- Recommendations
  - Sufficient medications in carry-on luggage with medication list
  - Bring copy of most recent ECG and device cards
  - Contact the airline for accomodations
    - Limit ambulation
  - In-flight oxygen
  - Consider medical evacuation insurance (international)

JACC. 2004; e86-e292. Can J Cardiol. 2004; 20:1313-1323.
Heart. 2010; 96:ii1-ii16. JAMA. 2018; 320:2580-2590
Aerospace medical association. 2003; 74:A1-A19. Am J of Med. 2016; 129:1000e1-1000e6.

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Key Points

- The cabin environment may result in physiologic changes in patients with cardiopulmonary disorders
- Most IME are minor. Providers should be aware of common chief complaints.
- Medical providers should be familiar with the contents of the emergency medical kit.
- Airlines contract with ground based medical support.
- Medical providers who render aid are generally protected from liability.

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AED use in-flight

- Peterson NEJM 2013 outcomes
  - 0.3% of IME, but accounts for 86% of in-flight deaths
  - AED applied in 24 cases, 5 shocks. ROSC in 9 patients.
  - Flight not diverted in 42% of patients
- O'Rourke et al 1997
  - AED used 109 occasions (46 times for cardiac arrest)
  - 27 episodes of cardiac arrest (16 witnessed)
    - 21/27 unshockable rhythms
    - 6 with shockable rhythms, 5 with ROSC, 2 with long-term survival

- Brown et al 2010
  - AED used 169 occasions (40 cardiac arrests)
    - Sinus 114
    - Asystole/PEA 30
    - VT/VF 10 (9 defibrillations)
    - Atrial fibrillation/flutter 7
    - Complete heart block 4
    - SVT 4
- Overall survival, 14-55%
- Limited in space, interventions and resources
- Approach essentially limited to BLS (+ epinephrine)
- Diversion should be recommended if resuscitation is successful

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Legal ramifications: Common questions

- Do any airlines themselves provide indemnity?
  - Some like British Airways and Virgin Atlantic.

J R Soc Med. 2006; 99:628-631. N Engl J Med. 2002; 346:1067-1073.
Medical Law International. 2017; 17:65-98. N Engl J Med. 2015;373: 939-45.

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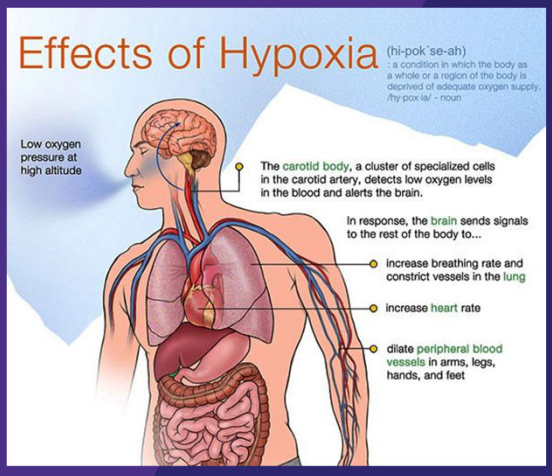
The cabin environment: Physiology of air travel

- Coronary bed vasodilation
- Pulmonary vasoconstriction
- Increased HR and BP
- Increased myocardial contractility
- Increased PA pressure



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