As the flight begins its descent, a call comes over the intercom: “Is there a physician on board?”

Has this ever happened to you??

Air Travel

- Air travel has emerged as one of the most popular, safe and convenient forms of travel
- The number of passengers traveling on commercial airlines has increased to close to 2 billion
- The average age of passengers and the number of passengers traveling with chronic disease is increasing
  - **Meaning:** the number of events aboard commercial airlines will increase

Physician Responders

- As a physician responder you may find yourself in a difficult environment
  - In front of many onlookers
  - In cramped quarters
  - Noise from the engine
- Must try to provide care with an incomplete history
  - History not known to clinician
  - Patient unable to obtain a history
- An incomplete Exam
  - Patient is not undressed in gown
  - Normal sitting position

How Often Do Medical Emergencies Occur?

- The precise incidence of inflight medical emergencies is unknown because there is no uniform or required reporting system
- Flight crews do not routinely report minor inflight medical incidents that do not require ground medical support

Physician Responders

- Managing conditions you do not normally treat
  - A pediatrician assisting an adult traveler
- With unfamiliar equipment
How Often Do Medical Emergencies Occur?

- One recent estimate shows that a medical event occurs in 1 of 14,000 passengers worldwide.
  - With a death rate of 0.1 to 1 per million passengers.
  - This estimate is probably high (350 events per day).
- A 2000 Federal Aviation Agency study involving ground-based medical support found a rate of 13 medical events per day on US domestic flights.

What emergencies are likely to occur?

- The most common events:
  - Fainting, near-fainting, dizziness, and hyperventilation.
- The most common serious events:
  - Cardiac, neurologic, and respiratory problems.
  - Account for the most flight diversions.
- Cardiac emergencies account for the most number of deaths.

What emergencies are likely to occur?

- Most medical events that occur are minor:
  - Less than half are serious enough to require ground-based medical assistance.
  - Only 13% are serious enough for the pilot to change course.
  - Pediatric emergencies occur less commonly.
- 1 call for every 21,000 flights.
- One study reported 11% of in-flight pediatric emergencies resulted in diversion of the aircraft.

How Often Do Medical Emergencies Occur?

- There is no standardized reporting system.
  - Minor emergencies are not reported.
- Some believe that we need a standardized reporting system for all inflight emergencies:
  - Improve the ability of the airline industry and physicians to better manage these events.
- Standardization should include a systematic debriefing for all those involved:
  - Debriefing would help improve the recording of the event as well as how to improve the handling of the incident.

What emergencies are likely to occur?

- Most inflight medical events are not serious:
  - 65% are related to preexisting problems.
  - 28% to new medical conditions.
  - 7% to traumatic injury (burn from hot drink or injury from falling luggage).

Medical emergencies involving children:

- Most are related to infectious disease (27%).
- Neurologic (15%).
- Respiratory (13%).
- GI problems (10%).
- Allergy (9%).
- Diversions for pediatric emergencies are more likely for neurologic (seizure) and respiratory (asthma) emergencies.
Inflight medical emergencies may occur because of the unique physiologic stresses of air travel:
- Cabin pressure
- Cabin air quality

Normal cruising altitude of commercial aircraft is 30,000 – 40,000 feet.
It is impractical to maintain cabin pressure at sea level pressure:
- Because of the weight of the aircraft and fuel economy
- Cabin pressure on commercial aircraft is usually equivalent to the barometric pressure found at an altitude of 5000 – 8000 ft above sea level.
  - There can be variation in pressure depending on the aircraft, weather conditions, and need for passenger comfort in turbulent conditions.

The normal cruising altitude of commercial aircraft is approximately 30,000 – 40,000 feet above sea level. However, maintaining cabin pressure at sea level would be impractical for several reasons:
- The weight of the aircraft and fuel economy
- The need for passenger comfort in turbulent conditions

Cabin pressure is usually equivalent to the barometric pressure found at an altitude of 5000 – 8000 ft above sea level, which is lower than at sea level. This difference in pressure can cause a decrease in the partial pressure of arterial oxygen in normal individuals.

The barometric pressure drops from 760 mmHg at sea level to approximately 560 mmHg at cruising altitude. This drop causes a decrease in the partial pressure of arterial oxygen.

In normal individuals, the PaO2 drops from a baseline of 95 mm Hg to 56 mmHg, representing a 4% reduction in the oxygen carried by blood. Since the partial pressure of 56 mm Hg lies on the flat part of the curve, there is only a 4% reduction in oxygen carrying capacity.

In a study by Goebert et al., the oxygen saturations of healthy passengers were measured.
- They found a decrease from 99% before takeoff to 96% during flight.
- Passengers may respond to this relative hypoxia with increased heart rate, cardiac output, respiratory rate, and respiratory volume.

In passengers with cardiopulmonary disease, the partial pressure of arterial oxygen at sea level is lower than normal, which can cause a steeper drop in oxygen saturation at ordinary cabin pressure.
- They are at increased risk for hypobaric hypoxia.
With cardiopulmonary disease the starting partial pressure is lower and on the steep portion of the curve causing a dramatic fall in oxygen saturation with the same decrease in barometric pressure.

Boyle’s Law

\[ P \times V = P' \times V' \]

Air and gas in the body decrease in pressure.

A cabin pressure equivalent to an altitude of 5000 ft results in expansion of air or gas volume by up to 30%.

In healthy passengers air expansion causes minor symptoms abdominal cramping or aural symptoms.

- The middle ear – most passengers have discomfort due to air expansion in the middle ear.
  - Equilibrate pressures by yawning, valsala, chewing gum or frequent swallowing.
  - Infants can suck on a bottle or pacifier.
  - Failure to equilibrate can cause tinnitus, vertigo, hearing loss or rupture of TM.
  - May be caused by otitis media, effusions, sinusitis and allergies.

Expansion of gas in the lungs:

- Pneumothorax
  - Especially in patients with COPD, CF or recent thoracic surgery.

Increased pressure in the GI tract:

- Abdominal distention
- Pain
- Nausea
- If recent abdominal surgery –
  - Risk of wound dehiscence, hemorrhage or bowel perforation.

Medical Devices with pneumatic components:

- Urinary catheters
- Feeding tubes
- Pneumatic splints
- Air filled cuffs of tracheostomy tubes
  - Instilling water instead of air can avert these problems.

Plaster casts applied within 48 hours should be bivalved to reduce the chance of circulatory injury.

There have been many studies to show aircraft cabins are safe and pose no risk to passengers.
Cabin Air Quality

- Cabin air is very dry
  - Humidity 10 to 20%
  - Can exacerbate reactive airway disease
  - Dry the skin and eyes

Transmission of air borne pathogens
- The aircraft’s air conditioning and ventilation system is able to maintain a low bacteria and fungi count
- Transmission has been reported for
  - TB
  - Influenza
  - Measles
  - Smallpox
  - Cholera
  - Enteritis
  - SARS

Risk of infection is greatest for
- Flights longer that 8 hours
- Among passengers sitting within 2 rows of the affected passenger

***CDC and WHO have established guidelines on when and how to notify passengers and flight crew who need antimicrobial chemoprophylaxis

Fear of liability has been cited as a reason preventing medical personnel from assisting during medical emergencies
- Gross et al asked 52 residents and attending physicians in NYC if they would volunteer on an airplane if help were requested
  - Not one physician surveyed admitted she would refuse care
  - Nor did they cite fear of legal liability as a deterrent

In the United States, Canada and UK physicians are not legally obligated to respond to an emergency
- Unless there is a preexisting physician patient relationship
- However, it is widely considered an ethical duty to provide help when possible

Some European countries (France and Germany) as well as Australia do impose a legal obligation for a physician to respond when help is requested by the crew
- The country in which the aircraft is registered has legal jurisdiction
- But it is possible that the laws of the country where the incident occurs or where the patient resides may play a role
Medical Liability

- Medical-legally responding to an emergency is very low risk
- There has never been a case of a physician being sued for providing assistance during an in-flight medical emergency

Medical Liability

- The Air Carrier Act of 1998 protects an physician who responds to a medical emergency
  - "An individual shall not be liable for damages for any action brought in 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 is guilty of gross negligence or willful misconduct"

Medical Liability

- The volunteer must
  - Be medically qualified to perform the service
  - Act voluntarily
  - Act in good faith
  - Not engage in gross negligence or willful misconduct
  - Receive no monetary compensation
  - Accepting a travel voucher, a free drink, or seat upgrade is NOT considered monetary compensation

Medical Liability

- Recommendations to avoid legal complications:
  - Obtain patient consent when possible
  - Use an interpreter if necessary
  - Recommend diversion to closest airport for any serious condition
  - Document in writing – history, exam, impression, treatment and communication with ground crew medical support
  - Be cautious with unfamiliar interventions

Who is available?

- 1991 study: physician travelers available for 85% of reported in flight emergencies.
- 2000 FAA study: 69% of all in flight emergencies occurring aboard US aircrafts between 1996 and 1997 were attended by a health professional.
  - 40% physician
  - 25% nurse
  - 4% paramedic

Additional personnel

- Flight attendants and pilots must be trained in CPR, including use of AED's
  - required to recertify every 2 years
- Remote emergency response centers
  - [www.medaire.com](http://www.medaire.com)
What is Medaire?

- Established in 1985 and credited as being the world's first global emergency response center
- Staffed by emergency physicians, registered nurses, and communication specialists 24 hours a day.

Medaire assistance while in flight

- Detailed information such as vital signs and ECG readings can be electronically sent to emergency personnel
- Some aircrafts have even become equipped with telemedicine devices

What is Medaire?

- Serves more than 2000 clients worldwide
- Provider of choice for:
  - 75% of the Fortune 100
  - the world's leading aircraft manufacturers
  - 50% of the world's superyachts
  - 115 airlines around the world

What equipment is available?

- FAA requires that all carriers with a payload capacity of more than 7,500 pounds (typically ≥ 30 passengers), and with at least 1 flight attendant must have an AED.
- Emergency medical kits (EMK) have also become a requirement.

Emergency Medical Kits

- Stethoscope
- Sphygmomanometer
- Oral/nares airways (range)
- Syringes (range)
- Needles (range)
- IV catheters (range)
- IV tubing
- Swabs, gloves
- Sharps box
- Urinary catheter
- Tourniquet
- Gauze, tape
- Surgical masks
- Flashlight, batteries
- Thermometer (non-mercury)
- Emergency (thoracotomy)
  - catheter for large-gauge IV
- Umbilical cord clamp
- Bag-valve-mask
- Basic life-support, advanced life-support cards
- List of equipment

Note: UC, ultrasound; US, ultrasound

Table 2: Medical equipment in the emergency medical kit

<table>
<thead>
<tr>
<th>Item 1</th>
<th>Item 2</th>
<th>Item 3</th>
<th>Item 4</th>
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Emergency Medical Kits

- Most EMK's have tubing to attach a portable oxygen source to a bag and mask device, with flow generally limited to 2–4L per minute.
- FAA recommends replacement of all medications annually.
- May be necessary to ask other passengers to volunteer their medications when they are not available in the EMK.

What to do in the event of an emergency

- Identify yourself to the flight crew as a medically qualified person
- Obtain verbal consent to examine and treat passenger or assume implied consent if passenger is unconscious or incapacitated
- Ask for EMK

Basic guidelines

- Acute agitation
  - benzodiazepine
  - may need restraints, request assistance to avoid injury and place in left lateral recumbent position
- Allergic reaction
  - diphenhydramine
  - epinephrine and steroids for anaphylaxis

Emergency Medical Kits

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What to do in the event of an emergency

- Do not hesitate to ask for help and establish communication with a ground based medical team
- Consider diversion of the plane if the passenger has chest pain, shortness of breath or dyspnea, severe abdominal pain, persistent unresponsiveness, signs of stroke, refractory seizure, or severe agitation.
  - ultimately up to the captain as a diversion can cost $3,000 to $100,000.

Basic guidelines

- Angina
  - morphine
  - oxygen
  - nitroglycerin (0.4 mg sublingual every 5 minutes prn), caution if patient is hypotensive
  - Aspirin
  - Request to fly plane at lower altitude to increase cabin pressure and improve oxygenation
Basic guidelines

- Dehydration
  - Normal saline bolus

- Seizure
  - Move away from objects for patient safety
  - Check for fever and hypoglycemia
  - Diazepam

- Shortness of breath
  - Bronchodilator
  - Consider steroids
  - Can request to fly at lower altitude

Basic guidelines

- Syncope
  - Vasovagal: elevate patient’s legs
  - Check glucose

- Unconscious
  - Oxygen
  - Establish IV
  - Check glucose
  - Naloxone
  - Check cardiac rhythm on the AED

Medical Fit for Travel

- The Air Carrier Access Act of 1986 prohibits airlines from discriminating against passengers with disabilities
  - Airlines do have a right to refuse passengers who are not medically fit to travel

Medical Fit for Travel

- Patients who should not fly:
  - Decompensated heart failure
  - Plaster casts applied within 48 hours
  - Feeding tubes or other catheters may be affected by the expansion of air or gas while flying
  - Those who have had a major surgical procedure within 14 days
  - Those with contagious diseases

Medical Fit for Travel

Prevention of in flight emergencies

- Passengers should carry medications on board rather than in checked luggage.
- Encourage passengers to stand and stretch their legs, especially during long flights.
Case # 1

- You are flying to Orlando when the flight attendant asks for any medical personnel to please identify themselves. After you tell them that you are a physician they ask you to help with a 4 yo girl who ate a cookie containing peanuts. She has a known peanut allergy. She now has stridor, hives, and swollen lips.
- Allergic reaction, possibly anaphylaxis
- What will you do?

Case # 1

- Ask for EMK
- Ask for Epipen or draw up Epi 0.01ml/kg of 1:1000 IM, max 0.5ml
- Consider steroids IM/IV
- Benadryl IV/PO
- Consider IVF
- Repeat Epi every 5 to 20 min as needed
- Talk to ground based medical team and flight crew

Case # 1

- Epipen has clear and simple directions on the device
- Can use another passenger’s meds if needed
- EpiPen
  - 0.3mg Epi
  - >30kg
- Epipen Jr
  - 0.15mg Epi
  - 15-30kg

Case # 2

- You are called to help with an 83 yo woman who is SOB and complaining of chest pain. She has a history of HTN, high cholesterol, some “heart trouble”. She has a long list of medications. She appears pale and sweaty.
- What will you do?

Case # 2

- Ask for help!
- Ask for EMK
- Check for pulses, BP, rhythm?
- Put AED on pt
- MONA
  - Morphine 3mg IM/IV
  - Oxygen
  - Nitroglycerine 0.4mg SL q5min x 3, caution if BP low
  - Aspirin 325 mg PO
- Check blood sugar

Case # 2

- Request captain to fly at lower altitude to increase cabin pressure and improve oxygenation
- Talk to ground based medical team
- Consider emergency landing
Case # 3
- You are called to help a 28 yo woman who is 32 weeks pregnant and complaining of severe back pain, nausea, and SOB. She has had an uncomplicated pregnancy thus far.
  - What will you do?

Case # 3
- Ask for help
- Ask for EMK
- Any other symptoms?
  - CP, HA, blurred vision, abdominal pain
  - Back pain details
- Vitals, especially BP
- Consider IVF
- Arrange for emergency landing

Case # 3
- As you are talking with the flight crew about an emergency landing, she complains of severe pressure “down there” and feels like she needs to push.
- You realize that she is in fact in labor and about to deliver…
- You deliver the baby’s head, suction the mouth then the nose, deliver the baby completely then dry/stimulate the baby as you instruct someone to clamp and cut the umbilical cord.
- Oxygen for baby, keep warm
- LAND!!

Case # 4
- You are called to help with a 19 yo male who passed out in his seat. He is traveling alone. He is pale, clammy and only responds to painful stimuli. He appears to have been incontinent of urine.
  - What will you do?

Case # 4
- Seizure/ hypoglycemia/ intoxication/ cardiac??
- Ask for EMK
- Vitals
- Give oxygen and put AED on
- Quick PE for any clues
- Establish IV if possible
- Check BS or give dextrose empirically
- Nalaxone 0.1 mg to 0.2 mg IV/IM

Case # 4
- Contact ground medical team
- Arrange for emergency landing
Buskin RJ. In-flight medical emergencies: time for a registry? Critical Care 2009; 13:121
Dowdall N. "Is there a doctor on the aircraft?" Top 10 in-flight medical emergencies. BMJ 2000; 321:1336
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