



**Into the Wild Blue Yonder:
Responding to In-Flight Medical Emergencies**

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Today's flight plan

1. Describe the **pathophysiology** of air travel and **contraindications** to boarding an airplane.
2. Reflect upon a medical provider's **duty to act** and **protections** for individuals who volunteer care.
3. Understand **how to approach an in-flight medical emergency (IME)** and **provide appropriate care** based on the symptoms/presentation.

Once bitten... (a real-life experience)

- Call for medical assistance on overnight trans-Pacific flight (Auckland to Honolulu) operated by a US-based carrier
- 20-something year-old woman had syncopal episode after exiting the lavatory and was now laid out in the galley
- Medical volunteers included a Family Medicine attending physician, Pediatrics resident physician, ICU nurse, and Anesthesiologist
- Direct communication with pilot revealed that diversion of the aircraft was not possible
- Cabin crew provided paper for documentation only upon request

Planes, trains, and automobiles

- Despite being surrounded by advanced technology, in some ways, aerospace medicine is **austere medicine**, like responding to an injury in the wilderness
- Commercial aircraft lack dedicated medical space and personnel (unlike cruise ships) and have limited medical equipment onboard
- Data on in-flight medical emergencies (IMEs) are lacking, and guidelines/best practices for volunteer medical professionals are unclear

Chandra/Conry, Donner, Nable/Brady (2018)

Under pressure

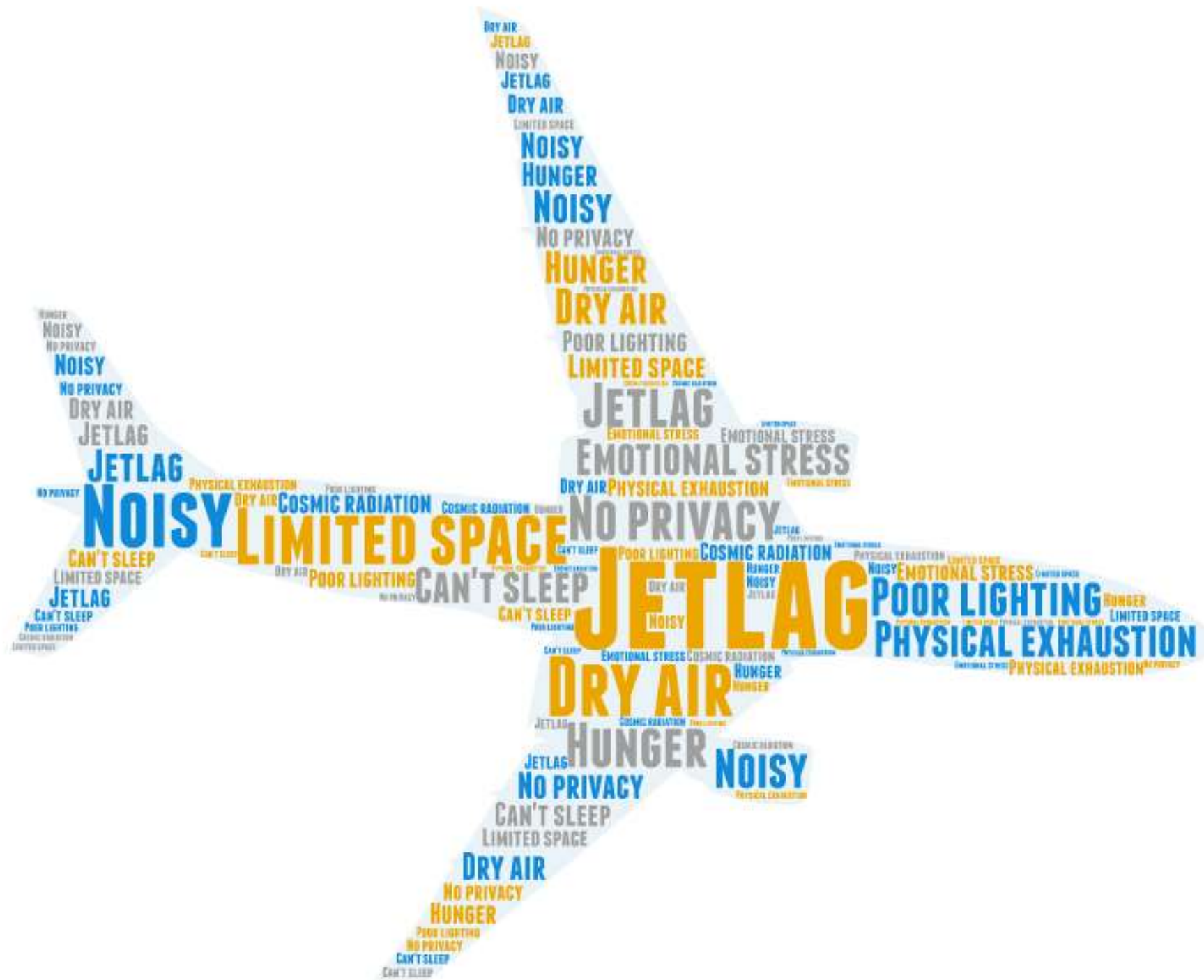
- Normal cruising altitude is 30,000-40,000 feet
- Aircraft cabin pressurized to equivalent of 5,000-8,000 feet
 - By comparison, Aspen is at about 8,000' elevation and La Paz is at about 11,975' elevation
 - The average person can ascend to about 7,800' without difficulty; however, COPD, Sickle Cell disease, OSA, etc. can cause impairment
- Lower partial pressure can result in mild hypoxia
 - Mean arterial oxygen saturation decreases by 3-5%
- Pressurization causes closed gas-containing spaces to expand as much as 30%
 - This can cause ear and sinus pain, and even dental pain

Bourell/Turner, Chandra/Contry, Donner, Kesapli et al, Martin-Gill et al, Meyers et al, Nable et al (2015)

Raindrops on roses (and whiskers on kittens)

- Cabin humidity is low (~2-7%)
 - This can cause dry eyes and dehydration (especially if drinking alcohol)
 - “Ideal” humidity for health and comfort is 40-50%
- No more than 40-50% of cabin air is recycled
 - High-efficiency filtration removes 94-99.9% of airborne microbes
 - Nonetheless, there may be some exposure to allergens, “fumes” (jet oils), and communicable diseases
- Cosmic radiation (about 0.003 mSv/h)
 - By comparison, a standard chest x-ray gives 0.1 mSv and a chest CT scan gives 7 mSv
 - Pregnant women should experience <1 mSv over their whole pregnancy (equivalent of about 30 one-way long-haul flights)

Donner, Martin-Gill et al



Bourell/Turner, Donner, Ho et al, Kodama et al, Nable et al (2015)

Pre-existing conditions

- Nearly two-thirds of IMEs are related to pre-existing health issues; less than one-third result from a new medical problem
 - Of pre-existing problems, respiratory issues, cardiovascular problems, and abdominal complaints were the most common
- Use caution with medical devices (e.g., pneumatic splints, feeding tubes, cuffed endotracheal/tracheostomy tubes, and urinary catheters)
- Portable oxygen concentrators (recommended if resting oxygen saturation <92% at sea level) need pre-flight approval by the airline

Bourell/Turner, Donner, Hinkelbein et al, Martin-Gill et al

Fitness to fly

- Individual airlines have their own policies regarding medical “clearance” prior to air travel
- The International Air Transport Association (IATA) recommends completion of a Medical Information Form (MEDIF):
 - If fitness to travel is in doubt due to recent illness, injury, hospitalization, surgery, or instability of acute/chronic medical condition, *or*
 - If special services are required (e.g., portable oxygen)
- Medical clearance is generally *not* required for wheelchairs or other assistive devices



O Médico assistente do viajante deve responder todas as perguntas. Use a página 4 como guia.

Marque "X" em "sim" ou "não", e fornecer respostas concisas e precisas.

Preencha este formulário pelo computador ou por escrito, em letras maiúsculas

The traveler's attending physician should answer all questions. See page 4 for guidance.

Mark "X" in the "Yes" or "No" boxes, and provide precise, concise answers.

Complete this form by computer or writing in block letters.

Este formulário deve ser assinado, digitalizado e enviado aos profissionais médicos designados pela United através do email medif.brasil@united.com.

This form must be signed, scanned and returned to United's designated medical professionals via email at medif.brasil@united.com.

Para ser integralmente preenchido pelo MÉDICO ASSISTENTE do passageiro (To be fully completed by ATTENDING PHYSICIAN)					
Código de referência das empresas aéreas Airline's reference code	Este formulário destina-se a fornecer informações CONFIDENCIAIS que permitam ao departamento MÉDICO da UNITED avaliar a adequação da saúde do passageiro em relação ao voo. Caso o passageiro seja aceito, estas informações permitirão que sejam tomadas as providências necessárias para proporcionar segurança e conforto ao mesmo. This form is intended to provide confidential information to enable United's designated medical professionals to assess the passenger's fitness to travel. If the passenger is fit to fly, this information will help United arrange and provide special assistance.				
MEDA 01	Identificação do PACIENTE (nome, idade, sexo): (PATIENT'S NAME, GENDER, AGE)				
MEDA 02	Identificação do MÉDICO ASSISTENTE ATTENDING PHYSICIAN	Nome e endereço (Name and address)	Contatos telefônicos Telephone numbers	Consultório: Business	Residência: Home
MEDA 03	INFORMAÇÕES MÉDICAS (MEDICAL DATA)				
	DIAGNÓSTICO: em detalhes (incluindo sinais vitais) DETAILED DIAGNOSIS (including vital signs)	Início dos primeiros sintomas Day/month/year of first symptoms	Data de cirurgias e/ou diagnósticos: Date of operation and/or diagnosis	PROGNÓSTICO para a viagem aérea: PROGNOSIS for the flight(s)/diagnosis	
MEDA 04	Portador de doença contagiosa e transmissível? Does the patient have a contagious or communicable disease?	Não <input type="checkbox"/> Sim <input type="checkbox"/>	Especificar: Specify		
MEDA 05	A condição física e/ou mental pode ser de alguma forma estressante ou desconfortável para os outros passageiros? Would the patient's physical and/or mental condition likely cause distress or discomfort to other passengers?	Não <input type="checkbox"/> Sim <input type="checkbox"/>	Especificar: Specify		
MEDA 06	O paciente é capaz de usar o assento da aeronave na posição vertical quando necessário? Can the patient use a normal aircraft seat with the seat back placed in the upright position when required?	Não <input type="checkbox"/> Sim <input type="checkbox"/>			

Contraindications to airplane travel

- <3 weeks after an uncomplicated myocardial infarction
 - <10 days after thoracic or abdominal surgery
 - <7 days after neurosurgical intervention
 - <24 hours after laparoscopy or colonoscopy
 - <24 hours after SCUBA diving
 - >34 weeks gestation[†]
- *And basically any unstable medical/psychiatric condition or active communicable disease*

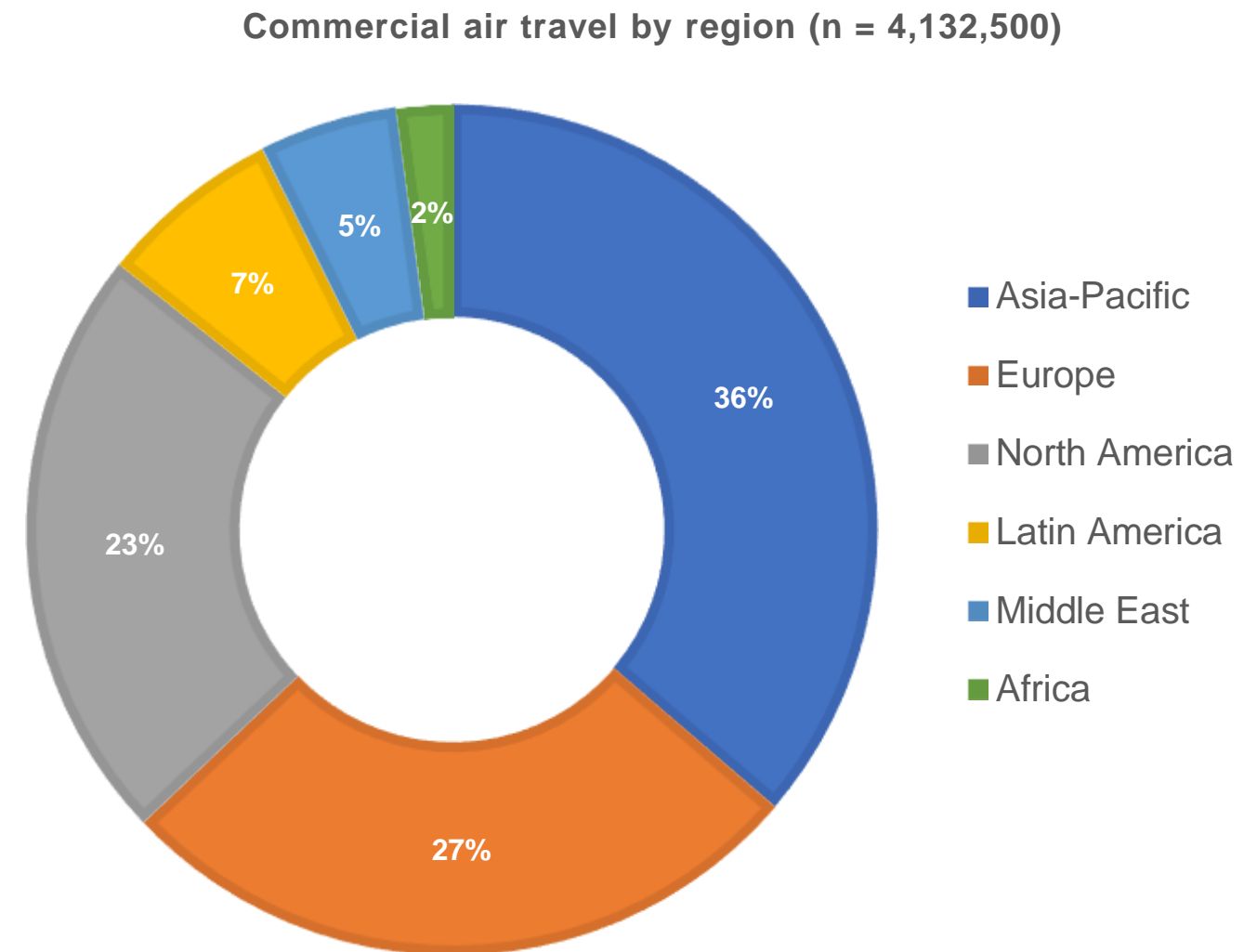
AsMA, Bourell/Turner, CDC, Donner, WHO

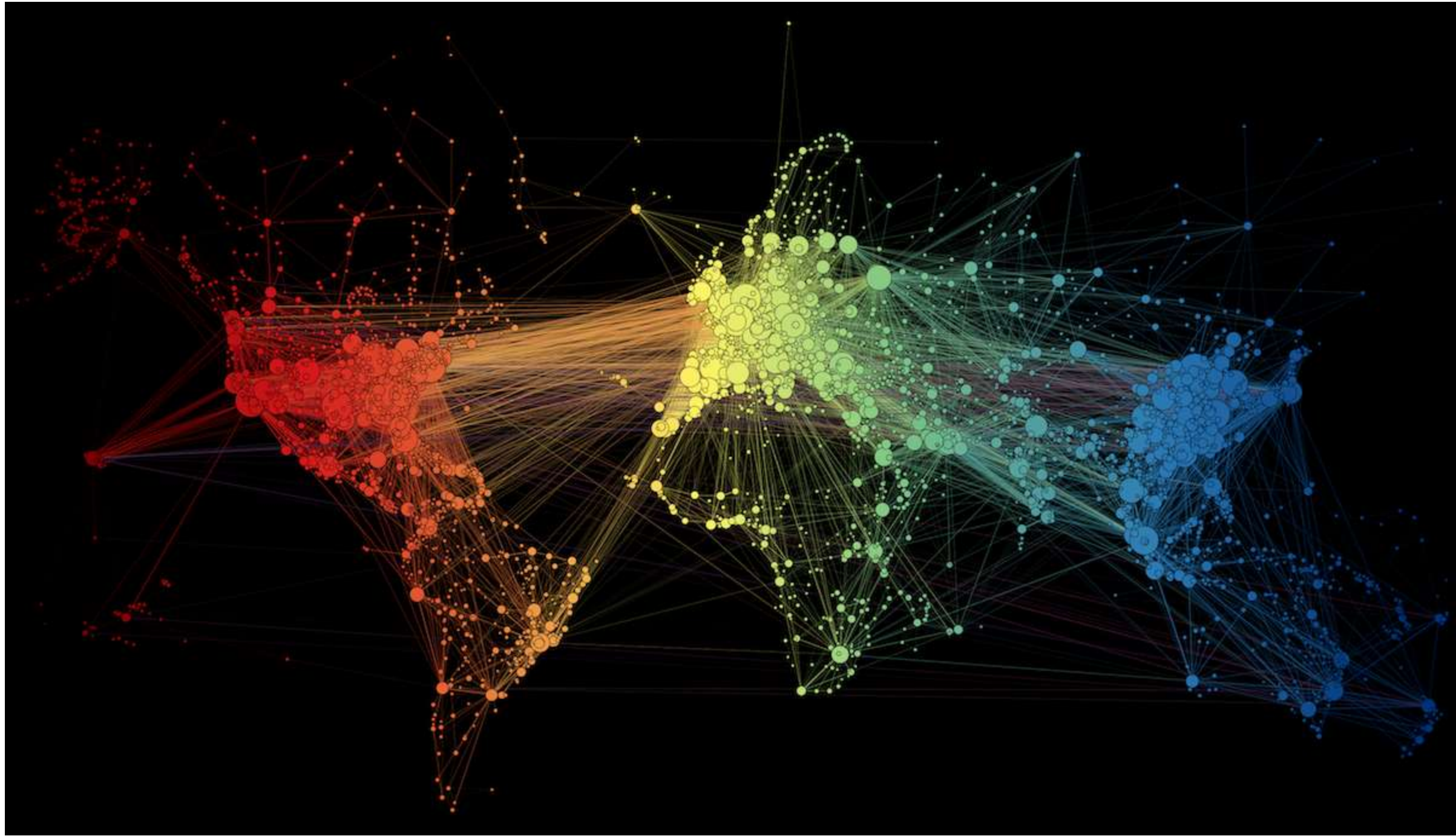
So what are “in-flight medical events”?

- Events range from trivial to serious
- Most issues are successfully managed with simple first aid (e.g., reassurance, OTC medications)
- In-flight medical emergencies (IMEs) are rare (considering the volume of passengers) but require higher-level care (e.g., additional equipment/supplies, medical advice from ground support, volunteer health professional, flight diversion)

Air traffic

- The IATA reported that 4.1 billion passengers[‡] traveled on scheduled, commercial airline services in 2017





Frequency of IMEs

- Unfortunately, airlines neither have to log nor report these events (unless they result in flight diversion)
- There is no internationally agreed-upon, standardized recording or classification system
 - It has been argued that creating such a system would be expensive and logistically-difficult
- **Best estimates are that 1 in 604 flights is affected by an IME**
 - With >100,000 commercial flights worldwide each day, this means ~166 IME/day
- With an aging global population, IMEs may be increasingly frequent

AsMA, Donner, Kesapli et al, Kodama et al, Martin-Gill et al, Nable/Brady (2018)

Cabin crew

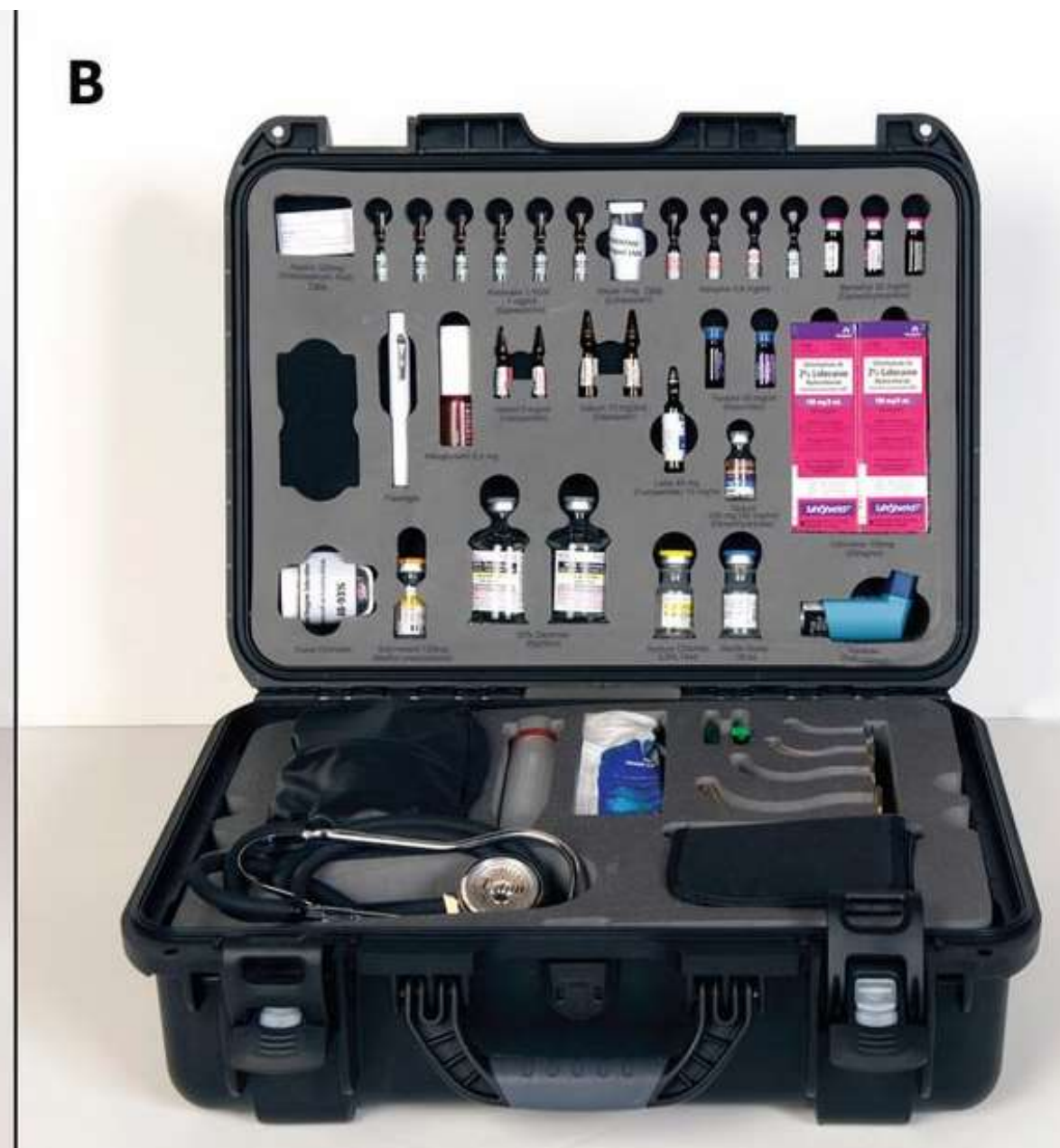
- Prior to World War II, nearly all American flight attendants were nurses; this was discontinued later to support the war effort
- Though the IATA provides a sample syllabus, medical training (and protocols) is up to the individual air carrier
 - The crew can handle most medical events on their own
 - They are trained in CPR and use of an AED
- Most airlines contract with third-party entities for ground-based medical support (e.g., MedAire, StatMD)
 - The crew may use a written telemedicine checklist (or not)

AsMA, Chandra/Conry, Kodama et al, Martin-Gill et al, Nable et al (2015), Nable et al (2017), Nable/Brady (2018)

On-board medical supplies

- Since 1986, the Federal Aviation Administration (FAA) has required emergency medical kits on commercial airplanes with a maximum payload capacity >7500 pounds and at least one flight attendant
 - In 2001, an AED was added as mandatory equipment (not required in Europe)
- These kits are intended for *unplanned* medical events and their contents are highly variable
 - Equipment generally must be justified by cost/benefit analysis
- The most commonly-used equipment includes oxygen, IV saline, and aspirin

AsMA, Donner, Martin-Gill et al, Meyers et al, Nable/Brady (2018)



Kodama et al

Typical aircraft first-aid kit

- Antiseptic swabs
- Hand cleanser or cleaning towelettes
- Disposable gloves (several pairs)
- Adhesive bandage strips
- Gauze bandage 7.5cm x 4.5cm
- Triangular bandage 100cm folded and safety pins
- Burn dressing, 10cm x 10cm
- Sterile compress (dressing), 7.5cm x 12cm
- Sterile gauze (dressing), 10.4cm x 10.4cm
- Adhesive tape, 2.5cm standard roll
- Surgical adhesive tape, 1.2cm x 4.6m
- Skin closure strips
- Pad with shield or tape for eye
- Scissors, 10cm (if permitted by applicable regulations)
- Tweezers, splinter
- Thermometer (non-mercury)
- Resuscitation mask with one-way valve
- First-aid manual (an operator may decide to have one manual per aircraft in an easily-accessible location)
- Incident record form
- Does *not* include ammonia inhalants

AsMA, Donner

Typical aircraft emergency medical kit

- Sphygmomanometer (electronic preferred)
- Stethoscope
- Oropharyngeal airways (appropriate range of sizes)
- Syringes (appropriate range of sizes)
- Needles (appropriate range of sizes)
- Intravenous catheters (appropriate range of sizes)
- System for delivering intravenous fluids
- Antiseptic wipes
- Venous tourniquet
- Sharp disposal box
- Disposable gloves
- Surgical mask
- Tape adhesive
- Urinary catheter with sterile lubricating gel
- Sponge gauze
- Emergency tracheal catheter (or large gauge intravenous cannula)
- Umbilical cord clamp
- Thermometer (non-mercury)
- Flashlight and batteries (operator may choose to have one per aircraft in an easily-accessible location)
- Bag-valve mask
- Basic life support cards
- Carriage of automated external defibrillator (AED) determined by operator based on risk assessment (i.e., not mandated by ICAO)

AsMA, ASHP, Chandra/Conry, Donner, Martin-Gill et al, Nable et al (2015/2018)

Typical medications in an aircraft kit

- Epinephrine 1:1000
- Epinephrine 1:10000 (can be a dilution)
- Injectable or oral antihistamine
- Injectable or oral adrenocortical steroid
- Sodium chloride 0.9% (1000mL recommended)
- 50% dextrose, 50mL (single dose ampule or equivalent)
- Nitroglycerin tablets or spray
- Strong non-narcotic injectable or oral analgesic
- Oral acetylsalicylic acid (i.e., aspirin)
- Oral beta-blocker
- Injectable diuretic
- Injectable local anesthetic
- Injectable or oral antiemetic (e.g., ondansetron)
- Bronchodilator inhaler (e.g., albuterol) with disposable collapsible spacer
- Anti-psychotic drug (e.g., haloperidol)
- Injectable sedative/anticonvulsant
- Injectable atropine
- If available, epinephrine auto-injectors can be used by cabin crew under direction from ground medical advisor
- Similarly, alternative methods of drug administration (e.g., nasal spray, sublingual spray, oral-dissolving tablet) may be used instead of injection

AsMA, ASHP, Chandra/Conry, Donner, Kodama, Martin-Gill et al, Nable et al (2015/2018)

Typical aircraft universal precaution kit

- Dry powder that can convert small liquid spill into a granulated gel
- Germicidal disinfectant for surface cleaning
- Skin wipes
- Face/eye mask (separate or combined)
- Disposable gloves
- Impermeable full-length long-sleeved gown that fastens at the back
- Large absorbent towel
- Pick-up scoop with scraper
- Bio-hazard disposal waste bag
- Instructions



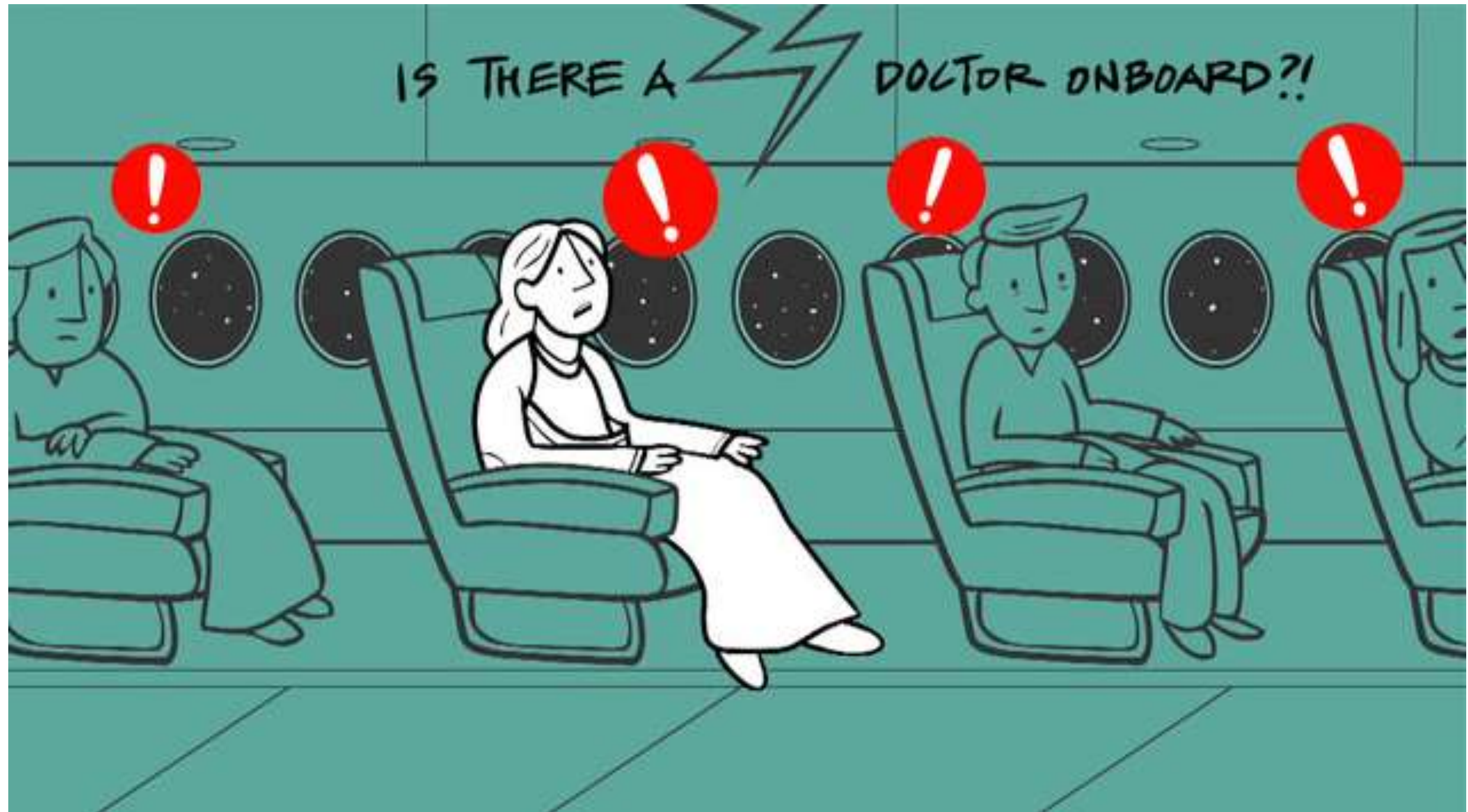
AsMA

So what's missing?

- Equipment for pediatric or obstetric emergencies, or dental problems
- Antibiotics
- Glucometer
- Naloxone
- Splinting material



Martin-Gill et al, Nable et al (2017), Nable/Brady (2018)



To volunteer or not to volunteer (that is the question)

- Think about whether you're ready to volunteer *before* an IME occurs
- Honestly consider your own abilities/capabilities
 - Defer to other personnel who may be better suited to respond
- Weigh your ethical and legal responsibilities
- Medical volunteer's role:
 - Gather information
 - Assess ill/injured passenger
 - Aid with communication to ground-based support
 - Potentially administer medications and/or perform procedures



AsMA, Chandra/Conry, Kodama et al, Martin-Gill et al

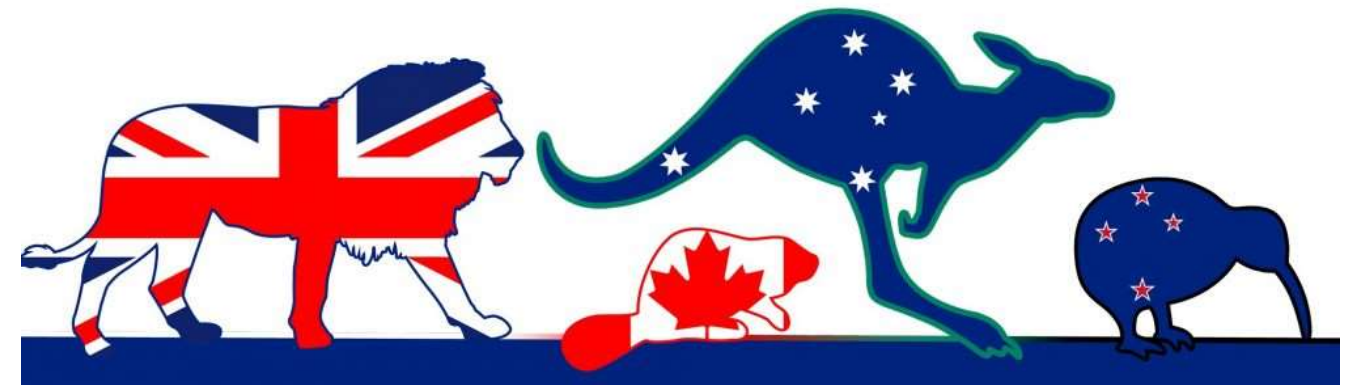
Ethical imperatives

- Most medical providers feel an ethical duty to act
- But first, do no harm
- Even if you don't feel able to provide medical decision-making, you can still offer your hands, both to other volunteers and to the patient who may need comfort

Ho et al, Martin-Gill et al, Roach

Legal liability

- *In the US, Canada, and UK, off-duty medical professionals have no legal duty to help; in Australia, New Zealand, and much of Europe, however, they are*
- When the plane is airborne, the law of the country where the carrier is registered is what is in effect



Bourell/Turner, Chandra/Conry, Martin-Gill et al, Meyers et al, Nable et al (2017)

Aviation Medical Assistance Act (1998)

- “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**.” (Section 5b)

<https://www.govinfo.gov/content/pkg/CRPT-105hrpt456/pdf/CRPT-105hrpt456.pdf>

AMAA (con't)

- Does *not* give medical providers legal authority over the crew
 - But it *does* allow protection against harm caused by lack of appropriate equipment or refusal/inability to divert the aircraft
- Only covers “emergencies,” but providers do not need to be asked to give assistance to receive the protections
 - If the patient does not consent to treatment, a volunteer could be accused of battery if they touch them
- The volunteer should maintain confidentiality, but the airline itself does not have to follow health care privacy
- Receipt of monetary compensation *may* jeopardize the protections afforded by the AMAA (no case law yet exists)

Nable et al (2015), Roach

Providing medical care

- **Competence**
 - Work within the limits of your training
- **Communication**
 - Both with the patient and the crew
 - Disclose specialty and level of training
 - Apprise crew of your clinical assessment
- **Collaboration**
 - With crew and any other volunteers
- **Consent**
- **Clinical documentation**
 - Maintain medical notes and monitoring records



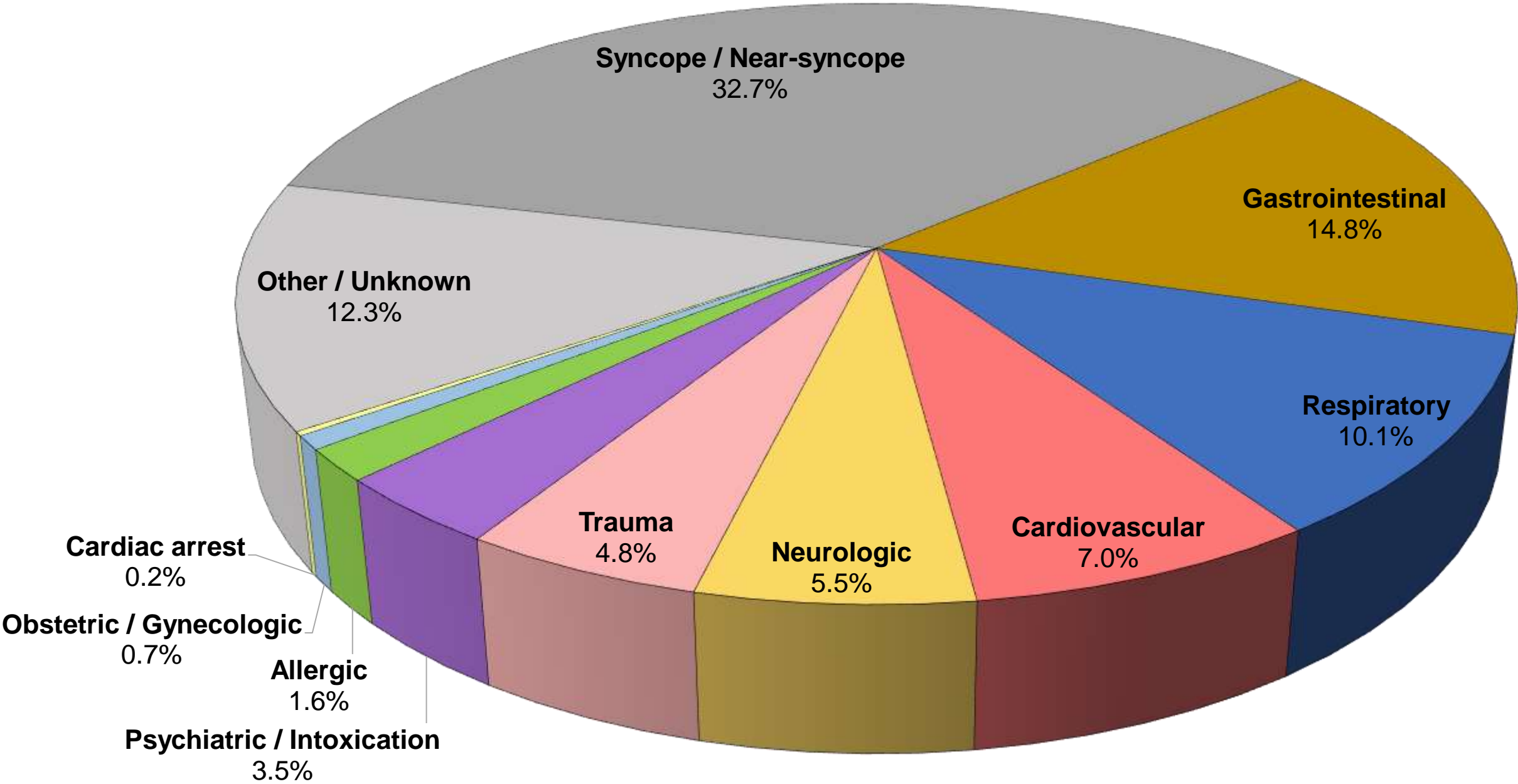
Ho et al

In-flight assessment and plan

- Patient age/gender
- Mental status (consciousness)
- Vital signs (pulse, blood pressure, respiratory rate)
- Type and duration of symptoms
 - High-risk symptoms include chest pain, shortness of breath, and focal weakness
- Injuries (if present) and other pertinent physical findings
- Clinical impression/diagnosis
- Urgent/emergent treatment needed
- Recommendations regarding flight diversion

Ho et al, Martin-Gill et al

Frequency of In-Flight Medical Emergencies by Condition (n = 49,100)



Martin-Gill et al

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
Stroke-like 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

Martin-Gill et al

Guiding light

- *Ground-based recommendations ultimately direct care on board*
 - Communication is usually via the pilot in command (captain)
 - The co-pilot (first officer) usually takes over flying the aircraft while the captain takes over cockpit management of the IME



AsMA, Donner, Ho et al, Kesapli et al, Martin-Gill et al

Specific situations

- Loss of consciousness most likely due to vaso-vagal syncope
- If concern for significant communicable disease, separate the patient from other passengers
- Trauma on board more often burns than blunt trauma (as from falling luggage), lacerations, or fractures

AsMA, Donner, Ho et al, Kesapli et al, Martin-Gill et al

The clot thickens

- Symptoms of a DVT or PE usually present hours to days after completing air travel, but can even occur during long flights or multiple flights in succession
 - Asymptomatic emboli may occur in up to 10% of long-haul passengers!
 - Risk of venous thromboembolus in flights >4 hours (high risk if >8 hours)
 - 4-fold increase in incidence of DVT 2 weeks after a long-haul flight
 - Incidence 1.5/million in flights >5000km (by comparison, 0.01/million in flights <5000km)
 - Aspirin prophylaxis may not help, but a single dose of LMWH 2-4 hours before travel might

Bourell/Turner, Kesapli et al, Martin-Gill et al

Be still my beating heart

- Cardiac events are not the most common IME, but they do account for the majority of in-flight deaths
- Could consider asking the pilot to take the aircraft to a lower altitude (so mean cabin pressure is closer to that of sea level)
- Sudden in-flight cardiac arrest likely due to VF/VT (89% of cases)
- Survival rates after cardiac arrest/use of AED range from 20-40%
- Death occurs in approximately 0.3% of all IMEs

Bourell/Turner, Donner, Kesapli et al, Hinkelbein et al, Nable et al (2015), Nable/Brady (2018)

Living wills and DNR instructions

- No international or case law covers these orders
- *Airlines generally do not recognize them*, so a volunteer medical professional may be tasked with whether to proceed
 - If they decline, based on ethical values and/or limited legal knowledge of the situation, the airline may actually seek another volunteer!



AsMA

Table 5. Approach to common in-flight medical incidents.

Syncope	Assess vital signs, cardiovascular exam, and neurological exam. Recommend diversion for hypotension, arrhythmia, or suspected stroke.
Altered Mental Status	Assess for toxidromes. Administer oxygen, establish intravenous access and administer normal saline and dextrose 50%.
Seizure	Clear space around passenger. Administer sedative/anticonvulsant (benzodiazepine if available). Provide supportive care during post-ictal period. Recommend diversion for status epilepticus.
Chest Pain	Assess vital signs. Perform cardiovascular and respiratory exam. Administer oxygen, nitroglycerin, and aspirin. Recommend diversion for arrhythmia, abnormal vital signs, or concern for myocardial infarction.
Respiratory	
a) Asthma Exacerbation	a) Administer inhaled bronchodilator and oxygen. Consider intravenous steroid for moderate to severe symptoms. Consider intramuscular epinephrine (0.3 to 0.5 ml of 1:1000 solution) for severe symptoms.
b) Suspected Pneumothorax	b) Perform needle thoracostomy for suspected tension pneumothorax (unequal breath sounds, chest pain, dyspnea). Recommend diversion.
c) Suspected Congestive Heart Failure	c) Administer oxygen, assess vital signs and establish intravenous access. Administer oral nitroglycerin and intravenous diuretic. Recommend diversion.
Allergic Reaction	For mild allergic reaction, administer intravenous antihistamine and corticosteroids. For severe allergic reaction/anaphylaxis, administer intramuscular epinephrine (0.3 to 0.5 ml of 1:1000 solution).
Gastrointestinal	
a) Nausea/Vomiting	a) Administer antiemetic. Establish intravenous access and administer normal saline.
b) Diarrhea	b) Establish intravenous access and administer normal saline.
Pregnancy Complications	Assess vital signs and establish intravenous access. Recommend diversion for abdominal pain or vaginal bleeding.

Chandra/Conry



SYNCOPE / NEAR-SYNCOPE

30% of all in-flight emergencies

Initial assessment-suspect

- ☐ **Vasovagal:** Pale, diaphoretic, improves with simple measures in 15-30 min.
- ☐ **Cardiac cause (eg, myocardial infarction):** Chest pain, dyspnea, arm or jaw pain, persistent bradycardia.
- ☐ **Pulmonary:** Dyspnea, pleuritic chest pain.
- ☐ **Stroke:** Slurred speech, facial droop, or arm weakness.
- ☐ **Hypoglycemia:** Diaphoretic, cool skin; assess with glucometer if available.

Management and expected course

- ☐ **If unconscious** ▶ Lie flat, elevate legs, apply oxygen. If no pulse or signs of life, follow cardiac arrest card.
- ☐ **If transient syncope** ▶ Supine position, elevate legs. Oral fluids with head raised if nausea absent. If improves in 15-30 min, slowly sit up and return to seat if tolerated.
- ☐ **If hypoglycemia** ▶ Oral glucose or 25 g of dextrose 50% intravenously.
- ☐ **If other conditions suspected** ▶ Refer to relevant card.
- ☐ **If no improvement or not progressing as expected** ▶ Contact ground-based medical support for additional recommendations.



CARDIOVASCULAR SYMPTOMS

7% of all in-flight emergencies

Initial assessment

- ☐ Identify if any prior myocardial infarction or other cardiovascular history.
- ☐ In some settings, a 12-lead electrocardiogram may be obtained and transmitted for ground review (and/or volunteer review if qualified to read).
- ☐ **Suspected acute coronary syndrome:** Chest pain, dyspnea, arm or jaw pain.
- ☐ **Suspected arrhythmia:** Persistent bradycardia, tachycardia, or irregular heartbeat.
- ☐ **Suspected dyspepsia:** Isolated epigastric burning with no associated symptoms. This is a consideration of exclusion, supported by history of similar symptoms.

Management and expected course

- ☐ **If suspected acute coronary syndrome** ▶ Aspirin, 325 mg orally; nitroglycerin, 0.4 mg sublingually every 5-10 min (if systolic blood pressure is ≥ 100 mm Hg).
- ☐ **If any dyspnea or respiratory distress** ▶ Give oxygen, unless saturations are known to be near or at normal levels.
- ☐ **If dyspepsia suspected** ▶ Antacids or other analgesics can be given after appropriate risk stratification. Alternative causes should first be considered.
- ☐ **If persistent or additional symptoms** ▶ Contact ground-based medical support for additional recommendations.

Martin-Gill et al



GASTROINTESTINAL ILLNESS

15% of all in-flight emergencies

Initial assessment

- ☐ Identify extent and timing of symptoms, including nausea, vomiting, diarrhea, bleeding, and specifics of any abdominal pain (location, quality, and severity).

Management and expected course

- ☐ **If nausea/emesis** ▶ Use an oral antiemetic if available; if not tolerated, consider a parenteral antiemetic.
 - Provide oral hydration if tolerated.
 - Use sugar-containing liquids if symptoms of hypoglycemia.
 - If oral intake not tolerated, consider intravenous fluids.
- ☐ **If dyspepsia** ▶ Use an antacid if available in the emergency medical kit.
- ☐ **If diarrhea** ▶ Use an antidiarrheal if available in the emergency medical kit.
 - If patient has fever and persistent diarrhea (>14 d), contact ground-based medical support, as local public health authorities may need to be contacted at the destination.
- ☐ **If severe abdominal pain, tenderness on examination, rigid abdomen, or blood in bodily fluid** ▶ Contact ground-based medical support for additional recommendations.



STROKELIKE SYMPTOMS

Up to 5% of all in-flight emergencies

Initial assessment

- ☐ A focused history should include the time of symptom onset, specific motor and sensory components, and any other associated symptoms including headache or sensorium changes.
- ☐ **Screening for stroke:** Speech disturbance, facial droop, or arm weakness.

Management and expected course

- ☐ Administer oxygen, unless saturations are known to be near or at normal levels.
- ☐ **If patient has ongoing neurological deficits suggestive of a stroke** ▶ Contact ground-based medical support.
 - Recommendation may include diversion, which may not be to the closest airport if stroke care is not present at that airport.
 - Ground-based team should have information on capabilities for medical care near most major airports.

Martin-Gill et al



RESPIRATORY DISTRESS

10% of all in-flight emergencies

Initial assessment

- ☐ Identify history of respiratory disease, scuba diving, extremity swelling, or infectious symptoms.
- ☐ If available, check pulse oximetry.

Management and expected course

- ☐ **If ongoing dyspnea or known oxygen saturation is <95% ▶** Administer oxygen.
 - If passenger's portable oxygen concentrator fails or is not used for a patient with preexisting lung disease, consider trial of oxygen therapy.
 - If passenger uses ≥ 4 L/min on the ground, the onboard oxygen supply may not be enough to reverse hypoxia.
 - Monitor flow rate of oxygen administered; canister consumption is variable and aircraft may not have sufficient oxygen for continuous use for the duration of the flight.
- ☐ **If bronchospasm ▶** Administer albuterol, 2.5 mg inhaled.
- ☐ **If allergic reaction ▶** Refer to allergic reaction card.
- ☐ **If passenger does not improve ▶** Contact ground-based medical support for additional recommendations.



SEIZURE

Up to 5% of all in-flight emergencies

Initial assessment

- ☐ **Identify the symptoms the passenger exhibited during the event:** Including onset, duration of movement activity, quality of movements (eg, tonic-clonic), and loss of bowel or bladder function.

Management and expected course

- ☐ **If unresponsive ▶** Lay passenger on floor on side, monitor airway, and assess vital signs with ongoing neurological examination as above.
- ☐ **If ongoing seizing ▶** Administer parenteral benzodiazepines if available in the emergency medical kit (not usually available on US commercial airlines).
- ☐ **If alert following a prolonged or recurrent seizure ▶** Ground-based medical support may recommend an added dose of the patient's own antiepileptic medication (if history of seizures and available) or an oral benzodiazepine (if available in the emergency medical kit).
- ☐ **If seizure resolves and patient regains normal mental status ▶** Diversion is not commonly necessary.

Martin-Gill et al



TRAUMA

5% of all in-flight emergencies

Initial assessment

- ☐ Assess all injuries for any open wounds, tenderness, deformity, or active bleeding.
- ☐ Assess patients with injury to the head, neck, or back for any neurological symptoms.

Management and expected course

- ☐ **Injuries from falling luggage** ▶ Typically minor and may be assessed further at the destination.
- ☐ **Active bleeding** ▶ Control bleeding with direct pressure using a gloved hand.
- ☐ **Ongoing heavy extremity bleeding** ▶ Consider applying a tourniquet.
- ☐ **Suspected long bone or joint injuries** ▶ Splinting material is not commonly found in the emergency medical kit, but may be improvised from available equipment (eg, a U-shaped half-rolled magazine secured with tape will make a good forearm or wrist splint).



ALLERGIC REACTION

2% of all in-flight emergencies

Initial assessment

- ☐ Identify any known or likely allergen exposure; duration and severity of symptoms; and any airway swelling, respiratory involvement, or signs of systemic reaction such as generalized hives.
- ☐ **Suspected local allergic reaction:** Localized pruritic rash or isolated hives.
- ☐ **Suspected anaphylaxis:** Airway swelling, respiratory distress, generalized hives, hypotension, nausea/vomiting.

Management and expected course

- ☐ **If local allergic reaction** ▶ Diphenhydramine, 25-50 mg in adults or 1 mg/kg in children orally.
 - If unable to tolerate oral ingestion, diphenhydramine intravenously/intramuscularly at above dose.
 - Try a different histamine blocker if available in the emergency medical kit.
- ☐ **If anaphylaxis** ▶ Epinephrine, 1 mg/mL (0.3 mL in adults, or 0.15 mL in children intramuscularly), diphenhydramine, and steroids if available in the emergency medical kit. Epinephrine may be available as an autoinjector or in an ampoule to be drawn up via syringe.
- ☐ **If there is no improvement** ▶ Contact ground-based medical support for additional recommendations.

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PSYCHIATRIC SYMPTOMS

Up to 3% of all in-flight emergencies

Initial assessment

- ☐ Aim to create a rapport with the passenger to deescalate the situation.
- ☐ Elicit information and consider the passenger's use of mood-altering substances.
- ☐ Identify if patient takes specific psychiatric medications, dosing, last dose taken, and if available on aircraft.

Management and expected course

- ☐ **If verbal deescalation ineffective** ▶ Consider a benzodiazepine if available from an extended emergency medical kit.
 - Benzodiazepines are not commonly available in the emergency medical kit and are infrequently necessary even when available.
- ☐ **If combative** ▶ Refer to flight crew for individual airline security protocols, which take precedence over attempts at medical management.
 - Airline security protocols vary by airline and may include restraining the passenger or diverting the aircraft for the safety of other passengers and crew.



OBSTETRIC EMERGENCIES

1% of all in-flight emergencies

Initial assessment

- ☐ Identify onset and detailed description of symptoms, along with information about the pregnancy (eg, parity, gestational age, and any preceding complications).
- ☐ **Vaginal bleeding:** Assess duration and severity (ie, equivalent of pads per h).
- ☐ **Labor suspected:** Regular contraction, gush of vaginal fluid.

Management and expected course

- ☐ **If vaginal bleeding <1 pad per h** ▶ Expectant management is common.
- ☐ **If preterm labor in third trimester** ▶ Place the passenger on left side and consider fluid intravenously if any concerns exist for blood loss or distress.
- ☐ **Active labor, ongoing/severe vaginal bleeding, or increasing/severe abdominal pain** ▶ Contact ground-based medical support for additional recommendations.

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SUBSTANCE ABUSE AND WITHDRAWAL

Up to 3% of all in-flight emergencies

Initial assessment

- ☐ Identify type, amount, and timing of substances used.
- ☐ Identify symptoms and mental status, along with vital signs.
- ☐ **Suspected opioid ingestion:** Altered mentation, constricted pupils, respiratory depression.
- ☐ **Suspected alcohol ingestion:** Altered mentation, slurred speech, behavior changes.
- ☐ **Suspected stimulant ingestion:** Altered mentation, tachycardia, dilated pupils, agitation.

Management and expected course

- ☐ **If normal vital signs and no respiratory compromise** ▶ Observation only.
- ☐ **If suspected opioid ingestion with respiratory depression** ▶ Naloxone, 0.4-0.8 mg intravenously or 2 mg intramuscularly/intranasally.
- ☐ **If suspected alcohol overdose** ▶ Observe and provide antiemetic therapy.
- ☐ **If suspected stimulant ingestion** ▶ Observe and hydrate (for tachycardia). Consider benzodiazepine if available from the emergency medical kit.
- ☐ **If ongoing respiratory distress or combativeness** ▶ Contact ground-based medical support for additional recommendations. Refer to airline crew for individual airline security protocols.



CARDIAC ARREST

0.2% of all in-flight emergencies

Initial assessment

- ☐ Check breathing and pulse; limit pulse checks to <10 seconds.

Management and expected course

- ☐ **If no pulse or signs of life** ▶
 - Start chest compression-only cardiopulmonary resuscitation, with addition of bag-valve-mask ventilation (30 compressions to 2 ventilations) when the emergency medical kit is available and someone skilled is present.
 - Obtain and apply automated external defibrillator as soon as possible and follow instructions for defibrillation.
 - If no shock is advised, or AFTER a shock is delivered, resume cardiopulmonary resuscitation if there is no pulse.
 - If no response to cardiopulmonary resuscitation and automated external defibrillator, initiate an intravenous line. Administer epinephrine (0.1 mg/mL) 1 mg intravenously, along with consideration of causal reversible conditions such as hypovolemia and tension pneumothorax.
- ☐ Instruct flight crew to notify the ground team and pilot if not already done. If no shock is delivered, the decision to divert will be influenced by how long ongoing cardiopulmonary resuscitation exists without return of circulation.

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“Hey, this isn’t Albuquerque!”

- Diversion of aircraft occurs in approximately 2-8% of IMEs
- Emergency landing decisions (ELDs) depend on many factors, including remaining fuel on board (may have to be dumped), closest airport and its facilities, and time to actually land (≥ 30 minutes from cruising altitude)
- Diversion most often due to cardiac symptoms/arrest, suspected stroke, and obstetric emergencies
- *The pilot in command ultimately decides whether to divert or not*
- Cost of diversion ranges from \$3,000-900,000 (!)

AsMa, Bourell/Turner, Chondra/Conry, Donner, Kodama et al, Martin-Gill et al, Meyers et al, Nable et al (2017)



Martin-Gill et al

Termination of resuscitation

- CPR should be continued until:
 - Spontaneous breathing/circulation resume
 - It becomes unsafe to continue CPR (e.g., severe turbulence)
 - All rescuers are too exhausted to continue
 - Care is transferred to EMS upon landing, *or*
 - The victim is presumed dead (≥ 30 min CPR without signs of life, no shocks advised by AED)
- Only a physician can pronounce death during a flight, but this may be unwise due to various legal implications

Donner, Martin-Gill et al, Nable et al (2015)

An ounce of prevention

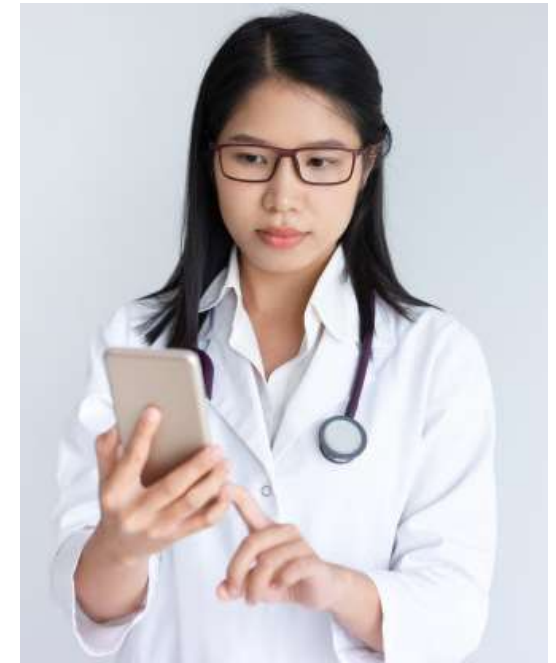
- Passengers with medical conditions (e.g., diabetes, hypoxia) should carry appropriate equipment (e.g., glucometer, extra battery for portable oxygen concentrator)
- Stay hydrated and eat meals/snacks regularly
- Avoid alcohol
- Rest as possible, but don't forget to stretch



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Airline programs and other preparation

- Inquire about programs such as Lufthansa's "Doctor On Board"
- Use your smartphone to your advantage; it can give you access to pharmacopias (e.g., ePocrates, About Herbs, AirRx), key papers, etc.



Roach

Challenges of IMEs

- Lack of standardization in medical kits
- Lack of mandatory or standardized reporting of IMEs
- Lack of post-flight follow-up on non-emergent issues (e.g., DVT)
- Lack of standardized medical protocols
- Relative infancy of telemedicine technologies

Checklist for volunteer medical professionals

- Prior to travel, consult with malpractice insurance provider as to what is covered
- Carry a copy of medical license/proof of credentials (generally not required)
- During travel, only volunteer if free of other distractions/liabilities (e.g., traveling with a small child, have ingested alcohol or sedative medication)
- Ask the crew for more information (e.g., information on personal liability, contract with medical ground support company)
- If feasible, ask the passenger for permission to treat
- Request appropriate supplies (e.g., medical kit, telemedicine equipment, AED)

AsMA, Chandra/Conry, Roach

Summary checklist (con't)

- Request a crew member remain available to fetch equipment, help with procedures, communicate with the pilot, act as interpreter, etc.
- If the passenger cannot remain seated, move him to a location which will interfere with the least with mobility of the crew/other passengers
- Evaluate any DNR documentation that is presented and decide personally if this is acceptable
- Document the encounter (evaluation and treatment); keep a copy
- *Do not practice beyond your level of expertise*

AsMA, Chandra/Conry, Roach

Ladies and Gentlemen, one of our passengers is experiencing mild non-specific generalized symptoms that will likely get better on their own...
Is there a Naturopathic doctor on the plane?



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