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Conflict of Interest Disclosure Statement

- *Erin M. Foley, DNAP, MSNA, CRNA, FAANA*
- I have no financial relationships with any commercial interest related to the content of this activity.
- I will **not** discuss off-label use during my presentation.

2

Learner Outcomes

1. Identify the most common in-flight medical emergencies (IME).
2. Identify the equipment and resources available to CRNAs in an IME.
3. Discuss the role of the medical volunteer in an IME.
4. Discuss the medico-legal issues of the medical volunteer in an IME.

3

4

The Numbers

- Number of flights worldwide in 2021 was 22.2 million down from 38.9 in 2019
- 4.5 billion passengers in 2019
- 115,000 commercial flights per day
- Expected to increase 4.3% per annum over the next 20 years

5

6

Occurrence of IME

- In-flight medical emergencies or events are estimated to occur in approximately 1 per 604 flights
- 24 to 130 IMEs per 1 million passengers
- Equivalent to 260-1,420 events every day worldwide

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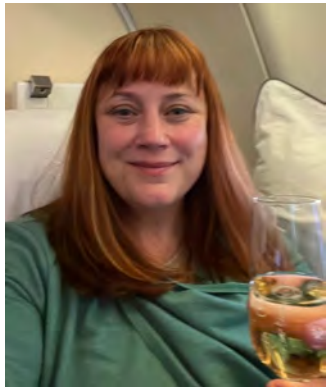

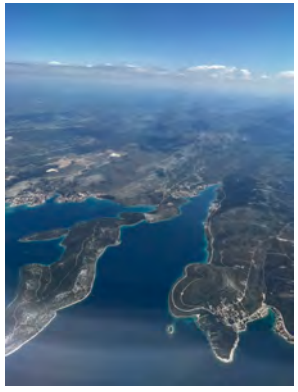

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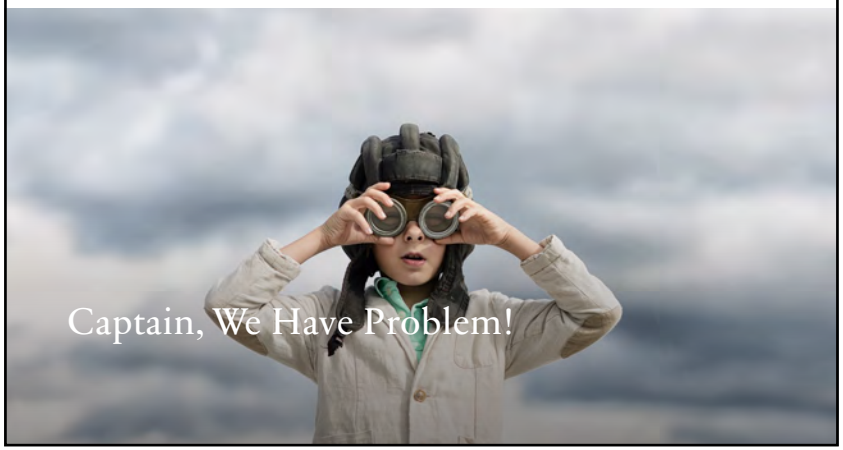

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Minimum Requirements in US

- AED
- Equipment to obtain a basic assessment, hemorrhage control, and initiation of an intravenous line
- Medications to treat basic conditions.
- Other countries have different minimum medical kit standards, and individual airlines have expanded the contents of their medical kit

11

Required Medications

•Analgesic, nonnarcotic, 325-mg tablets, 4
•Antihistamine, 25-mg tablets, 4
•Antihistamine injection, 50-mg single-dose ampule or equivalent, 2
•Atropine injection, 0.5-mg single-dose 5-mL ampule or equivalent, 2
•Aspirin, 325-mg tablets, 4
•Bronchodilator, metered-dose inhaler or equivalent
•50% Dextrose injection, single-dose 50-mL ampule or equivalent
•Epinephrine injection, 1:1000 (1 mg/mL) single-dose 1-mL ampule or equivalent, 2
•Epinephrine injection, 1:10,000 (0.1 mg/mL) single-dose 2-mL ampule or equivalent, 2
•Lidocaine injection, 20-mg/mL single-dose 5-mL ampule or equivalent, 2
•Nitroglycerin, 0.4-mg tablets, 10
•0.9% Sodium chloride injection, 500 mL
•Basic instructions for use of the drugs in the kit

12

FAA Medical Kit

13

CONTENTS	QUANTITY
Sphygmomanometer	1
Stethoscope	1
Airways, oropharyngeal (3 sizes): 1 pediatric, 1 small adult, 1 large adult or equivalent	3
Self-inflating manual resuscitation device with 3 masks (1 pediatric, 1 small adult, 1 large adult or equivalent)	1; 3 masks
CPR mask (3 sizes), 1 pediatric, 1 small adult, 1 large adult, or equivalent	3
IV Admin Set: Tubing w/ 2 Y connectors	1
Alcohol sponges	2
Adhesive tape, 1-inch standard roll adhesive	1
Tape scissors	1 pair
Tourniquet	1
Saline solution, 500 cc	1
Protective nonpermeable gloves or equivalent[1]	1 pair
Needles (2-18 ga., 2-20 ga., 2-22 ga., or sizes necessary to administer required medications)	6
Syringes (1-5 cc, 2-10 cc, or sizes necessary to administer required medications)	4
Analgesic, non-narcotic, tablets, 325 mg	4
Antihistamine tablets, 25 mg	4
Antihistamine injectable, 50 mg, (single dose ampule or equivalent)	2
Atropine, 0.5 mg, 5 cc (single dose ampule or equivalent)	2
Aspirin tablets, 325 mg	4
Bronchodilator, inhaled (metered dose inhaler or equivalent)	1
Dextrose, 50%/50 cc injectable, (single dose ampule or equivalent)	1
Epinephrine 1:1000, 1 cc, injectable, (single dose ampule or equivalent)	2
Epinephrine 1:10,000, 2 cc, injectable, (single dose ampule or equivalent)	2
Lidocaine, 5 cc, 20 mg/ml, injectable (single dose ampule or equivalent)	2
Nitroglycerine tablets, 0.4 mg	10
Basic instructions for use of the drugs in the kit	1

14

- Common enhancements to the medical kit include a glucometer, urinary catheter, and medications for nausea, moderate to severe pain, seizures, and additional cardiac medications.
- Controlled substances are not commonly available in medical kits on US airlines but may be available in kits on some non-US airlines.

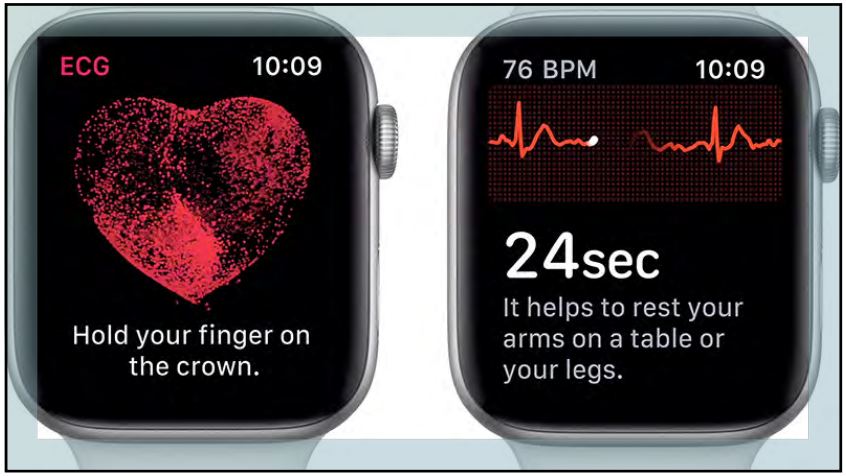
15

	FAA-Mandated Emergency Medical Kit[a]
Equipment	Airways, oropharyngeal Adhesive tape, 1-in Alcohol sponges Cardiopulmonary resuscitation mask Intravenous administration set Needles Protective gloves Sphygmomanometer Stethoscope Syringes Tape scissors Tourniquet (for intravenous catheter placement) Manual resuscitation device, 3 masks Instructions on kit use

16

Additional Contents[b]
Burn dressings
Cord clamps
Disposable scalpel
Endotracheal tubes
Emergency tracheal catheter
Glucometer
Insulin syringe
Laryngoscope blade
Pulse oximeter
Skin closure strips
Thermometer
Tourniquet (for hemorrhage control)
Umbilical cord clamp
Urinary catheter

17



18

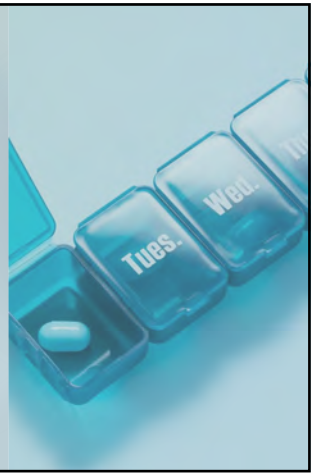
Medications	Analgesic, nonnarcotic
	Antihistamine, 50 mg, injectable
	Antihistamine tablets, 25 mg
	Aspirin tablets, 325 mg
	Atropine, 0.5 mg, 5 mL
	Bronchodilator, inhaled
	Dextrose, 50%/50 mL, injectable
	Epinephrine, 1:1000, 1 mL, injectable
	Epinephrine, 1:10 000, 2 mL, injectable
	Lidocaine, 5 mL, 20 mg/mL, injectable
	Nitroglycerin tablets
	Saline solution, 500 mL

19

Antacid tablets (eg, calcium carbonate)	Glucose gel
Calcium chloride	Glucagon
Chlorphenamine	Haloperidol
Cinnarizine	Hydrocortisone
Decongestant spray	Hyoscine
Dexamethasone	Ibuprofen
Diazepam	Ketorolac injectable
Diclofenac sodium, injectable	Lorazepam
Diclofenac sodium tablets	Meclizine
Digoxin	Methylprednisolone
Dimenhydrinate	Metoprolol
Epinephrine autoinjector	Morphine
Fexofenadine	Nalbuphine
Furosemide	Naloxone
	Ondansetron
	Oxytocin
	Promethazine

20

- Since some countries do not allow any medication in the first aid kit, some airlines will carry an extra kit containing over the counter medication to be used passively, i.e. only given to passenger on specific request by the passenger. This kit typically includes items such as:
- Mild to moderate analgesic for adults and children
- Antiemetic
- Nasal decongestant
- Antacid
- Antihistaminic
- Antidiarrheal



21

IME's: Health Related vs. Injury

Health issues:

- Anxiety about the flight
- Feeling dizzy and faint
- Heart attack
- Severe allergic reaction

Injuries:

- Scalds from hot drinks
- Injuries following severe turbulence
- Onboard fights

22

Most Common IMEs

- Syncope or near syncope make up nearly one-third of these events
- Gastrointestinal (14.8%)
- Respiratory (10.1%),
- Cardiovascular symptoms (7.0%)
- In-flight cardiac arrest was rare (0.2% of IMEs).

23

24

Responders. Are you one?

- A 2013 study, published in the *New England Journal of Medicine*, found that medical personnel help in about three-quarters of IMEs—
- 48.1% of the time it was physicians responding
- 25% of the time it was a nurse or other emergency personnel
- Aircraft diversion happened in 7.3%.

25

Captain, We Have a Problem!

Flight crew identify problem

Trained in basic first aid	ABCs.	Call for help

SAMPLE.
Symptoms, **A**llergies, **M**edication, **P**revious history, **L**ast **M**eal, and **E**vents

26

IME Treatment Approach for Volunteer Medical Professionals

1. Identify yourself
2. Complete a H&P
3. Identify high-risk symptoms (chest pain, SOB, neurologic defecits)
4. Obtain VS

27

IME Treatment Approach for Volunteer Medical Professionals

- Inform cabin crew of your clinical impression and recommendations
- Initiate ground-based consultation
- Administer treatment as needed (O2, AED)
- Document clinical presentation and care provided

28

Pathophysiology

Commercial aircraft fly at a cruising altitude of 30,000 to 40,000 ft

- Passenger cabins are pressurized to 12 psi to 11 psi, which is equivalent to being at an altitude of 5000 to 8000 ft
- This pressurization leads to expansion of closed gas-containing spaces in the body (sinuses and middle ear) and non-physiological gas collections (pneumothorax, gastrointestinal, ocular, or intracranial surgery)

29

Under Pressure

- At 8000 ft of altitude or equivalent, the volume of gas in an enclosed space increases by approximately 30%;
- Altitude changes commonly trigger discomfort in patients, especially those with existing upper respiratory tract inflammation or infection, including sinusitis or otitis media.

30

Pathophysiology

The aircraft cabin has a lower partial pressure of oxygen at altitude, with resultant mild hypoxia in healthy passengers (decreasing mean arterial oxygen saturation from 97% to 93%)

Use of a portable oxygen concentrator during flight needs approval by the airline, a physician's certification of need, and sufficient battery life, all typically coordinated at least 48 hours prior to the flight.

31

Pathophysiology

Prolonged sitting and hypoxia may trigger:

- decreased venous flow
- systemic inflammation
- platelet activation
- explains the association between air travel and venous thromboembolism

→

Symptoms of deep venous thrombosis or pulmonary embolism most commonly present hours to days after completing air travel but can occur on flights of long duration or during multiple flights in succession.

→

The risk of lower limb venous thrombosis in high-risk passengers may be up to 5% per flight, and symptomless venous thromboembolism may occur in up to 10% of passengers on flights of long duration (ie, >4 hours)

32

Pathophysiology

Cabin air, is drawn from an outside dry environment at altitude and pressurized and dehumidified by cycling through the engine compartment, may contribute to dehydration among passengers.

Recycling of air may also expose passengers to potential allergens, even when the source of allergens is several rows away from a passenger.

Although the enclosed and limited-space environment of aircraft raises concern for transmission of communicable diseases, preexisting exposure is a more common infectious source.

33

Altitude Sickness

- About ½ of all people who are above 8,000 ft above sea level
- Altitude sickness results from a rapid change in air pressure and air oxygen levels at higher elevations.
- High altitude and lower air pressure can lead to fluid leaking from blood vessels.

34

Who is at High Risk?

Have a lung or heart condition

Are pregnant

Live at low elevation

Previously had altitude sickness

35

Symptoms

- Dizziness.
- Fatigue and loss of energy.
- Shortness of breath.
- Coordination problems and difficulty walking.
- Severe Headache, nausea, vomiting.
- Chest tightness or congestion.
- Inability to walk.
- Confusion.
- Fluid buildup in the lungs or brain.

36

Treatment

- OTC for headache
- Move to lower elevation
- Oxygen
- Dexamethasone
- Intubation

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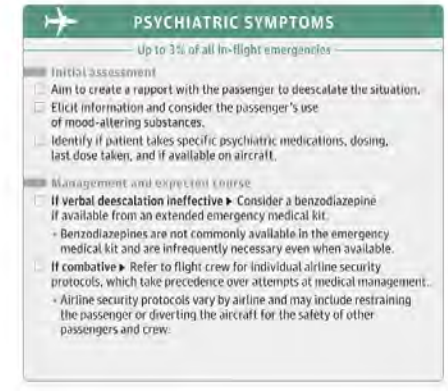

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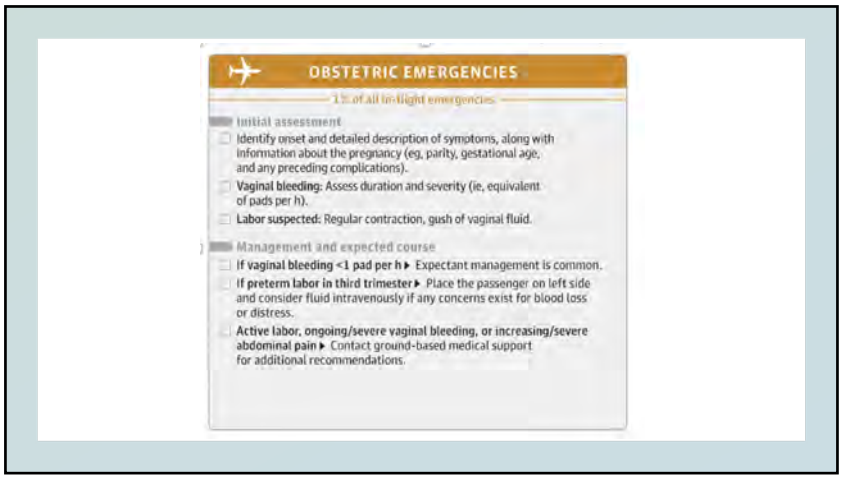
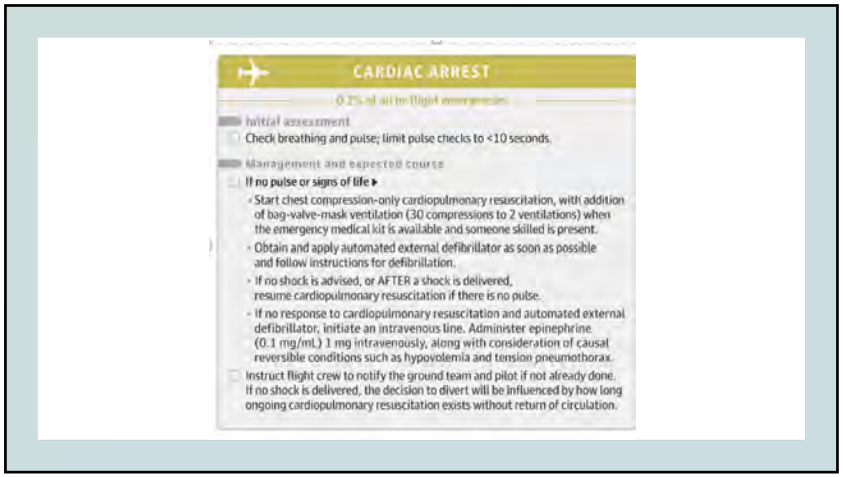

OBSTETRIC EMERGENCIES
1% of all in-flight emergencies
Initial assessment
Identify onset and detailed description of symptoms, along with information about the pregnancy (eg, parity, gestational age, and any preceding complications).
Vaginal bleeding: Assess duration and severity (ie, equivalent of pads 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.

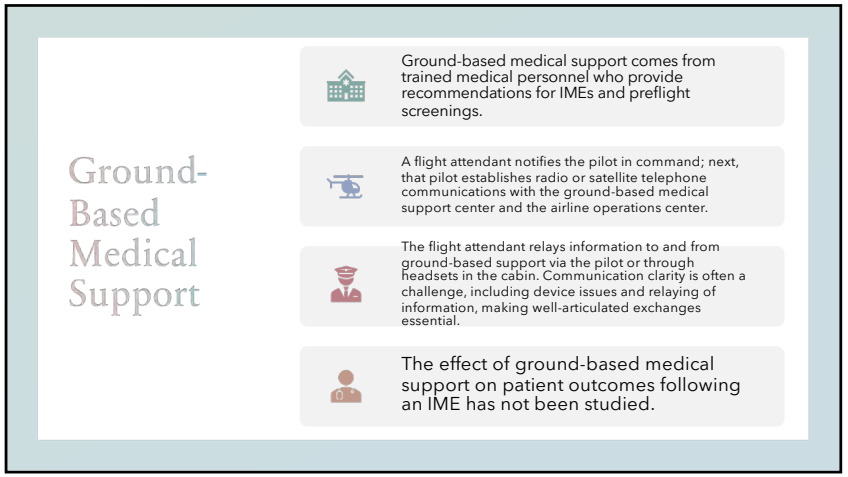
41


SUBSTANCE ABUSE AND WITHDRAWAL
Up to 5% 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.

42


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.

43


Ground-Based Medical Support
Ground-based medical support comes from trained medical personnel who provide recommendations for IMEs and preflight screenings.
A flight attendant notifies the pilot in command; next, that pilot establishes radio or satellite telephone communications with the ground-based medical support center and the airline operations center.
The flight attendant relays information to and from ground-based support via the pilot or through headsets in the cabin. Communication clarity is often a challenge, including device issues and relaying of information, making well-articulated exchanges essential.
The effect of ground-based medical support on patient outcomes following an IME has not been studied.

44

Diversion

- Based on the information received from cabin crew and the medical professional onboard or from the remote support agency
- Captain's final decision as to whether to divert the flight
- Other factors will come into play here, such as the phase of the flight, the distance to destination, and the proximity of a suitable alternative airport.

45

Diversion

01	02	03
What facilities are at the diversion airport?	Whether the aircraft will be overweight to land there?	Whether an appropriate medical response will be able to attend on landing?

46

Diversion: Not a Light Decision

- Diversions usually only take place in the most serious of situations.
  - most frequently resulted in diversion included cardiac arrest, obstetric emergencies, cardiac symptoms, and suspected stroke
- Diverting a flight causes delays and is costly to the airline.
- Emirates previously stated that a single flight diversion can cost anywhere from $50,000 up to $600,000 or more, depending on the situation.

47

Legal and Ethical Considerations

Do Not attempt to practice beyond your level of expertise

In the United States, medical volunteers are generally protected by the Aviation Medical Assistance Act of 1998, or Good Samaritan Law

There is no equivalent law governing international travel, and legal jurisdiction depends on the patient's and medical professional's countries of citizenship and the country in which the aircraft is registered.

Warsaw Convention, Montreal Convention, and Tokyo Convention

DO NOT ASK FOR COMPENSATION!

48

Legal and Ethical Considerations

In addition to differences in "Good Samaritan" volunteer protections, which are not present in many other countries, the duty to respond also varies by country.

In the United States, Canada, England, and Singapore, there is no legal duty for an off-duty medical professional to assist during an IME.

Conversely, Australia and many European countries require physicians to render assistance during IMEs.

49

In the News

- Eurostar urged to carry adrenaline injectors in first-aid kit after medical alert
- **A doctor was shocked to find no anti-allergy pens on board the train, though operator says law forbids it at present**

50

In the News

- **Going beyond the OR: CRNA uses critical skills during medical emergency in the air**
  - After her flight home was delayed for two hours due to weather and a mechanical issue, Rishelle Zhou, DNAP, LLB, CRNA, was just glad to finally board the plane. She was looking forward to eating dinner and going home. She didn't expect that she'd use her skills as a Certified Registered Nurse Anesthetist (CRNA) to save a woman's life during the flight.

51

- Zhou said at that point, another passenger showed up and identified himself as a physician.
- "I turned around and asked, 'What's your specialty?' He said he was a dermatologist. I said I was a CRNA, and then he said **he'd follow my lead**."

52

- Zhou said she was glad she could help a fellow passenger and was proud to use her skills beyond the perioperative area. She also encouraged other CRNAs to follow her lead.
- "I want to encourage other CRNAs to respond in a crisis moment because our training is more valuable than you realize. Our skills — especially our critical thinking skills and airway training — are invaluable. We're extremely qualified and experienced to handle critical moments and medical emergencies because we deal with them all the time."

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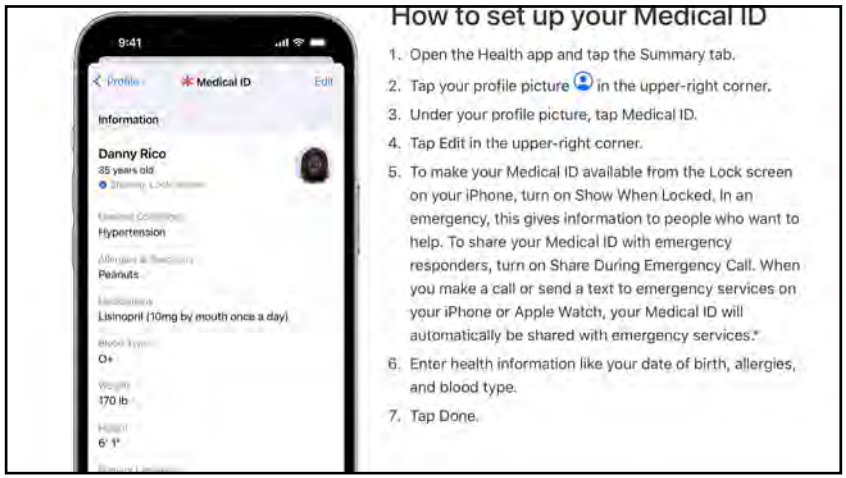

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55