Title: Is there a doctor on board this flight?

Moderator 1:
Denise Chan, M.D.
Clinical Instructor
Pediatric Anesthesiology
Lucile Packard Children's Hospital at Stanford University

Moderator 2:
Calvin Kuan, M.D., FAAP
Clinical Associate Professor
Pediatric Cardiac Anesthesiology
Lucile Packard Children's Hospital at Stanford University
Pediatric Intensive Care
UCSF Benioff Children's Hospital Oakland

Goals

1. Identify medical resources most likely available to you during an in-flight emergency.
2. Review options for treatment and disposition of a patient on an airplane.
3. Discuss the medical and legal implications of helping a stranger on a domestic and international flight.
4. Understand the process of plane diversion.
5. Review the risks associated with air travel.

Case Description:

You are flying home from an international cleft lip and palate surgical mission and have settled into your seat, headphones on and cocktail in hand. Two hours and three drinks into the flight, you hear the overhead announcement, "if there is a physician or nurse on board, would you please ring your call button."

You volunteer and find a 5 year-old boy in respiratory distress.
(*Optional issue: The flight attendant asks to see your medical license or other proof that you are a doctor, but you are not carrying this with you. You state that you are an anesthesiologist practicing in Columbus, Ohio. She says unfortunately you are not allowed to touch the patient. The boy's mother, in obvious distress, insists that you be permitted to help.)*

Question: What do you do first?

You turn to the child's mother, who says they were having a snack of peanuts when he began to cough suddenly, and vomited once. His past medical history includes

asthma (mild-intermittent) and sickle cell disease. He is generally a picky eater, and his mom cannot remember if he's ever tried peanuts before.

Questions: What else do you want to know? What do you do now?

On physical exam, you note that the patient is quite tachypneic and has subcostal and suprasternal retractions. You estimate his respiratory rate to be around 40 breaths per minute. His extremities are warm, with a capillary refill time of one second. His radial pulse is fast, and you estimate his heart rate to be around 120 beats per minute.

Question: How is your ability to do a thorough and accurate physical exam and assessment affected by being on a plane at 37,000 feet? What are the physiologic effects to the patient?

You are not able to hear breath sounds over the noise of the plane. You can barely make out the heart sounds also. The child appears to be in respiratory distress, and he becomes more agitated as you are examining him.

Questions: If you were in your home hospital, what resources would you be using to care for this patient? What resources are available to you on a plane? In your professional opinion, what resources should ideally be carried on every flight?

You ask the flight attendant to retrieve the medical kit and portable supplemental oxygen.

The flight attendant brings an oxygen mask and portable oxygen tank. She says an AED is available if you want it. She also shows you the medical kit, which you open to find the following equipment and medications:
It includes a manual sphygmomanometer, medium quality adult stethoscope, one 22-gauge and one 18-gauge IV catheter, one 500 ml bag of Lactated Ringer's solution, two 10 cc syringes, two 18 gauge needles, two sterile alcohol swabs, and one pair of latex gloves. Medications include aspirin 325 mg tablets x 5; atropine 0.5 mg/ml, 5 ml vial; dextrose 50%, 50 ml vial; diphenhydramine 50 mg/ml, 1 ml vial; epinephrine 1:10,000, 2 ml ampule.

As you are sifting through the contents of the medical kit, the child's work of breathing increases and his extremities become cool and clammy.

Question: What do you do now? What are your differential and working diagnoses?

You place a face mask on the patient to provide supplemental oxygen. You suspect he has either aspirated a peanut or is having an anaphylactic reaction.

Question: What specific findings on physical exam are most important to you at this point? How do you listen to breath sounds and determine a blood pressure?

You are unable to hear breath sounds or a pulse using the stethoscope provided in the medical kit, so you place one ear directly on the child's chest. You watch the pulsation of the needle on the sphygmomanometer gauge and palpate the brachial pulse to estimate systolic and diastolic values.

Question: How will you rule out foreign body aspiration if you are unable to hear breath sounds?

You estimate the patient's blood pressure to be 75/40 mmHg and decide to treat for anaphylaxis. The patient is becoming increasingly agitated, and his mother is crying and clinging to him.

Question: What interventions are needed at this point? How will you delegate tasks to flight attendants and other helpers?

You ask a flight attendant to take care of the patient's mother, and two other flight attendants are made available to assist you.

Question: Would you give the patient a bronchodilator? If so, how would you obtain this medication?

You ask the mother if she is carrying albuterol for the patient, which she is not. The flight attendant makes an overhead announcement to request an albuterol inhaler from any fellow passengers. An elderly man with a barrel chest offers his inhaler.

Question: How would you administer it?

The child's mother states he has never used an inhaler, since they have a nebulizer machine at home. You cut a hole out of the bottom of a plastic cup, large enough to fit the mouthpiece of the inhaler. You place the cup over the patient's nose and mouth as you administer several puffs of albuterol (Or you cut a hole in the oxygen mask.)

Meanwhile, you are also preparing to place an IV.

Question: Where would you attempt to place an IV? What are the pros and cons of possible IV locations?

The two flight attendants restrain the patient so you can place an IV.

Question: What medications would you give, and how would you accurately administer them?

You estimate the child to be 20 kilograms, and you would like to give diphenhydramine 1 mg/kg. You draw up 9 ml out of the bag of Lactated Ringer's solution into a 10 cc syringe, and then add the vial of diphenhydramine. You give 4

cc out of this syringe.

Question: How much IV fluid would you give as a bolus?

You give a bolus of 20 ml/kg of Lactated Ringer's solution, asking a flight attendant (or other helper) to hold the bag up as high as possible.

As you are administering IV diphenhydramine and IV fluids, the flight attendant asks if you think an emergency landing is needed.

Question: Is plane diversion necessary in this situation? What medical conditions necessitate a diversion, or would benefit from a diversion? What are the risks/costs and benefits of diversion? How is a decision ultimately made?

The pilot informs you that you are 4 ½ hours from your destination, and 20 minutes by ambulance to a hospital once landed. The closest safe alternate landing site is 85 minutes away, with an additional 25 minutes by land to a hospital. You have 25 minutes to make a decision and change the flight path.

Question: What do you do now?

The child's respiratory rate remains around 45 breaths per minute and he is still in obvious respiratory distress. You take another blood pressure reading, which you estimate at 60/30 mmHg.

Question: What is your next step?

Since the patient's condition has not improved with IV diphenhydramine and IV fluid administration, you decide to give epinephrine.

Question: How will you measure out the correct dose of epinephrine for this patient?

You look up to notice the flight attendant holding an empty bag of Lactated Ringer's solution – she has given the entire 500 ml bag as a bolus.

Question: How do you measure out the correct dose of epinephrine now? (*multiple options)*

After a few minutes, his respiratory rate is 25 breaths per minute and the retractions have subsided. The next blood pressure reading is 135/100 mmHg. You and the pilot decide that diversion of the plane is not necessary, and emergency services will meet the plane at the intended destination.

Questions: What documentation of these events is required by law and/or to

protect yourself? What is your obligation to the patient for the remainder of the flight and after the flight? What kind of follow up is done by the airline after an in-flight emergency?

Questions: Would you volunteer your assistance? How does your consumption of alcohol affect this decision? Should you ask for compensation for providing your services? What are your ethical and legal obligations to help a fellow passenger? Do these differ on an international versus domestic flight? How does the Good Samaritan law apply in this situation?

Discussion:

Air travel has become increasingly accessible to much of the population, with almost three billion passengers flying worldwide each year. One in 10-40,000 of these passengers will have an in-flight medical emergency, with children constituting approximately 9% of these. However, the true incidence of these events is unknown, as documentation is highly variable and there is not central database for in-flight emergencies.

The most common in-flight medical events amongst adults relate to syncope, respiratory issues, gastrointestinal symptoms (e.g. nausea and vomiting), and cardiac events. In children, it is infection (e.g., otitis media), neurologic causes (e.g. seizure), and respiratory symptoms (e.g. asthma exacerbation). In-flight death is a rare event; about 0.1% of the pediatric emergencies will result in fatality. Most airlines carry emergency medical kits, but the contents vary widely from kit to kit. Both the FAA and JAA (European Joint Aviation Authorities) have increased their emergency medical kit requirements over the years. Automated external defibrillators were introduced to in-flight emergency kits in 2001.

TABLE 2. FAA Emergency Medical Kit Requirements

Contents	Quantity
Sphygmomanometer	1
Stethoscope	1
Airways, oropharyngeal (3 sizes): 1 pediatric, 1 small adult, and 1 large adult or equivalent	3
Self-inflating manual resuscitation device with 3 masks: 1 pediatric, 1 small adult, and 1 large adult or equivalent	1:3 masks
CPR mask (3 sizes): 1 pediatric, 1 small adult, and 1 large adult or equivalent	3
IV administration set: tubing with 2 Y connectors	1
Alcohol sponges	2
Adhesive tape, 1-in standard roll adhesive	1
Tape scissors	1 pair
Tourniquet	1
Saline solution, 500 mL	1
Protective nonpermeable gloves or equivalent*	1 pair
Needles (2- to 18-, 2- to 20-, and 2- to 22-gauge, or sizes necessary to administer required medications)	6
Syringes (1–5 and 2–10 mL, or sizes necessary to administer required medications)	4
Analgesic, nonnarcotic (tablets), 325 mg	4
Antihistamine (tablets), 25 mg	4
Antihistamine (injectable), 50 mg (single-dose ampule or equivalent)	2
Atropine, 0.5 mg, 5 mL (single-dose ampule or equivalent)	2
Aspirin tablets, 325 mg	4
Bronchodilator (inhaled; metered-dose inhaler or equivalent)	1
Dextrose (injectable), 50%/50 mL (single-dose ampule or equivalent)	1
Epinephrine 1:1000 (injectable), 1 mL (single-dose ampule or equivalent)	2
Epinephrine 1:10,000 (injectable), 2 mL (single-dose ampule or equivalent)	2
Lidocaine (injectable), 20 mg/mL, 5 mL (single-dose ampule or equivalent)	2
Nitroglycerine tablets, 0.4 mg	10
Basic instructions for use of the drugs in the kit	1

As of April 12, 2004. New requirements are shown in bold. CPR indicates cardiopulmonary resuscitation; FAA, Federal Aviation Administration; IV, intravenous. Adapted from Federal Aviation Administration. *Emergency Medical Equipment*. Washington, DC: US Department of Transportation. AC no. 121-33A. Advisory Circular; 2003.

*Although the FAA requires only 1 pair of protective gloves, it recommends that operators keep additional pairs accessible on the aircraft. This would allow crew members to access a pair of gloves without having to locate and open an emergency medical kit.

(from Moore 2005)

The incidence and severity of in-flight medical emergencies can be reduced by prescreening of high-risk passengers, as pre-existing medical conditions can be exacerbated while in-flight. Those with cardiopulmonary disease may not tolerate the hypoxia resulting from cabin pressure, which causes the PaO_2 of even a healthy individual to drop from 95 mmHg to 60 mmHg. Cabin hypoxia, combined with seat sharing, may put "lap infants" at higher risk for apnea. Gas expansion and increased risk of thromboembolism also pose potential problems. Passengers with reactive airway disease, for example, should bring their inhaled bronchodilators on board rather than in checked-in luggage. Those with more serious medical conditions may need to bring a qualified medical escort on board with them. Parturients are not advised to travel after 36 weeks gestation.

Although there is no legal obligation (according to British, US, and Canadian laws) for a physician to assist a fellow passenger during an in-flight medical emergency, one may argue that there is an ethical obligation. Many physicians are hesitant to assist during an in-flight medical emergency for fear of litigation, but no volunteer physician has ever been held liable for services rendered. The pilot will provide a written statement of indemnity if desired. The 1998 Aviation Medical Assistance Act includes a Good Samaritan provision, limiting liability for volunteer physicians acting in good faith.

The decision to divert an aircraft should be taken seriously, as it is quite costly ($15,000-$890,000+ per diversion) and has safety implications for the crew

and other passengers, such as suboptimal landing conditions and the need to dump excess fuel into the atmosphere to make a premature landing. The pilot is ultimately responsible for the decision to divert. Diversion occurs in about 10% of medical emergency cases, with the highest rates occurring when a physician volunteer is involved.

As mentioned earlier, documentation is highly variable amongst airlines. The US Department of Transportation does not require documentation unless a death occurs or the plane is diverted. A standardization of documentation of in-flight medical emergencies would facilitate data collection and analysis of these events.

References:

Cocks RA, Hung KKC, Graham CA. In-flight medical emergencies: ethical and clinical challenges. Eur J Emerg Med. 2012 Aug;19(4):207.

Cocks R, Liew M. Commercial aviation in-flight emergencies and the physician. Emerg Med Australas. 2007 Feb;19(1):1-8.

Hinkelbein J, Neuhaus C, Wetsch WA, Spelten O, Picker S, Emergency Medical Equipment On Board German Airliners. J Travel Med. 2014 Sep-Oct;21(5):318-23.

Mattison ML, Zeidel M. Navigating the challenges of in-flight emergencies. JAMA. 2011 May 18;305(19):2003-4.

Moore BR, Ping JM, Claypool DW. Pediatric emergencies on a US-based commercial airline. Pediatr Emerg Care. 2005 Nov;21(11):725-9.

Peterson DC, Martin-Gill C, Guyette FX, Tobias AZ, McCarthy CE, Harrington ST, Outcomes of medical emergencies on commercial airline flights. N Engl J Med. 2013 May 30;368(22):2075-83.

Rotta AT[1], Alves PM, Mason KE, Nerwich N, Speicher RH, Allareddy V, Allareddy V. Fatalities above 30,000 feet: characterizing pediatric deaths on commercial airline flights worldwide. Pediatr Crit Care Med. 2014 Oct;15(8):e360-3.

Sand M, Morrosch S, Sand D, Altmeyer P, Bechara FG. Medical emergencies on board commercial airlines: is documentation as expected? Crit Care. 2012 Dec 12;16(2):R42.

Silverman D, Gendreau M. Medical issues associated with commercial flights. Lancet. 2009 Jun 13;373(9680):2067-77.