



# Emergencies at 35,000 Feet

## *Is There a Medical Provider on Board?*

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Francis Guyette , MD, MPH,  
Professor of Emergency Medicine  
Medical Director, STAT MedEvac  
University of Pittsburgh Medical Center

By MICHELLE

Med  
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ISTOCKPHOTO

7 Comments

This story is part of HEALTH AND WELLNESS

Exercise helps insomnia, but not right away, study says

Drug makes PSA screening test more reliable

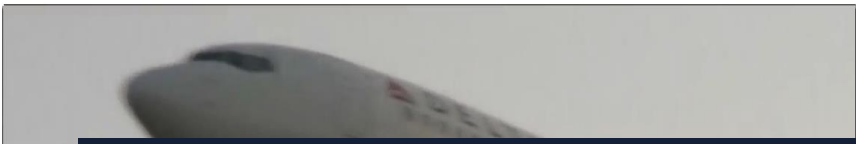
Housing, health care fuel record costs to raise a kid



# Medical emergencies occur on 1 of every 604 flights

Liz Szabo, USA TODAY 5 p.m. EDT May 29, 2013

## She had an allergic reaction on a plane. Now she's calling for change.



# Allergies in the sky: Airlines are pressed to treat severe reactions

The FAA is considering updates to emergency kits to include EpiPens, pediatric doses of antihistamines and medicine to reverse opioid overdoses.

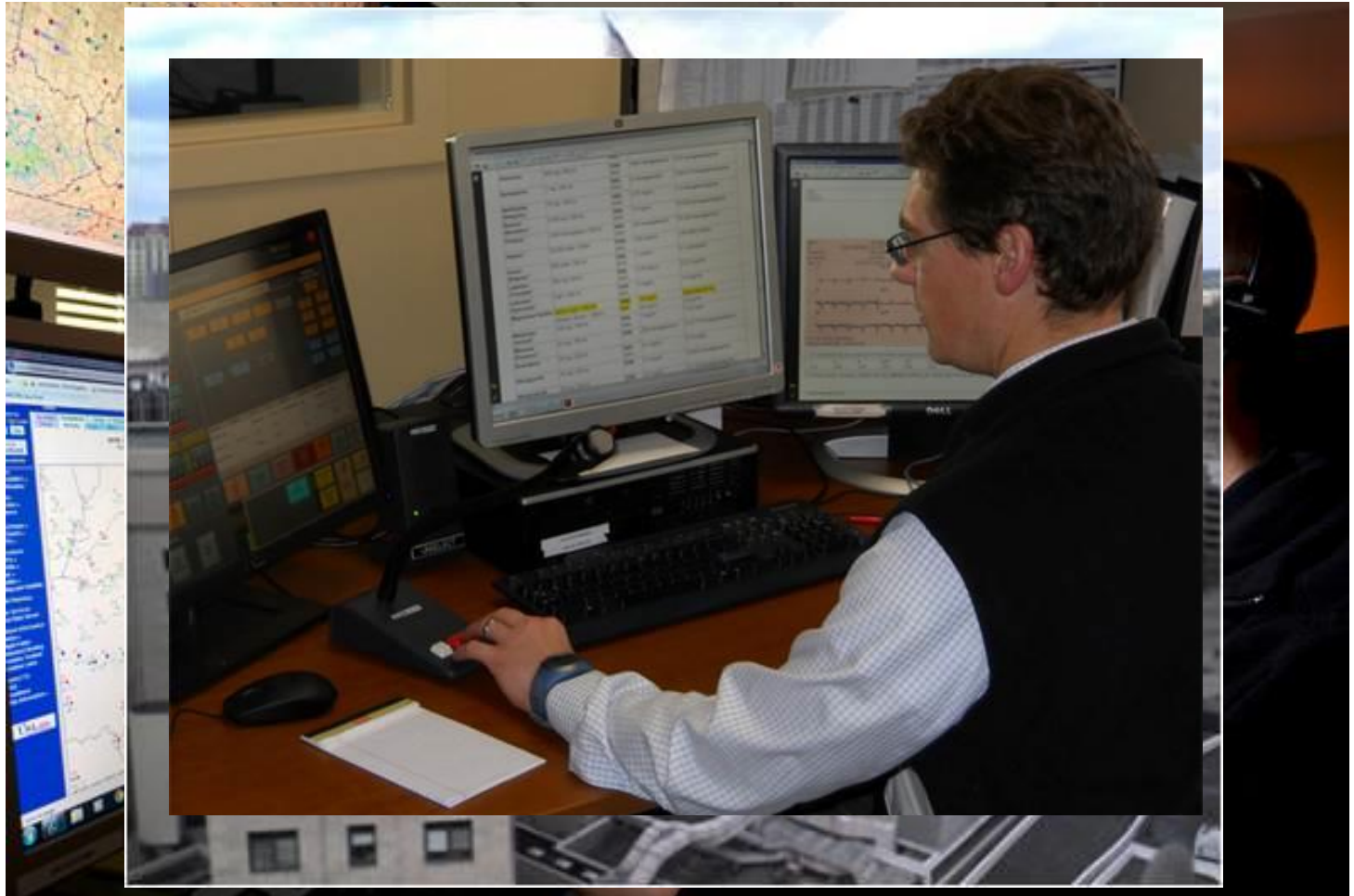
A woman visiting Richmond is raising concerns after she had an allergic reaction to nuts mid-flight and claims that staff on board didn't know how to use the type of epinephrine the plane carried.

# Objectives

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- Medical care with limited resources
- Altitude physiology
- Responding as an medical volunteer aboard a commercial airline
- Responding to medical issues before or after commercial airline travel

# STAT-MD Communications Center



## In-Flight Medical Emergencies A Review

Christian Martin-Gill, MD, MPH; Thomas J. Doyle, MD, MPH; Donald M. Yealy, MD

3 billion Passengers per  
year

Inflight Emergencies  
50 per 1 million  
passengers

1 IME per 600 flights

375 IMEs per day

*The* NEW ENGLAND JOURNAL *of* MEDICINE

ORIGINAL ARTICLE

### Outcomes of Medical Emergencies on Commercial Airline Flights

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

# Who is involved in an airline medical emergency & consultation?



Flight attendant  
Pilot  
Healthcare bystander



- Radio Communications Center



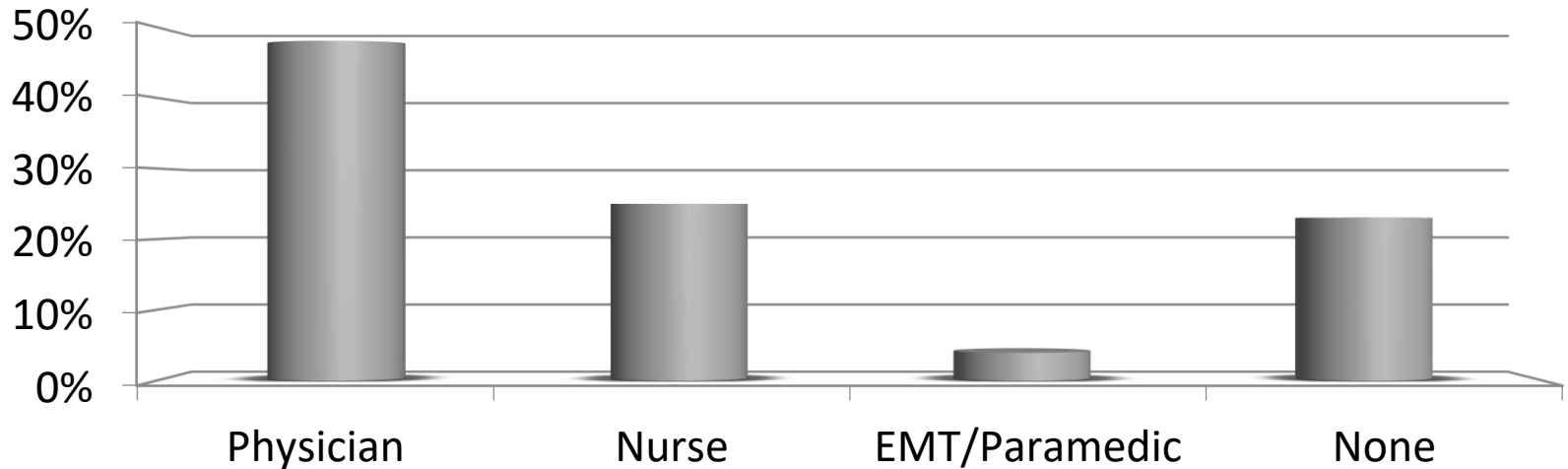
Airline Dispatch



Medical Communications Center



# Who is available on board to assist?



- Health professionals responding for assistance
  - Physician: 48% (5,742 cases)
  - Nurse: 25% (3,033 cases)
  - EMT or Paramedic: 4% (535 cases)
  - None: 23% (2,813 cases)

# Equipment available on board

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- Airline medical kits vary by airline
- All aircraft must have an AED



# AEDs & Monitors



**Phillips Heart Stream DL Aircraft**  
(can see rhythm)



**LifePac 500 NW aircraft**  
(cannot see rhythm)



**Biolog Heart Monitor**  
NW Aircraft XMK (outside pocket)  
Cable & leads or place on bare chest  
Visual EKG; no printout

# Emergency Medical Kit (EMK)

- Diagnostic Equipment
  - BP Cuff
  - Stethoscope
- IV Equipment
  - Needles (18G, 20G, 22G)
  - IV Catheters
  - Tourniquet
  - IV tubing, connectors
  - Alcohol, tape, gloves, etc
  - IV Fluids (NS 500 ml)
- Airway
  - BVM
  - OPA's
- Medications
  - Acetaminophen (Tylenol)
  - Aspirin
  - Nitroglycerin tablets
  - Albuterol inhaler
  - Benadryl
  - Epinephrine 1:1000 / 1:10000
  - Atropine
  - Lidocaine
  - Dextrose
- Automated external defibrillator

*Mandated by FAA*

# Enhanced EMK (varies by airline)

- Additional Medications:
  - Calcium chloride
  - Diazepam
  - Diphenhydramine
  - Haloperidol
  - Hydrocortisone
  - Lasix
  - Lorazepam
  - Meclizine
  - Methylprednisolone
  - Morphine
  - Metoprolol
  - Naloxone
  - Ondansetron
  - Promethazine
  - Sodium bicarbonate

- Additional Equipment
  - Glucometer
  - Biolog heart monitor
  - Laryngoscope & tubes
  - Tourniquet
  - Burn dressings
  - Steri-strips
  - Disposable scalpel
  - Urinary catheter

# Liability?



## Aviation Medical Assistance Act of 1998

One Hundred Fifth Congress  
of the  
United States of America

AT THE SECOND SESSION

*Begun and held at the City of Washington on Tuesday,  
the twenty-seventh day of January, one thousand nine hundred and ninety-eight*

### An Act

To direct the Administrator of the Federal Aviation Administration to reevaluate the equipment in medical kits carried on, and to make a decision regarding requiring automatic external defibrillators to be carried on, aircraft operated by air carriers, and for other purposes.

To land or not to land...

...that is the question

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# Diversion

- Based on medical emergency, aircraft may need to go to an alternate destination
- Final choice made by Captain/Pilot
- Usually done in consultation with a ground-based physician

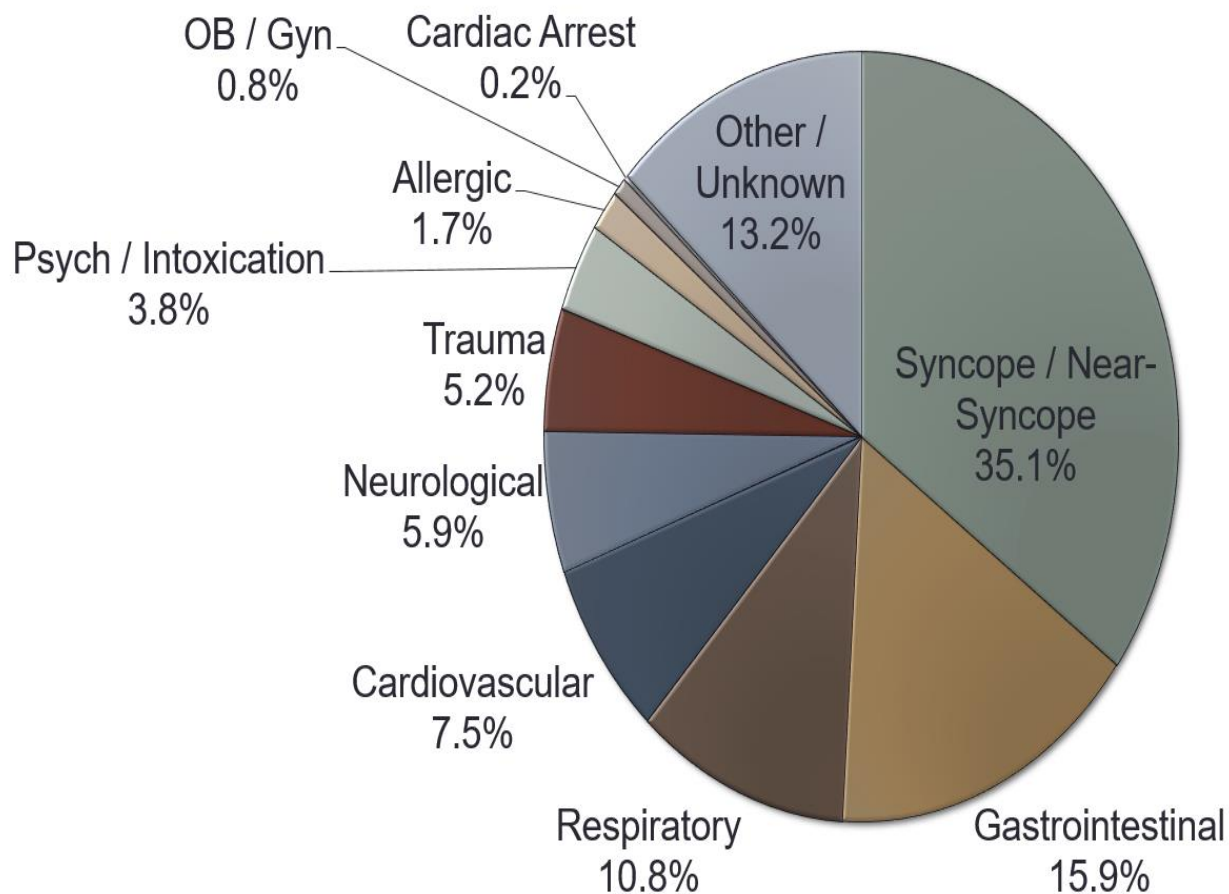
# Considerations for Diversion

- Medical Condition
  - Need for immediate evaluation and treatment?
  - Can the patient receive medical care upon arrival at intended destination?
- Appropriate medical facility?
- Appropriate airport?
- Can the plane land with a full fuel tank?
- High Cost (est. \$20,000 to \$725,000)
  - Missed connections
  - Airport charges
  - Re-fueling



# Management of Specific Emergencies

# Types of In-Flight Emergencies (N=49,100)





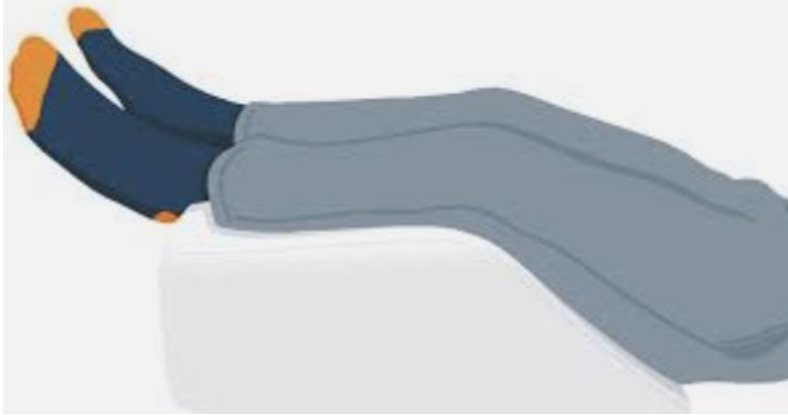
## SYNCOPE / NEAR-SYNCOPE

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.

# Syncope Management





## 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).

# Nausea, Vomiting & Abdominal Pain



NDC 65862-390-19

**Ondansetron Orally  
Disintegrating  
Tablets, USP**

**4 mg**

Rx only

10,000 Tablets





## 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.







# 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.





## STROKE-LIKE 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.





# 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.







# 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.





## 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.



NDC 60947-213-02

0.1 mL intranasal spray per unit  
For use in the nose only

**Rx Only**



**NARCAN** (naloxone HCl)  
**NASAL SPRAY 4 mg**

QUICK START GUIDE

**DO NOT TEST DEVICES OR OPEN BOX BEFORE USE.**

Use for known or suspected opioid overdose in adults and children.

This box contains two (2) 4-mg doses of naloxone in 0.1 mL of nasal spray.

**Two Pack**

CHECK PRODUCT EXPIRATION DATE BEFORE USE



**4 mg**

**NARCAN** NASAL SPRAY  
(naloxone HCl)

DO NOT TEST DEVICES OR OPEN BOX BEFORE USE



# 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.





## 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



# Cardiac Arrest

Rare but impactful...



# Outcomes of In-Flight Emergencies

Literature Review (N=14 articles)

- 4.4% of IMEs result in Diversion

UPMC Data with outcomes (N=875 diversions)

- 26% result in post-flight transport to hospital (by EMS)
- 9% result in hospital admission
- 0.3% result in death

# Case 1

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60 year old man running late for the plane

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Had to run between terminals to make connection

---

Arrives at gate holding his chest, appearing short of breath and with chest pain

---

*Is it okay for him to fly?*

## Case 2

---

70 year old female with COPD

---

Uses oxygen at home at night and as needed during the day

---

Plans to make a trip to Chicago

---

*Is it okay for her to fly?*

# Case 3

- 24 year old male involved in ATV accident
- Suffered chest trauma, including pneumothorax
- Was hospitalized for 5 days with chest tube in place, which was removed yesterday
- Wants to return home

*Is it okay for him to fly?*

# Case 4

- 30 year old female was vacationing in the Bahamas and flies back.
- She was scuba diving 12 hours prior to flight
- Develops chest pain in the flight

*What does she need?*

# Flight Physiology

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# Changes with Altitude

- Barometric pressure decreases
- Partial pressure of oxygen decreases
- Gases expand
- Temperature falls
  - 59° @ sea level → -5° @ 10,000 ft.

# Dalton's Law

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- As altitude increases, atmospheric pressure (and partial pressure of oxygen) decreases
  - → the availability of oxygen decreases as altitude increases.
  - Even though  $FiO_2$  does not change the  $PaO_2$  declines



# Cabin Pressurization

- Most passenger aircraft maintain a cabin pressure approximately equivalent to 8,000 ft of altitude

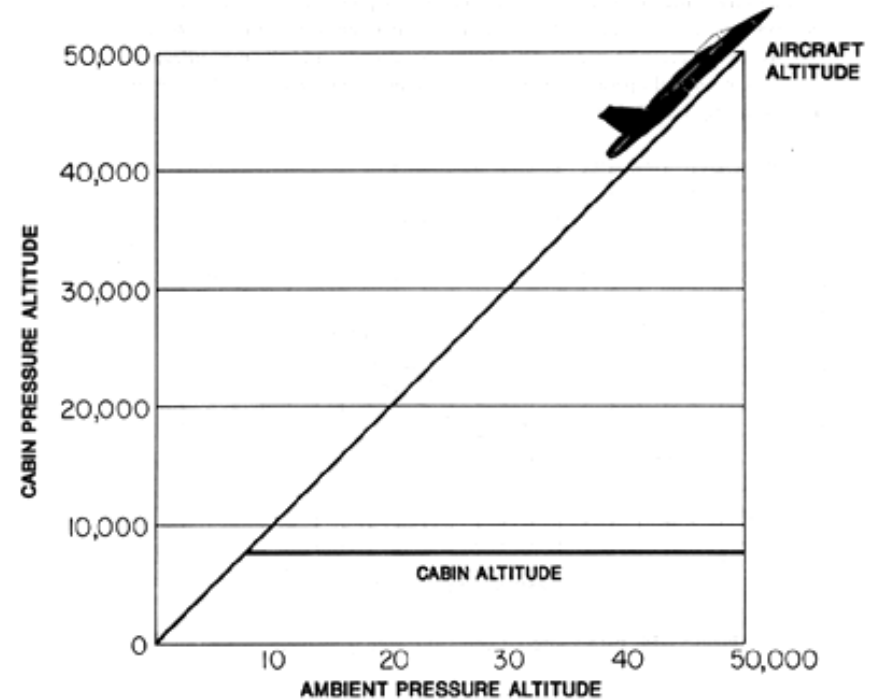


Figure 1-13. Isobaric pressure schedule.

# Dalton's Law in Action

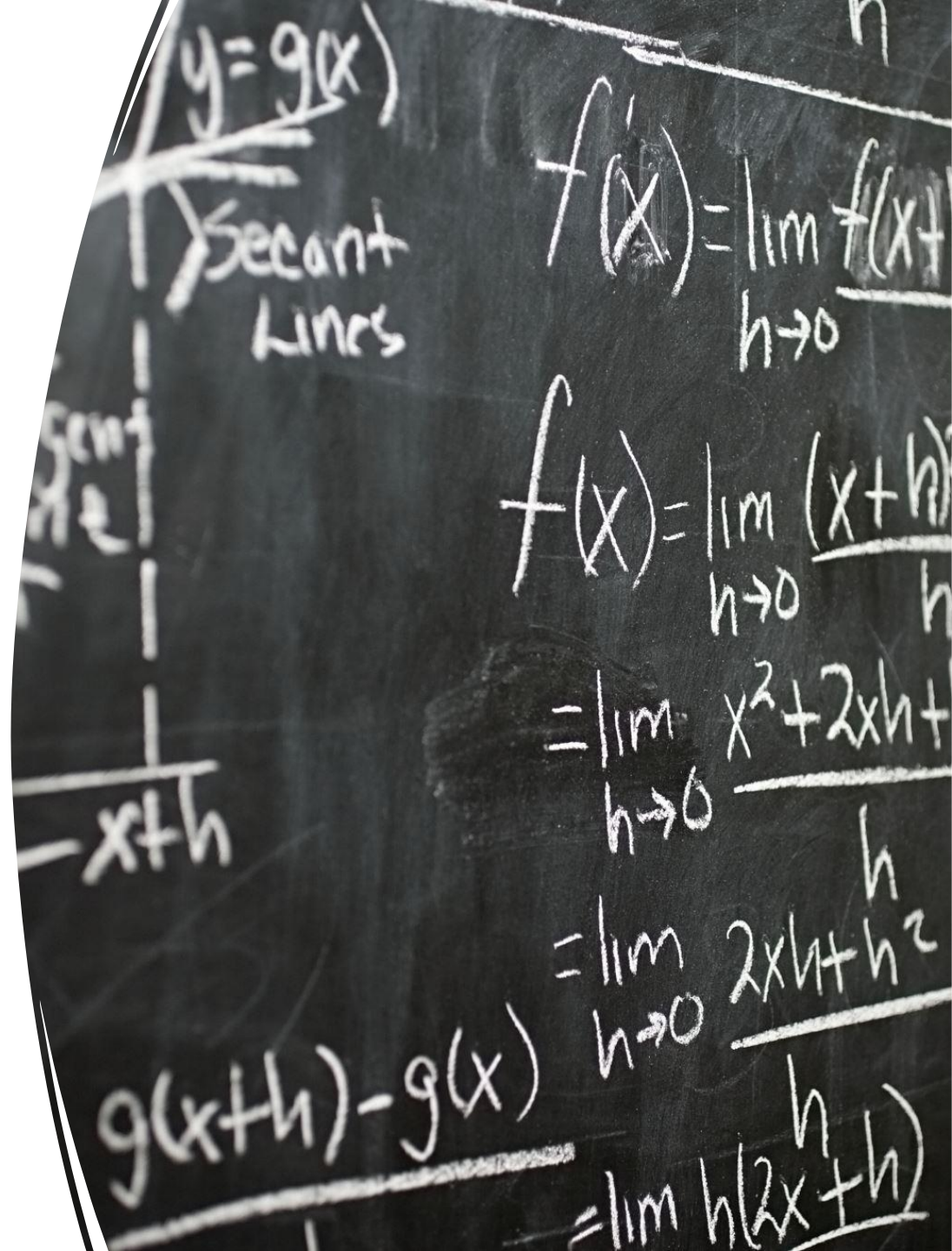
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- Patient with COPD
  - Room air O<sub>2</sub> Sat at sea level is 95%
  - Flight on commercial aircraft
  - At 8,000 ft, O<sub>2</sub> Sat is 86% → patient becomes short of breath
- Solution:
  - On commercial aircraft: Use of portable oxygen
  - On medical aircraft: Routine use of oxygen



# Boyle's Law

Expansion



# Boyle's Law (Expansion)

- As the aircraft ascends, the barometric pressure decreases
  - This causes any gas within an enclosed space to expand
  - The reverse occurs on descent
  - In flight gases expand at altitude
- Body is adaptable up to 10,000 feet above sea level



# GAS EXPANSION (BOYLE'S LAW)

$$\frac{P_2}{P_1} = \frac{V_1}{V_2}$$

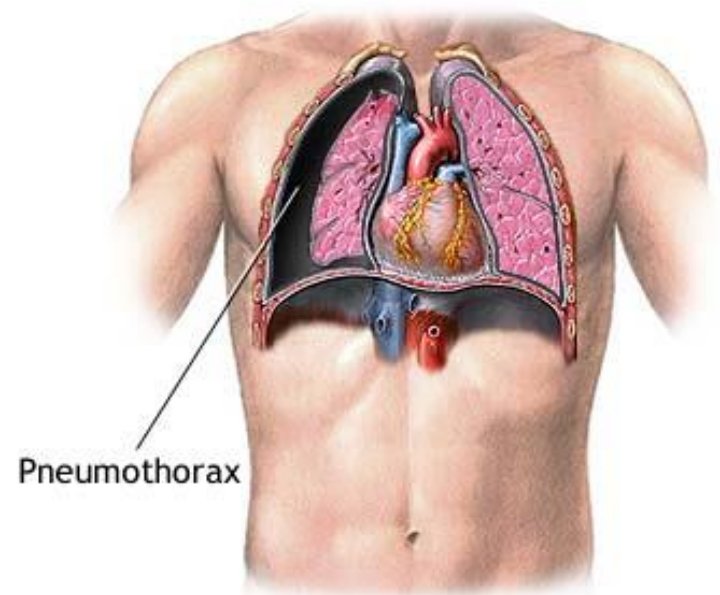


Sea Level

# Boyle's Law in Action

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- What would happen to a patient with a pneumothorax that travels at higher altitude?
- How much does the volume of the pneumothorax increase?
  - 2,000 feet (helicopter) → 5%
  - 6,000-8,000 feet (airplane) → 25-30%



# Henry's Law

Solubility

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# Henry's Law

- The amount of gas that will dissolve in a solution and remain in solution is directly proportional to the pressure of the gas over the solution
- Clinically important in the development of decompression sickness (i.e. dissolved gases in solution vaporize as the ambient pressure decreases)



# Gases in Solution (Henry's Law)

The amount of gas that will dissolve in a solution and remain in solution is directly proportional to the pressure of the gas over the solution



Opening the top results in decrease in pressure over the liquid



# Henry's Law in Action

- Diver boards commercial aircraft
  - Plane ascends to altitude
  - Nitrogen bubbles out of patient's bloodstream → **The Bends**
    - Air embolism to brain or lungs
    - Microemboli to body



# FAA Recommendations



Do not fly within 12 hours of a dive to 30 feet



Do not fly within 24 hours of a dive which requires any stages of ascent



Air medical transport may not have the luxury to wait in a medical emergency

Increase pressurization of cabin  
Fly at lower altitude

# Case 1

---

- 60 year old man running late for the plane
- Had to run across terminals to make connection
- Arrives at gate holding his chest, appearing short of breath and with chest pain

*Is it okay for him to fly?*

- Depends on history and if symptoms completely resolve

# Case 2

---

- 70 year old female with COPD
- Uses oxygen at home at night and as needed during the day
- Plans to make a trip to Chicago

*Is it okay for her to fly?*

- Likely needs oxygen at altitude
- NOTE! She cannot bring a tank on board!
- She needs a portable oxygen concentrator.

# Case 3

---

- 24 year old male involved in ATV accident
- Suffered chest trauma, including pneumothorax
- Was hospitalized for 5 days with chest tube in place, which was removed yesterday
- Wants to return home

*Is it okay for him to fly?*

- Probably not safe to fly immediately

# Case 4

---

- 30 year old female was vacationing in the Bahamas and flies back.
- She was scuba diving 12 hours prior to flight
- Develops chest pain in the flight

*What does she need?*

# Conclusions

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- Limited resources available in-flight
- Other medical providers may be available
- Diversion is a challenging issue.
  - Need to weigh risks and benefits
  - How soon does this patient need to be off the plane?
  - Where can the airplane land?
- Better to keep an ill person off the plane in the first place than have to divert.
- Volunteers should understand they are not alone and also not in charge.



Thank you

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Christian Martin-Gill MD, MPH  
Chief, Division of EMS

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TJ Doyle MD, MPH

Medical Director, STAT MD