In-flight Cardiorespiratory Emergencies: Respiratory Care above 30,000 Feet

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Alberto Santos Dumont (1873-1932)

Paris, France, Oct 19th, 1901

Paris, France, Oct 23rd, 1906
Air Transport (Passengers Carried Worldwide)

Data Source: The World Bank
Commercial Air Travel

- Bigger planes
- More people
- Longer routes
- More time in the air
- Something is bound to happen

Commercial Air Travel

- Lower air humidity
- Dehydration
- Changes in cabin pressure
- Hypoxia, hypoxemia
- Hyperventilation
- Altitude sickness
- Confined environment
- Crowded conditions
- Decreased mobility
- White noise
- Dimmed lights
- Limited resources
- Delayed access to definitive care
At Cruising Altitude

- Cruising altitude
  - 32,000 to 43,000 ft
- Cabin altitude
  - 6,000 to 8,000 ft
- $\text{PAO}_2$ at sea level
  - ~100 mmHg
- $\text{PAO}_2$ at cruising altitude
  - 72 to 64 mmHg

Commercial airline travel decreases oxygen saturation in children

ANDY P. LEE, MD, LOREN G. YAMAMOTO, MD, MPH, MBA, NATALIE L. RELLES, MD

*BMJ* 1998;316:887–94

Effect of exposure to 15% oxygen on breathing patterns and oxygen saturation in infants: interventional study

K J Parkins, C F Poets, L M O'Brien, V A Stebbens, D P Southall
In-Flight Respiratory Issues

- Bronchospasm (asthma)
- COPD
- Croup
- Cough
- Pneumonia
- Aspiration
- Anaphylaxis
- Sinus decompression
- Respiratory distress
- Pulmonary embolism
- Hypoxemia
- Pulmonary hypertension
- Pneumothorax
- Respiratory arrest

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.

DOI: 10.1056/NEJMoai1212052
IFME Characteristics

- 11,920 IFME
- 16 IFME / 1 million pax
- 1 IFME / 604 flights
- Mean age 48±21 yrs
- Age range (14d to 100 yrs)
- Aircraft Diversion: 7.3%

Table 1. In-Flight Medical Emergencies According to Medical-Problem Category and Outcome.

<table>
<thead>
<tr>
<th>Category</th>
<th>All Emergencies</th>
<th>Aircraft Diversion</th>
<th>Transport to a Hospital²</th>
<th>Hospital Admission³</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>All categories</td>
<td>11,920 (100)</td>
<td>11,920 (7.3)</td>
<td>2804/10,877 (25.8)</td>
<td>901/10,482 (8.6)</td>
<td>36</td>
</tr>
<tr>
<td>Syncope or presyncope</td>
<td>4,463 (37.4)</td>
<td>221/4,463 (5.0)</td>
<td>918/4,252 (22.1)</td>
<td>267/4,123 (6.5)</td>
<td>4</td>
</tr>
<tr>
<td>Respiratory symptoms</td>
<td>1,447 (12.1)</td>
<td>81/1,447 (5.6)</td>
<td>311/1,371 (22.7)</td>
<td>141/1,336 (10.6)</td>
<td>1</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>1,137 (9.5)</td>
<td>56/1,137 (4.9)</td>
<td>243/1,023 (23.7)</td>
<td>61/994 (6.1)</td>
<td>0</td>
</tr>
<tr>
<td>Cardiac symptoms</td>
<td>920 (7.7)</td>
<td>169/920 (18.4)</td>
<td>370/813 (45.5)</td>
<td>162/770 (21.0)</td>
<td>0</td>
</tr>
<tr>
<td>Seizures</td>
<td>689 (5.8)</td>
<td>83/689 (12.0)</td>
<td>224/626 (35.8)</td>
<td>75/602 (12.5)</td>
<td>0</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>488 (4.1)</td>
<td>50/488 (10.2)</td>
<td>164/412 (39.8)</td>
<td>41/391 (10.5)</td>
<td>0</td>
</tr>
<tr>
<td>Infectious disease</td>
<td>330 (2.8)</td>
<td>6/330 (1.8)</td>
<td>45/239 (18.3)</td>
<td>8/232 (3.4)</td>
<td>0</td>
</tr>
<tr>
<td>Agitation or psychiatric symptoms</td>
<td>287 (2.4)</td>
<td>16/287 (5.6)</td>
<td>38/249 (15.3)</td>
<td>17/244 (7.0)</td>
<td>0</td>
</tr>
<tr>
<td>Allergic reaction</td>
<td>265 (2.2)</td>
<td>12/265 (4.5)</td>
<td>40/233 (17.2)</td>
<td>8/228 (3.5)</td>
<td>0</td>
</tr>
<tr>
<td>Possible stroke</td>
<td>238 (2.0)</td>
<td>39/238 (16.4)</td>
<td>92/214 (43.0)</td>
<td>46/196 (23.5)</td>
<td>0</td>
</tr>
<tr>
<td>Trauma, not otherwise specified</td>
<td>216 (1.8)</td>
<td>14/216 (6.5)</td>
<td>34/185 (18.4)</td>
<td>5/180 (2.8)</td>
<td>0</td>
</tr>
<tr>
<td>Diabetic complication</td>
<td>193 (1.6)</td>
<td>15/193 (7.8)</td>
<td>45/181 (24.9)</td>
<td>13/172 (7.6)</td>
<td>0</td>
</tr>
<tr>
<td>Headache</td>
<td>123 (1.0)</td>
<td>10/123 (8.1)</td>
<td>23/108 (21.3)</td>
<td>4/107 (3.7)</td>
<td>0</td>
</tr>
<tr>
<td>Arm or leg pain or injury</td>
<td>114 (1.0)</td>
<td>6/114 (5.3)</td>
<td>27/100 (27.0)</td>
<td>4/98 (4.1)</td>
<td>0</td>
</tr>
<tr>
<td>Obstetrical or gynecologic symptoms</td>
<td>61 (0.5)</td>
<td>11/61 (18.0)</td>
<td>29/53 (54.7)</td>
<td>11/47 (23.4)</td>
<td>0</td>
</tr>
<tr>
<td>Ear pain</td>
<td>49 (0.4)</td>
<td>1/49 (2.0)</td>
<td>2/43 (4.7)</td>
<td>1/43 (2.3)</td>
<td>0</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>38 (0.3)</td>
<td>22/38 (57.9)</td>
<td>14/34 (41.2)</td>
<td>3/6 (16.7)</td>
<td>31</td>
</tr>
<tr>
<td>Laceration</td>
<td>33 (0.3)</td>
<td>1/33 (3.0)</td>
<td>3/26 (11.5)</td>
<td>0/25</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>821 (6.9)</td>
<td>62/821 (7.6)</td>
<td>162/705 (23.0)</td>
<td>36/679 (5.3)</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>8 (0.1)</td>
<td>0/8</td>
<td>0/8</td>
<td>0/8</td>
<td>0</td>
</tr>
</tbody>
</table>
Contents of Emergency Medical Kits

Airways, oropharyngeal
Adhesive tape, 1-inch
Alcohol sponges
CPR mask
IV administration set
Needles
Protective gloves
Sphygmomanometer
Stethoscope
Syringes
Tape scissors
Tourniquet
Manual resuscitation device with 3 masks
Basic instructions on use of the kit
Analgesic, non-narcotic
Antihistamine, 50 mg, injectable
Antihistamine tablets, 25 mg
Aspirin tablets, 325 mg
Atropine, 0.5 mg, 5 cc
Bronchodilator, inhaled
Dextrose, 50% / 50 cc, injectable
Epinephrine 1:1000, 1 cc, injectable
Epinephrine 1:10,000, 2 ml, injectable
Lidocaine, 5 ml, 20 mg/ml, injectable
Nitroglycerine tablets
Saline solution, 500 cc

Enhanced Medical Kit

Burn dressings
Cord clamps
Disposable scalpel
Endotracheal tubes
Emergency tracheal catheter
Glucometer
Laryngoscope blade
Steri-strips
Thermometer
Tourniquet
Urinary catheter
Calcium chloride
Diazepam
Digoxin
Glucose gel
Furosemide
Lorazepam
Haloperidol
Hydrocortisone
Meclizine
Methylprednisolone
Metoprolol
Morphine
Nalbuphine
Naloxone
Promethazine
Sodium bicarbonate
Lightening Rod Effect

1. The febrile, irritable, mottled infant
2. The child dancer with leg pain
3. The intoxicated anesthesiologist
4. The suicidal Englishman
5. The diaphoretic overweight man with chest pain
6. The bald, unconscious man with a midline scar
7. The apneic lady

Pediatric In-Flight Emergencies
4.76 billion passengers

114,222 in-flight medical emergencies

12,226 pediatric in-flight medical emergencies (10.7%)

- EMS not required 8380 (68.5%)
- Evaluated by MD released 2479 (20.3%)
- Refused care AMA 379 (3.1%)
- Missing data 347 (2.8%)
- Other 333 (2.7%)
- Evaluated in ED and released 233 (1.9%)
- Admitted to hospital 63 (0.52%)
- Death 14 (0.11%)

### Diagnostic Category

<table>
<thead>
<tr>
<th>Diagnostic Category</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal</td>
<td>4311 (35.3%)</td>
</tr>
<tr>
<td>Infection/fever</td>
<td>2469 (20.2%)</td>
</tr>
<tr>
<td>Neurologic</td>
<td>1486 (12.2%)</td>
</tr>
<tr>
<td>Allergic</td>
<td>1052 (8.6%)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>770 (6.3%)</td>
</tr>
<tr>
<td>ENT</td>
<td>598 (4.9%)</td>
</tr>
<tr>
<td>Trauma</td>
<td>241 (2%)</td>
</tr>
<tr>
<td>Dermatologic</td>
<td>216 (1.8%)</td>
</tr>
<tr>
<td>Psychiatric</td>
<td>189 (1.5%)</td>
</tr>
<tr>
<td>Burns</td>
<td>156 (1.3%)</td>
</tr>
<tr>
<td>Orthopedic/musculoskeletal</td>
<td>135 (1.1%)</td>
</tr>
<tr>
<td>Cardiac</td>
<td>104 (0.8%)</td>
</tr>
<tr>
<td>Dental</td>
<td>71 (0.6%)</td>
</tr>
<tr>
<td>Endocrine</td>
<td>52 (0.4%)</td>
</tr>
<tr>
<td>Other</td>
<td>376 (3.1%)</td>
</tr>
</tbody>
</table>
Pediatric In-Flight Emergencies

Gender
- Male: 5159, 42%
- Female: 7067, 58%

Medical Kit Use (%)
- Oxygen: 13
- Meds: 56.4
- Equip: 3.8

Pediatric In-Flight Emergencies

Route
- Domestic: 9907, 81%
- International: 2308, 19%

Aircraft Type
- Wide Body: 8693, 71%
- Single Aisle: 3521, 29%
Pediatric In-Flight Emergencies

Volunteer Provider Type (n)

<table>
<thead>
<tr>
<th>Provider Type</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew</td>
<td>8987</td>
</tr>
<tr>
<td>Physician</td>
<td>2274</td>
</tr>
<tr>
<td>Nurse</td>
<td>684</td>
</tr>
<tr>
<td>EMT</td>
<td>172</td>
</tr>
<tr>
<td>Other</td>
<td>109</td>
</tr>
</tbody>
</table>

Need for Aircraft Diversion (n=115, 0.94%)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergencies Involving Infants</td>
<td>3.65 (2.25-5.93)</td>
</tr>
<tr>
<td>Assisted by Physician Volunteer</td>
<td>8.47 (5.21-13.75)</td>
</tr>
<tr>
<td>Total Flight Duration</td>
<td>0.997 (0.995-0.998)</td>
</tr>
<tr>
<td>Flight Time Remaining</td>
<td>1.004 (1.003-1.005)</td>
</tr>
</tbody>
</table>

Pediatric In-Flight Emergencies
Pediatric In-Flight CPR

- 4.76 billion passengers
- 114,222 in-flight medical emergencies
  - 12,226 pediatric in-flight medical emergencies (10.7%)
  - 15 episodes of cardiorespiratory arrest (0.12%)

- AED Use
  - AED: 6
  - No AED: 9

- Sustained ROSC
  - 1 (6.67%)

- No ROSC
  - 14 (93.33%)

- Route
  - International: 1
  - Domestic: 14

- Aircraft Diversion
  - Yes: 7
  - No: 8

4.76 billion passengers
114,222 in-flight medical emergencies
12,226 pediatric in-flight medical emergencies (10.7%)
15 episodes of cardiorespiratory arrest (0.12%)
AED Use
- AED: 6
- No AED: 9
Sustained ROSC
- 1 (6.67%)
No ROSC
- 14 (93.33%)
Route
- International: 1
- Domestic: 14
Aircraft Diversion
- Yes: 7
- No: 8
Pediatric In-Flight CPR

Volunteer Provider Type (n)

- Crew: 1
- Physician: 10
- Nurse: 1
- EMT: 2

15 episodes of cardiorespiratory arrest

- Lap Infants (<2yrs)
  - 11 (73.3%)
  - Pre-existing condition: 6/11
  - No Pre-existing condition: 5/11

- Children >2 yrs
  - 4 (26.7%)
  - Pre-existing condition: 1/4
  - No Pre-existing condition: 3/4
Fatalities Above 30,000 Feet: Characterizing Pediatric Deaths on Commercial Airline Flights Worldwide*

Alexandre T. Rotta, MD, FCCM1, 2; Paulo M. Alves, MD, MSc1; Katherine E. Mason, MD1, 2; Neil Nerwich, MD5; Richard H. Speicher, MD1, 2; Veerasathipurush Allareddy, BDS, MBA, PhD, MMScc; Veerajalandhar Allareddy, MD, MBA1, 2

Pediatr Critical Care Med 2014; 15:e360-e363

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**Diagram:**

- 3.711 million passengers
- 611 medical emergencies in-flight, prompting remote medical consultation
- 7520 (0.3%) pediatric in-flight medical emergencies
- 10 (0.13%) deaths

- 6 had pre-existing medical issues
- 4 had pre-existing medical issues
- 5 infants (≤2 years old)
- 1 teenager
- 4 toddlers (≥2 ≤3 years old)
My 2 Cents

- Stay hydrated
- No “diuretics”
  - ETOH
  - Coffee
- Caution if pre-existing
  - Anemia
  - Cardio-pulmonary disease
  - Pulmonary hypertension
- Carry-on your medications
- Medical alert bracelet
- Got oxygen?
- Consider the no "lap infant” rule
- No children on aisle seat
- Properly restrain your children
Questions?

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