Airborne transmission of infections in travelers

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Airborne transmission of infections in travelers

- **in-flight**
  - bacterial: Tuberculosis, meningococcal disease
  - viral: Influenza, SARS

- **on cruise**: Norovirus, influenza

- **elsewhere**: Influenza, various
INTERNATIONAL TRAVEL AND HEALTH 2007

Communicable diseases

Research has shown that there is very little risk of any infectious disease being transmitted on board the aircraft.
Airflow in the aircraft

- Recirculation of air through HEPA-filters
- Air is exchanged 15 to 20 times per hour (similar to ventilation in hospitals)
Transmission of infection may occur between passengers who are seated in the same area of an aircraft, usually as a result of the infected person coughing or sneezing or by touch .... This is no different from any other situation where people are close to each other, such as on a train, bus or at a theatre.

Airlines may deny boarding to passengers who appear to be infected with a communicable disease.
In-Flight Disease Transmission

Concern has been increasing about the possible spread of communicable diseases during air travel. Infections of particular concern include tuberculosis, *Neisseria meningitidis*, measles, influenza, and SARS.

CDC: Health Information for International Travel 2005-6, Chapter 7
http://www2.ncid.cdc.gov/travel/yb/utils/ybGet.asp?section=transportation&obj=sprayair.htm
Transmission of Tuberculosis in an aircraft

Index case

Kenyon TA et al. NEJM 1996:334:933-8
More probable PPD conversion if
- seated within 2 rows
- flight > 8 h duration

Kenyon TA et al. NEJM 1996:334:933-8
To date, no case of active TB has been identified as a result of exposure on a commercial aircraft.

In only two of the investigations was there evidence to suggest transmission of M. tuberculosis infection:

- one from a cabin crew member to other crew members: evidence of transmission was limited to cabin crew with at least 12 hours' exposure to the infectious source

- another from a passenger to other passengers: transmission of infection occurred to only a few passengers seated in the same section as and in close proximity, and only on one flight lasting more than eight hours.
“Negative” investigations on TB transmission

1. Highly infective PAX – 5 long-haul flights in 5 weeks → 238 contacts, 206 with data: “inconclusive evidence”

2. Highly infective pulmonary TB – 14 hour flight
   277 PAX, 225 with data on 2-step PPD: “possible”

At least 5 more investigations documented
**Tuberculosis on aircraft: to do!**

<table>
<thead>
<tr>
<th>Condition</th>
<th>WHO</th>
<th>CDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious TB pt</td>
<td>postpone travel</td>
<td>private transport</td>
</tr>
<tr>
<td><strong>Notification after</strong> infectious TB pt aboard</td>
<td>only if flight ≥8h, &lt;3m ago</td>
<td>only if flight ≥8h</td>
</tr>
</tbody>
</table>
10. Recommendations

For physicians

3. Physicians should inform all infectious TB patients that they must not travel by air on a flight exceeding eight hours until they have completed at least two weeks of adequate treatment.

4. Physicians should inform all MDR-TB patients that they must not travel by air – under any circumstances or on a flight of any duration – until they are proven to be culture-negative.

5. Physicians should advise TB patients who undertake unavoidable air travel of short duration (less than eight hours) to wear a surgical mask when possible or to cover the nose and mouth when speaking or coughing at all times during the flight.*

6. Physicians should inform the relevant health authority when they are aware of an infectious TB patient’s intention to travel against medical advice.

7. Physicians should immediately inform the relevant health authority when an infectious TB patient has a recent history of air travel (i.e. within three months).
Procedures for informing passengers and crew when exposure to *M. tuberculosis* is suspected in Revision (2008)
Practical issues in conducting investigations concerning exposure to M. tuberculosis

- Investigations of possible M. tuberculosis transmission aboard commercial aircraft are usually initiated several weeks to months after the flight.
- Passengers are therefore often difficult to locate.
- Airline companies are expected to comply with the IHR and the laws of the countries in which they operate.
- Confidentiality must be ensured when health authorities need to release the name of a passenger with TB to an airline.
- Confidentiality is also a concern for airline companies when health authorities request the release of passenger and crew lists.
Tuberculosis and travel

Rieder HL. Clin Infect Dis 2001;33:1393-6

- Long-term Dutch travelers: PPD conversion
  - 3.5/1000 person-months of travel (all)
  - 2.8/1000 person-months of travel (HCW excluded)


- Tuberculosis at Hajj pilgrimage
  - 15/149 conversions (Quanti FERON TB assay)

Reducing the risk of exposure to M. tuberculosis on aircraft

- People known to have infectious TB must not travel by public air transportation until at least two weeks of adequate treatment have been completed.
- Patients with MDR-TB should not travel until they have been proved to be non-infectious (i.e. culture-negative).

GENERAL RULE: Passengers unwell with possible infection should delay their flight.
In-flight transmission of N. meningitidis

1. After international flight
   2 PAX with serogroup B, same allelic profile
   Most likely scenario transmission on board
   – either from one case to the other or
   – from an asymptomatic carrier to both cases

2. After military charter SW/USA > Frankfurt, 11 h
   Meningococcal disease, serogroup ?
   +
   1 member of civilian flight crew, serogroup B
   Riley LK. Aviat Space Environm Med 2006;77:758-60
Investigations on N. meningitidis transmission

CDC investigates about 12 cases per year

Often negative – “indicate the risk to other passengers in this setting is low.”

CDC Guidelines for the Management of Airline PAX Exposed to Meningococcal Disease

Identify and consider chemoprophylaxis for
- persons traveling with index patient (household, other)
- PAX / crew with direct contact with respiratory secretions
- PAX seated directly next to the index patient if flight ≥8 hours (total time on board!)

Notification of health departments concerned to enable enhanced surveillance

Airline should maintain PAX manifest

Airplane in Alaska grounded for 3 hours – no ventilation, 1 passenger with influenza

- 38 / 53 passengers (72%) ill
- 4 hospitalizations
- Influenza A / Texas / 1/77

Highly infectious conditions, such as influenza, are more likely to be spread to other passengers in situations when the aircraft ventilation system is not operating.

WHO 2007
"Anecdotally, many people complain of respiratory symptoms following air travel. However, studies of ventilation systems and patient outcomes indicate the spread of pathogens during flight occurs rarely."

Respiratory Tract Infections (RTI) in Travelers (Geosentinel)

- 1719 / 21,960 (7.8%) with RTI at presentation
  - influenza in 96 (5.6%)

Risk factors:
- **Duration** of travel
- **VFR**, business travel
- Lower respiratory tract infections associated with increasing **age**, **male** gender
- Africa, East Asia, Central Asia
- Influenza related to travel to the Northern Hemisphere during the **winter** season

RTI → Hospitalization in Italy

Prospective, multicenter in 12 tertiary care hospitals

- 40 of 540 (7.6%) cases with RTI
- 2/3 lower RTI, 1/3 upper RTI
- Pneumonia (35%) > TBC (15%)

57% migrants, 14% foreign visitor, 29 travelers

Etiology of pneumonia among travelers returning from abroad (n=17)

Site: Pitié Salpetriere, Paris

- 3 Mycobacterium tuberculosis
- 2 Streptococcus pneumoniae
- 2 Mycoplasma pneumoniae
- 1 Legionella pneumophila
- 1 Coxiella burnetii
- 1 Leptospira sp.

10 bacterial

OTHER

- Histoplasmosis, Schistosomiasis, Dengue
- 4 unknown

Ansart S et al. J Travel Med 2004;11:8791
Potential for International Spread: Global aviation network

Influenza pandemic threat, 21\textsuperscript{th} century – bad news

- population
- immunoincompetent
- urbanization
- senior citizen

Rapid spread $\rightarrow$ \textcopyright time to get prepared

## Flights with SARS transmission

**NOTE:** no cases after 23 March 2003!

<table>
<thead>
<tr>
<th>Date</th>
<th>Airline</th>
<th>Routing</th>
<th>Index</th>
<th>Infected</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>14Mar</td>
<td>SQ</td>
<td>JFK-FRA</td>
<td>32y (MD)</td>
<td>1/375</td>
<td>F/A cured</td>
</tr>
<tr>
<td>15Mar</td>
<td>CA</td>
<td>HKG-BJS</td>
<td>73y</td>
<td>24/120</td>
<td>20%!</td>
</tr>
<tr>
<td>22 Mar</td>
<td>AF</td>
<td>HAN-BKK</td>
<td>1 (MD)</td>
<td>3/166</td>
<td></td>
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<tr>
<td>23 Mar</td>
<td>N/A</td>
<td>N/A</td>
<td>2</td>
<td>1/265</td>
<td></td>
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WHO: personal communication
Alaska Cruise Ship

Courtesy: Prof. Annelies Wilder-Smith, U of Singapore
Large summertime outbreak of respiratory illness

- Cruise to Alaska, 1998
- Doctor visits for ARI per 1000 tourists: 11.6
- 5361 cases of ARI, 53% of ILI
- 171 (3.2%) pneumonia
- 4 deaths (all elderly)
- Influenza A in 71% of the isolates

Courtesy: Prof. Annelies Wilder-Smith, U of Singapore
Influenza on Cruises, NYC - Montreal with returns

Influenza in travelers

Follow-up study:
Febrile illness: 289 (19.9%)
Two serum samples: 211 (73.0%) + 321 matched controls

Seroconversion for influenza virus infection (WHO CC London)
40 (67% with fever, 33% asymptomatic, 18 w/≥4x ab)

Incidence rate / 100 person-months: 1.0
most frequent vaccine preventable infection!

Influenza among hajj pilgrims

500 pilgrims with upper respiratory tract symptoms — only those with fever >38.3°C, and/or sore throat included:

54 patients (10.8%) had positive viral throat cultures:

- influenza B  27 (50.0%)
- influenza A  3  (5.6%)

→ Estimated **24,000 cases** of influenza per Hajj season!

→ Very low influenza vaccination rate for the vaccine

Balkhy HH, Memish ZA, Bafaqeer S, Almuneef MA. Influenza a common viral infection among Hajj pilgrims: time for routine surveillance and vaccination. J Travel Med 2004;11(2):82-6

761 throat swabs collected during the 1991 and 1992 hajj: Viruses in 148 (19.5%); **influenza A most common**

Norovirus - Epidemics
## Norovirus on cruise ships — CDC

<table>
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<tr>
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<td>9502</td>
<td>65866</td>
<td>27324</td>
<td>24348</td>
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<tr>
<td>ill</td>
<td>1577</td>
<td>168</td>
<td>3988</td>
<td>479</td>
<td>1677</td>
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<tr>
<td>ill in %</td>
<td>7.65</td>
<td>1.77</td>
<td>6.05</td>
<td>1.75</td>
<td>6.89</td>
</tr>
</tbody>
</table>

(     ) = n cruise ships

Outbreak Updates for International Cruise Ships, CDC [http://www.cdc.gov/nceh/vsp/surv/GIIlist.htm](http://www.cdc.gov/nceh/vsp/surv/GIIlist.htm)
Legionella infections on cruise ships

- associated with public bath, 70 y/o male

- 1 sporadic case → 2 further cases + 1 non-pneumonic legionella infection
Legionella infections and travel – 2000 to 2002

Total: 10,322 cases reported

Travel: 654 associated with travel to
  – France (126)
  – Italy (111)
  – Spain (62)
  – etc.

Control and prevention of legionella infections

- Control measures in accommodations (European guidelines)

- Turn on warm shower – wait 1 minute outside?
VFRs as high risk population

- Tuberculosis

- various RTI
Acute pulmonary histoplasmosis in trekkers

25 trekkers in Martinique

13 through tunnel full of bats
- 1 fever, chills, cough
- 12 prolonged influenza

12 canyoning
- all healthy
- all H. capsulatum neg.

Histoplasmosis (all H. capsulatum pos.)

Conclusions: airborne transmission

- Short term movements: Influenza, noro frequent, tuberculosis, meningococcal disease, etc. rare
- Long term: migrants, refugees

Cope with imported diseases