

Airborne transmission of infections in travelers

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Airborne transmission of infections in travelers

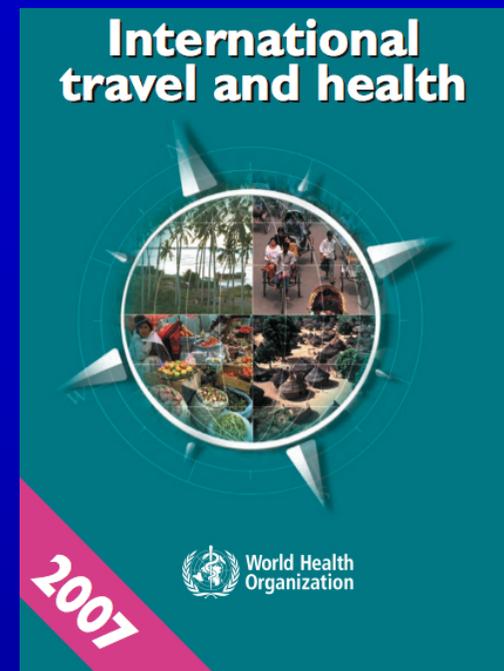
- **in-flight**

- **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

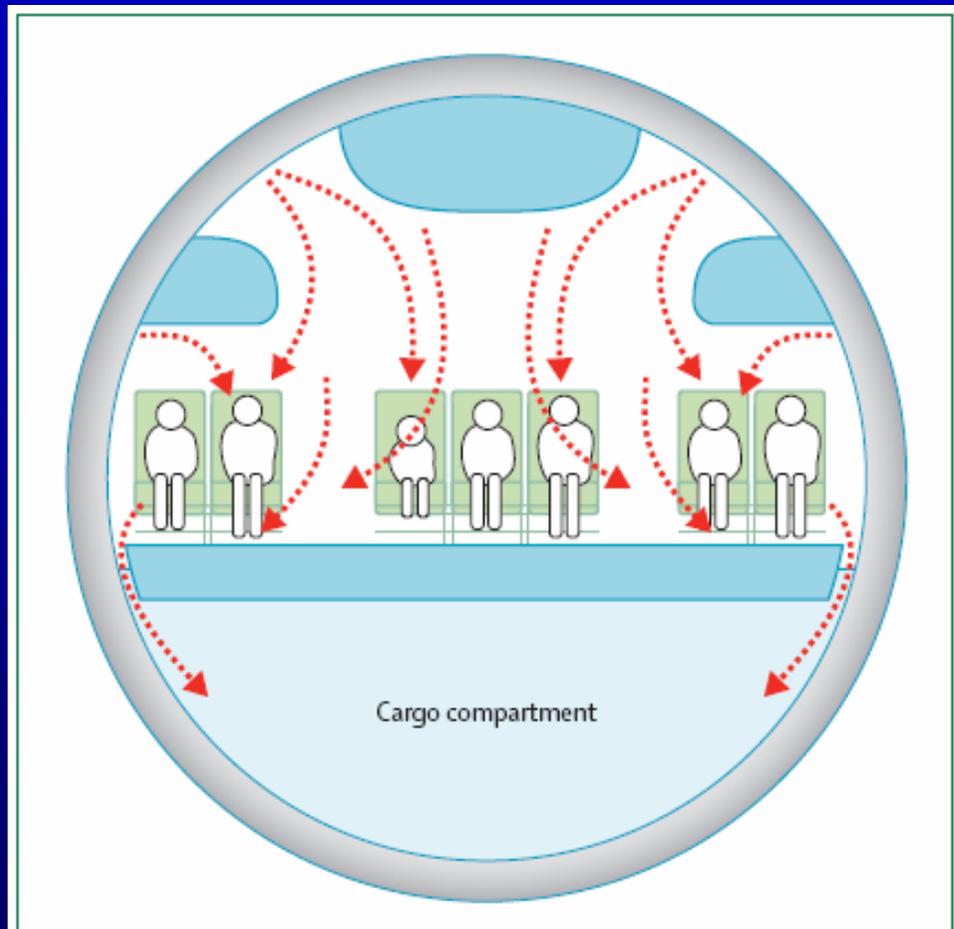


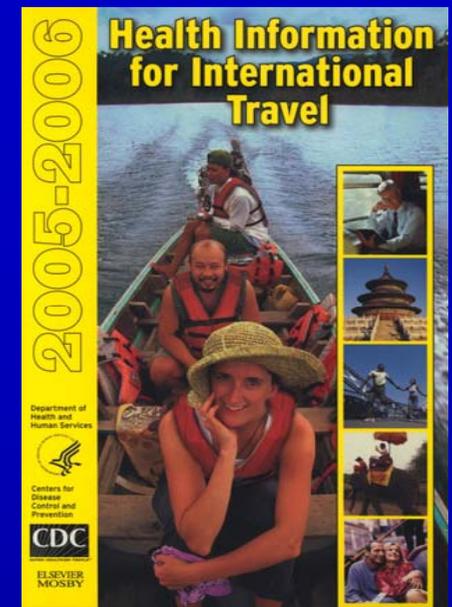
Figure 1: Air circulation pattern in typical airline passenger cabin
From WHO⁴ with permission of the publisher. Arrows show air currents.

- 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/utills/ybGet.asp?section=transportation&obj=sprayair.htm>

Transmission of Tuberculosis in an aircraft

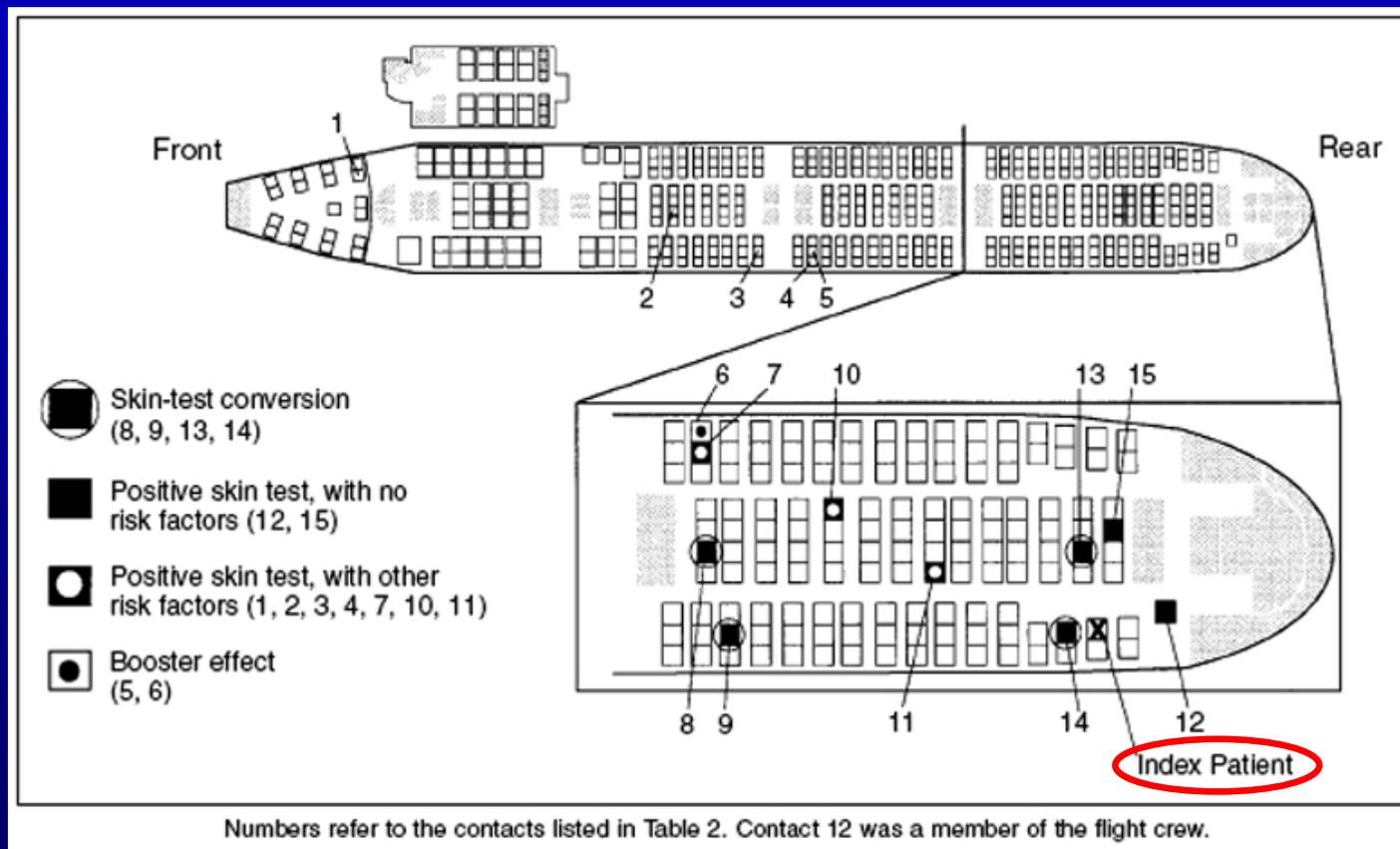


Figure 1. Chest Film of the Index Patient Eight Days after Flight 4, Showing Extensive Bilateral Pulmonary Disease with Cavitary Lesions.

Index case

Kenyon TA et al. NEJM 1996;334:933-8

Seat Assignment of the Passengers and Flight Crew on Flight Who Had Positive Tuberculin Skin Tests



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”**

Whitlock et al. NZ Med J 2001; 114:353-5

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

Wang PD. Am J Infect Control 2000;28:233-38

At least 5 more investigations documented

Tuberculosis on aircraft: to do!

Condition	WHO	CDC
Infectious TB pt	postpone travel	private transport
Notification <u>after</u> infectious TB pt aboard	only if flight ≥8h, <3m ago	only if flight ≥8h
http://www.cdc.gov/travel/tb_risk.htm	cdc.gov/travel/tb_risk.htm	who.int/gtb/publications/aircraft/PDF/98_256.pdf

TUBERCULOSIS *and* AIR TRAVEL



GUIDELINES FOR PREVENTION AND CONTROL

SECOND EDITION



World Health
Organization

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)

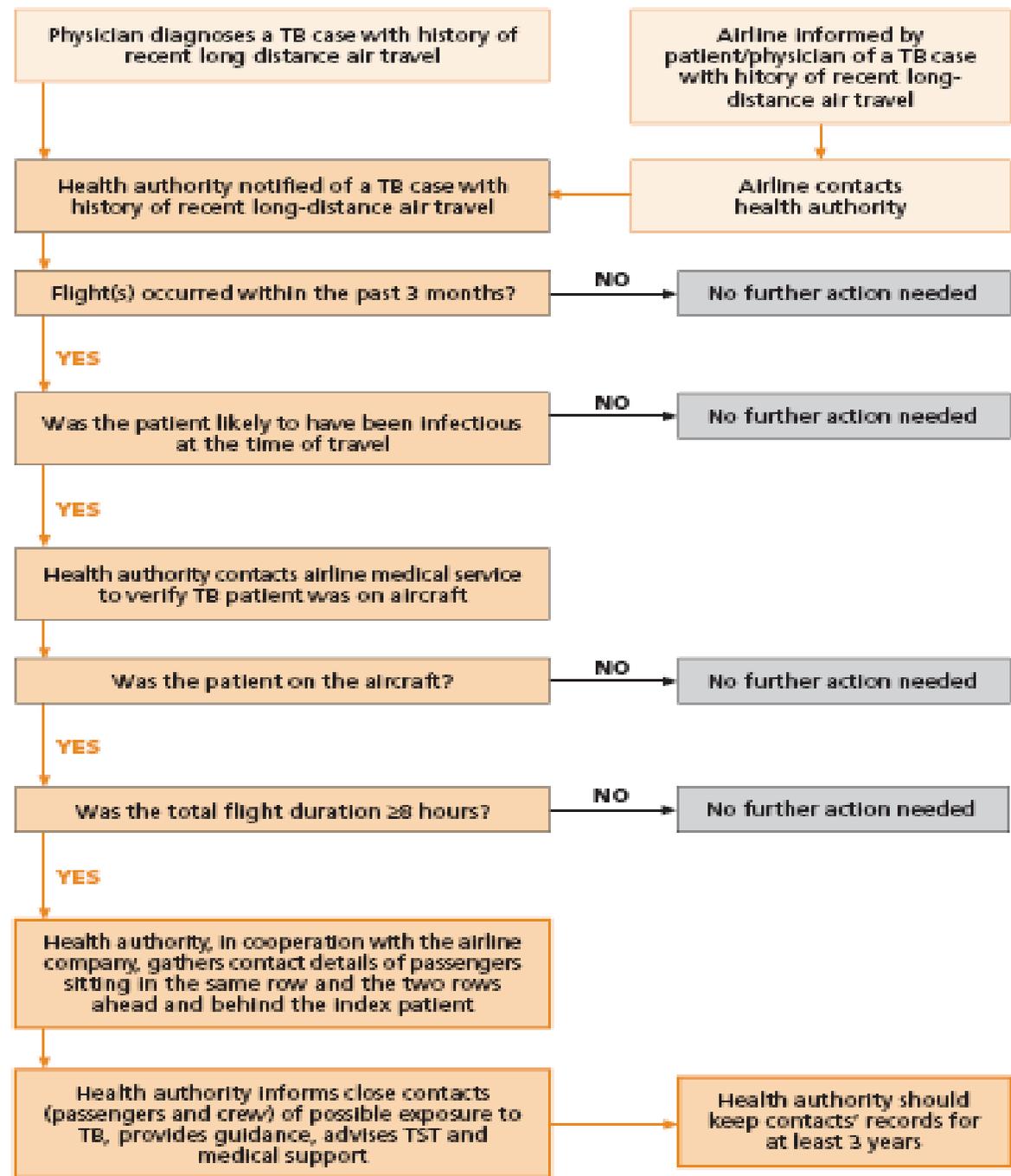


Figure 2. Steps to follow when deciding whether contact tracing is needed.

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)

Cobelens FGJ et al. Lancet 2000;356:461-5

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

Wilder-Smith et al. Trop Med Intern Health 2005;10:336-9

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**

O'Connor BA et al. Commun Dis Intell. 2005;29:312-4

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. Exposure to patients with meningococcal disease on aircraft
United States, 1999-2001.

- MMWR Morb Mortal Wkly Rep. 2001;50:485-9
- JAMA. 2001 Jul 11;286:160-1.

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!)

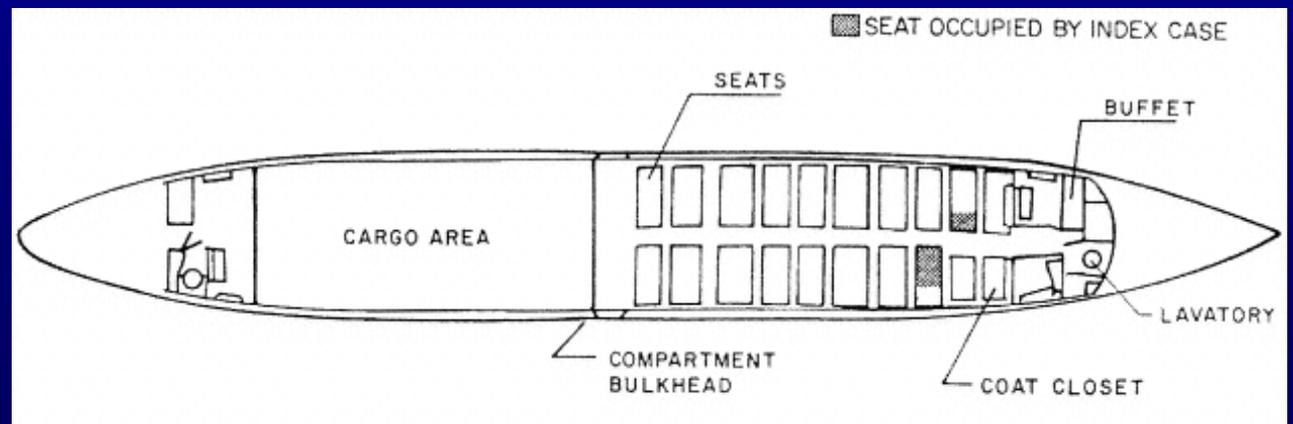
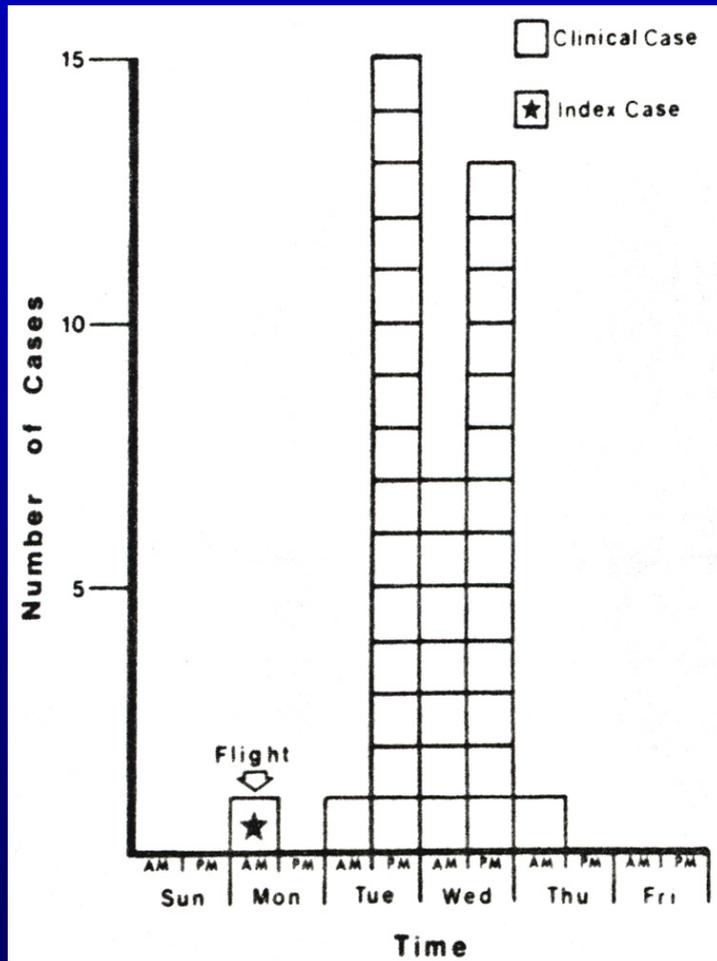
Notification of health departments concerned to enable **enhanced surveillance**

Airline should **maintain PAX manifest**

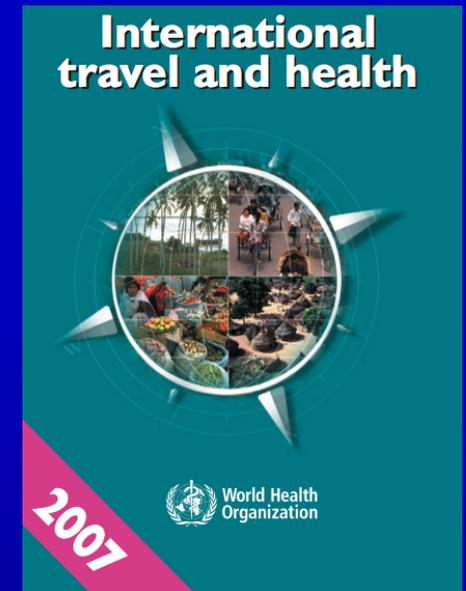
<http://www.cdc.gov/travel/menin-guidelines.htm>

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.**



”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.”

Leder K & Newman D. Intern Med J. 2005;35:50-5

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 burneti
- 1 Leptospira sp.

10 bacterial

OTHER

- Histoplasmosis, Schistosomiasis, Dengue
- 4 unknown

Potential for International Spread: Global aviation network



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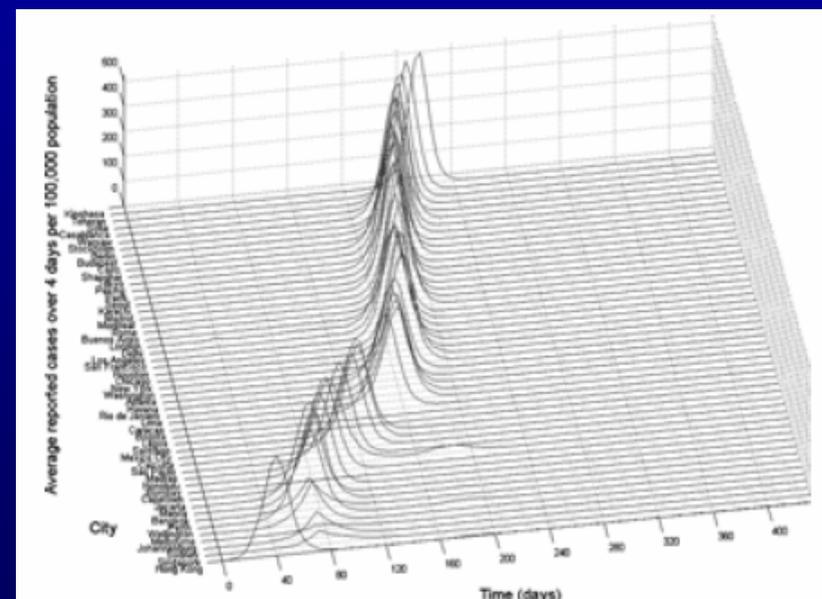
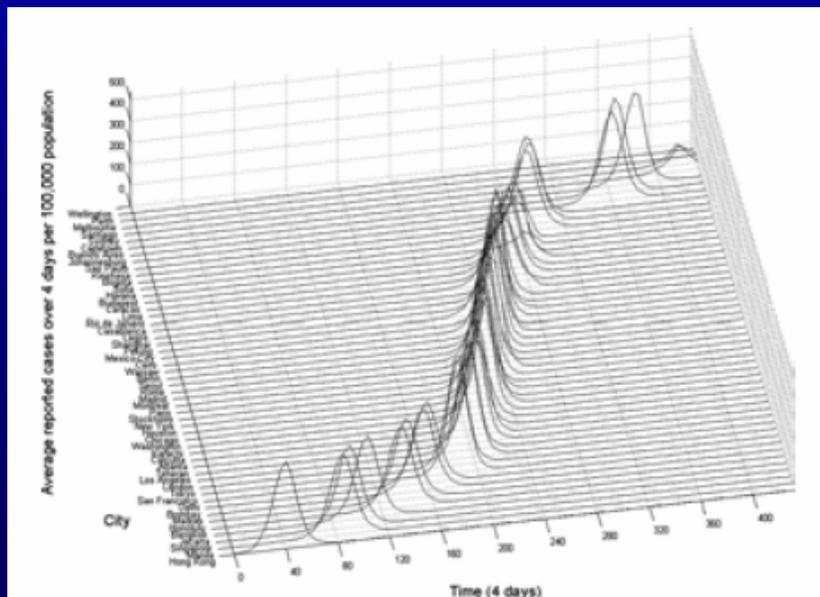
25000

Hufnagel, L. et al. (2004) Proc. Natl. Acad. Sci. USA 101, 15124-15129

Influenza pandemic threat, 21th century – bad news

- ↗ population
- ↗ immunoincompetent
- ↗ urbanization
- ↗ senior citizen

Rapid spread → ⏪ time to get prepared



Cross-Border Follow-up

Flight Associated Cases

Flight Hong Kong –
Beijing March 15

Inner Mongolia

Beijing

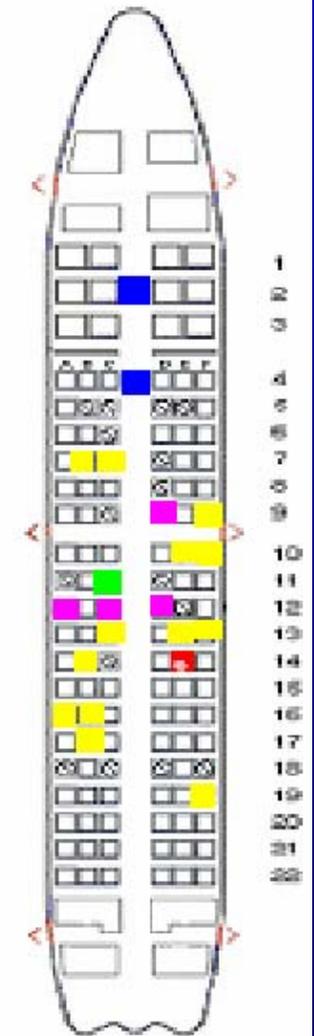
Flight: Bangkok –
Beijing March 23

Bangkok

Singapore

Hong Kong

Taiwan



Flights with SARS transmission

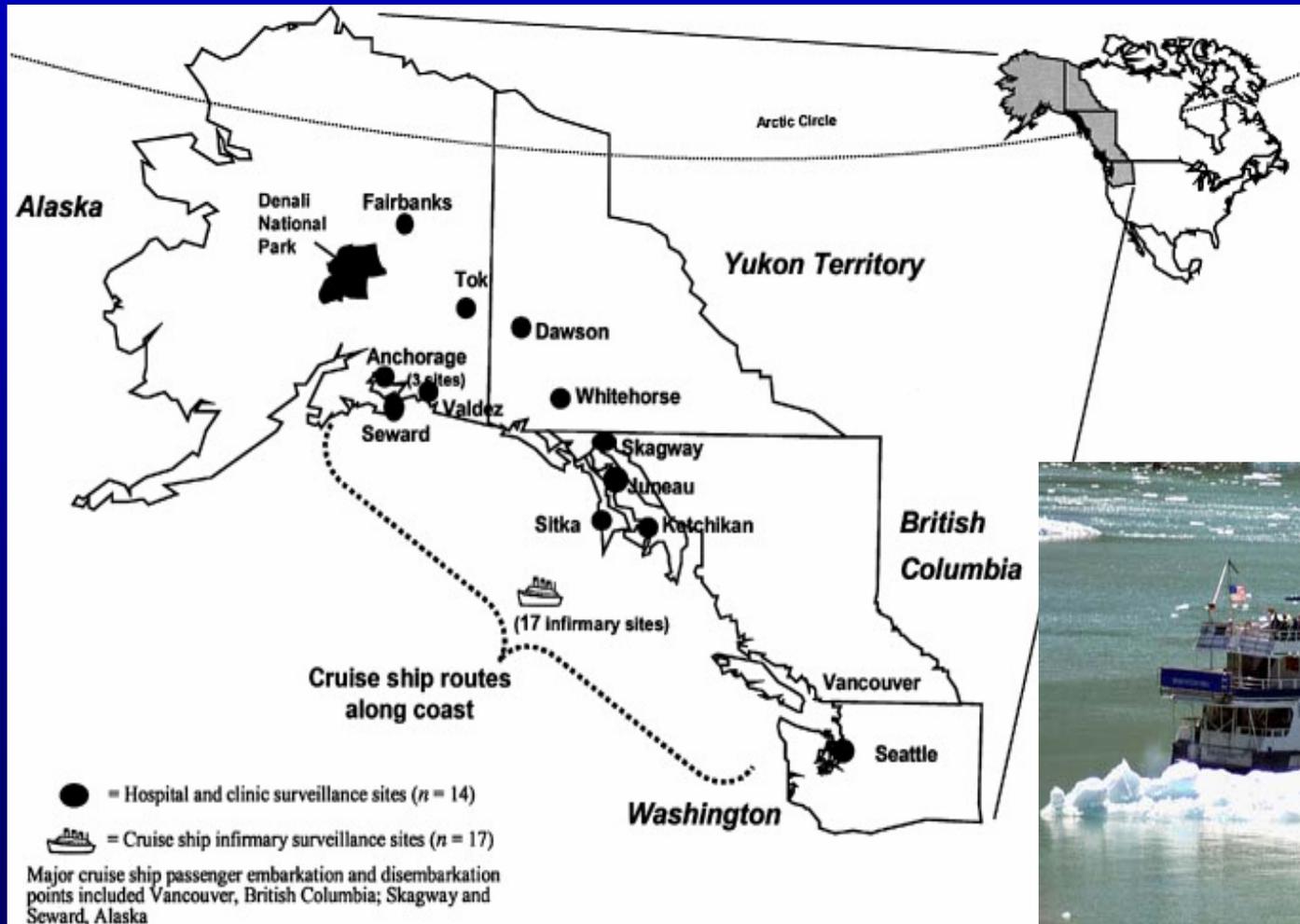
NOTE: no cases after 23 March 2003!

Date	Airline	Routing	Index	Infected	Remarks
14Mar	SQ	JFK-FRA	32y (MD)	1/375	F/A cured
15Mar	CA	HKG-BJS	73y	24/120	20%!
22 Mar 23 Mar	} AF	HAN-BKK	1 (MD)	3/166	} 1 F/A
		BKK-CDG		3/366	
23 Mar	N/A	N/A	2	1/265	

AHEAD: 7 rows BEHIND: 5 rows

WHO: personal communication
 Lim M. K. et al. Occup Environ Med 2003;60:539-40

Alaska Cruise Ship

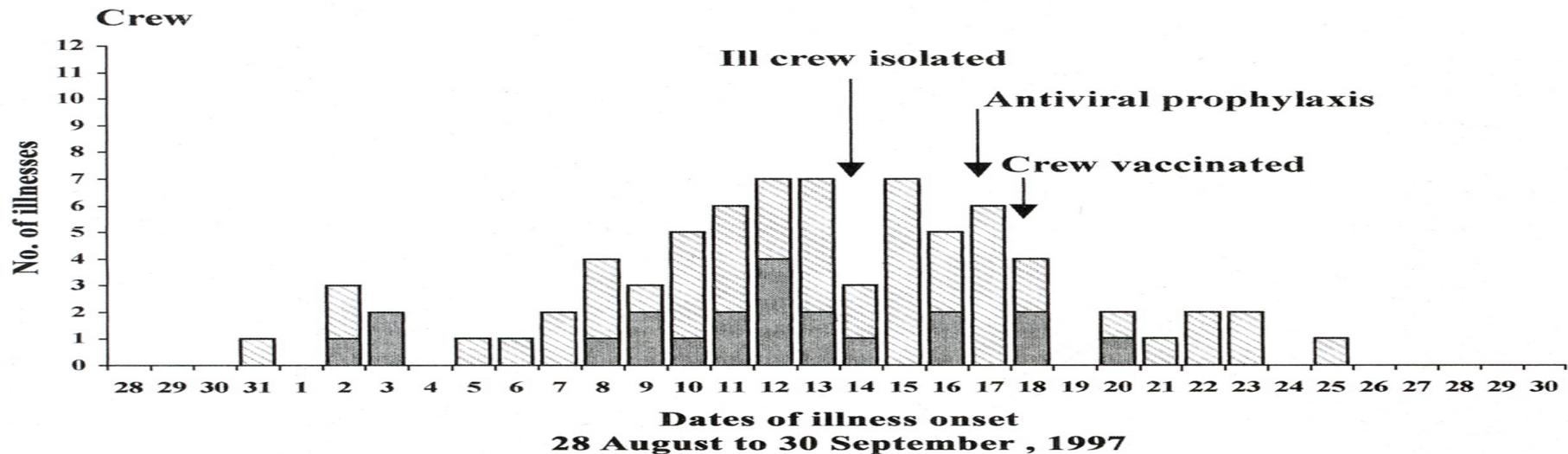
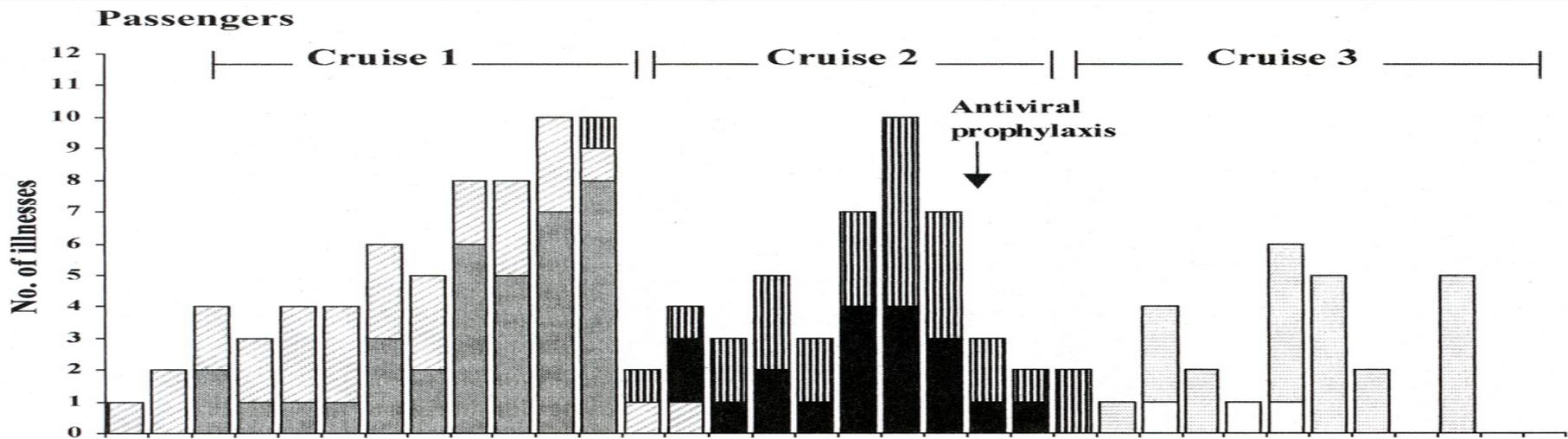


Uyeki TM et al. Clin Infect Dis 2003;36:1095-1102
 Courtesy: Prof. Annelies Wilder-Smith, U of Singapore

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

Influenza on Cruises, NYC - Montreal with returns



Passengers

- Cruise 1
 - Other ARI
 - ILI
- Cruise 2
 - Other ARI
 - ILI
- Cruise 3
 - Other ARI
 - ILI

Crew

- Other ARI
- ILI

Influenza in travelers

Follow-up study:

Population: 1450 travelers to developing countries (1/1998 -3/2000)

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 $>38.3^{\circ}\text{C}$, 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**

El-Sheikh SM, El-Assouli SM, Mohammed KA, Albar M. Bacteria and viruses that cause respiratory tract infections during the pilgrimage (Haj) season in Makkah, Saudi Arabia. Trop Med Int Health. 1998;3:205-9

Norovirus - Epidemics



Norovirus on cruise ships — CDC

Year	2007 (13)	2006 (31)	2005 (14)	2004 (15)	2003 (8)
	Pax	Crew	Pax	Crew	Pax
Total	20616	9502	65866	27324	24348
ill	1577	168	3988	479	1677
ill in %	7.65	1.77	6.05	1.75	6.89

() = n cruise ships

Outbreak Updates for International Cruise Ships,
 CDC <http://www.cdc.gov/nceh/vsp/surv/GIlist.htm>

Legionella infections on cruise ships

- associated with public bath, 70 y/o male

Kobayashi A et al. J Anesth 2004;18:129-31

- 1 sporadic case → 2 further cases +
1 non-pneumonic legionella infection

Regan CM et al. Comm Dis Public Health 2003;6:152-6

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.**

**Joseph CA and European Working Group for Legionella Infections,
Epidemiol Infect 2004;132:417-24**

Control and prevention of legionella infections

- **Control measures in accomodations**
(European guidelines)

Rota MC et al. Euro Surveill 2004;1:9

- **Turn on warm shower – wait 1 minute outside?**

VFRs as high risk population

- **Tuberculosis**

Angell SY and Cetron MS. Ann Intern Med 2005;142:67-72

- **various RTI**

Fulford M and Keystone JS. Curr Infect Dis Rep 2005;7:48-53

Acute pulmonary histoplasmosis in trekkers

25 trekkers in Martinique

13 through tunnel
full of bats

12 canyoning

1 fever, chills
cough

12 prolonged
influenza

all healthy

Histoplasmosis (all *H. capsulatum* pos.)

all *H. capsulatum* neg.

Conclusions: airborne transmission

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



**Cope with
imported diseases**