Introduction

Air travel is the main way that pandemic influenza is disseminated globally so it is important to limit dissemination via air travel during the containment stage, but there is little evidence for the effectiveness of control measures at borders. Passenger aircraft are also a setting for influenza transmission, but this risk is not well characterised. On 25 April 2009 WHO declared pandemic influenza A(H1N1) [pH1N1] a Public health emergency of international concern. That day a group of 24 students and teachers arrived in Auckland New Zealand (NZ) after a 3 week trip to Mexico:

- 12 had influenza symptoms, 9 subsequently confirmed as NZ’s first cases of pH1N1.
- All were seated in the rear section of a Boeing 747-400 long-haul (13 hour) direct flight from Los Angeles.
- 5 other passengers in the rear section later developed influenza symptoms suggesting possible in-flight transmission.

This was the containment phase of NZ’s influenza response so a vigorous attempt was made to follow-up all passengers on the flight.3

Aims of the investigation

1. Assess the risk of in-flight transmission of pH1N1
2. Measure the effectiveness (sensitivity, specificity) of symptom questions for case detection
3. Assess the effectiveness (completeness, timeliness) of contact tracing of exposed passengers

Methods

Design: Retrospective cohort investigation using a questionnaire administered to passengers to identify those with symptomatic illness.

Data collection: We obtained a passenger list and seating positions from the airline to identify passengers seated in the rear section of the aircraft.

Passengers were interviewed using a standard questionnaire to record symptoms, timing of illness and exposures to symptomatic people before and during the flight. Information on passengers and their management was also obtained from public health service records.

Nasopharyngeal swabs were obtained from symptomatic passengers, as well as some who were asymptomatic, and tested by real-time PCR using primers that distinguished pH1N1 from other influenza virus sequences. The student group also had serologic specimens collected 16-23 days post-flight.

Case definition: In-flight transmission: Laboratory-confirmed pH1N1 infection; Symptom onset post-flight within the influenza incubation period (influenza A = 0.6 - 3.2 days)4. No other plausible source identified.

Also distinguished: Lab-confirmed symptomatic case during flight; Suspected symptomatic case during flight; Immune case; Non-case

Results

Risk of In-flight Transmission: All 24 members of the school group were interviewed and had nasopharyngeal swabs and/or serological specimens collected:

- 9 had laboratory-confirmed symptomatic pH1N1 infection.
- We obtained interview information from 95% (97/102) other passengers in the rear section of the aircraft (see Figure 1):
  - 2 were classified as cases of in-flight transmission (laboratory-confirmed infection, 12 and 48 hours following the flight), both cases were seated within 2 rows of infected passengers.
  - 2 other passengers were possible cases of in-flight transmission (1 laboratory-confirmed case was part of the school group with symptom onset after 24 hours; 1 suspect case was part of the school group with symptom onset after 55 hours).
- Risk = 1.7% (95%CI 0.3-0.6) for passengers in the rear section of aircraft (2 / 107)
- Risk = 3.5% (95%CI 0.6-11.1) for those seated within 2 rows of infected passengers (2 / 57)

Figure 1: Seating plan of the rear section of the aircraft showing passengers according to their infection category and seating position.

Effectiveness of Symptoms for Case Detection: All but one of the confirmed pH1N1 infected travelers reported cough but more complex influenza case definitions had relatively low sensitivity (see table 1).

Effectiveness of Passenger Follow-up: Rigorous follow-up by public health workers located 93.1% of passengers, but only 52.2% within 72 hours of arrival (Table 2).

Discussion

Main findings: There is a low but measurable risk of transmission of pH1N1 on passenger aircraft. Risk appears concentrated within 2 rows of infected and symptomatic passengers. Other investigations report similar findings.5,6

Screening for people infected with influenza is likely to be more sensitive if it uses the presence of single symptoms, such as cough, rather than more complex case definitions.

Identification and management of passengers exposed to infections should be started before passengers leave the airport or board other flights.

Limitations: These cases of in-flight influenza transmission could potentially have been infected prior to boarding, but this is unlikely: cases of pH1N1 were rare outside Mexico at this very early stage of the pandemic; transmission before boarding would only have been possible at the extreme upper range of the incubation period.

This study is likely to have underestimated transmission risk: we excluded 2 likely cases; some of those infected in-flight would have been asymptomatic (serological testing could have helped identify such cases, but was not available on a large scale).

Generalisability of findings to other influenza viruses and other exposure settings is uncertain.

Implications: Transmission of influenza is most likely to be via short-range droplets from coughing and sneezing, rather than airborne aerosols distributed through ventilation system.7

Screening arriving passengers for influenza symptoms and following-up contacts of those who were symptomatic on flights is insufficient to detect arriving passengers with influenza. Such measures will miss asymptomatic passengers and those incubating disease. Preventing in-flight transmission is dependent on stopping infected passengers getting on flights. For future pandemics (which are likely to be more severe than this one), governments and the airline transport sector will probably need a much stronger focus on exit screening.

Reducing global dissemination of important pathogens by air travel will require a major systematic change in how we manage infectious disease risk in this setting.

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References: