

Short communication: **Low risk of transmission of severe acute respiratory syndrome on airplanes: the Singapore experience**

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Summary

The risk of transmission of severe acute respiratory syndrome (SARS) on airplanes is of major concern to the public and airline industry. We examined data from flights to Singapore with SARS patients on board in order to assess this risk. In-flight transmission occurred only in one of the three flights with symptomatic SARS patients on board. The incidence was estimated to be 1 out of 156 passengers. The risk of in-flight transmission of SARS appears to be far lower than that reported for influenza, but may be increased with superspreaders on board.

keywords SARS, Singapore, in-flight transmission, risk

Introduction

Severe acute respiratory syndrome (SARS) has emerged as a new infectious disease caused by a novel coronavirus and is associated with significant morbidity and mortality (Lee *et al.* 2003). SARS has created international anxiety because of its novelty, ease of transmission in certain settings, and the speed of its spread through jet travel (Wenzel & Edmond 2003). Transmission is thought to be by droplet spread and by direct or indirect contact (Chan-Yeung & Yu 2003). The main mode of introduction of SARS to countries around the world was via travellers on airplanes (Wilder-Smith & Freedman 2003). The risk of in-flight transmission of SARS became a major concern to the public and airline industry, and anxiety about this risk led to the near collapse of some airlines. We examined data from flights to Singapore with SARS patients on board in order to assess the risk of in-flight transmission.

Methods

Information on surveillance on passengers on flights with SARS patients was retrieved from the Ministry of Health. Information on flights carrying SARS patients was obtained from the Ministry of Health and Civil Aviation Authority of Singapore. The period of observation was from 25 February (when the first SARS patients arrived in Singapore) until 31 May 2003 (when Singapore was declared SARS free by the WHO).

Results

Surveillance

The Infectious Diseases Act was invoked on 24 March 2003 in Singapore to provide the legal basis to quarantine all contacts that had been exposed to SARS patients; and therefore home quarantine orders and active surveillance was instituted from 24 March 2003 onward for all passengers once a fellow passenger was notified to the Ministry as suspect or probable SARS patient. In addition, Singapore introduced health declaration cards on 7 April to all incoming passengers from SARS-hit countries, and from 29 April onwards to those of all countries. The purpose of these health declaration cards was not only to obtain recent travel and contact history, symptoms suggestive of SARS and recent intake of antipyretics, but also the flight seat and address in Singapore to facilitate contact tracing.

Flights with SARS patients on board

Seven airplanes with nine passengers on board later diagnosed as suffering from probable SARS (based on WHO criteria) arrived in Singapore between 25 February and 31 May 2003: three were from Hong Kong (with five cases of SARS), one from Beijing, one from New York, one from East Malaysia and one from Indonesia. Six of the nine travelers imported SARS to Singapore (from Hong Kong and Beijing) and three had acquired SARS in Singapore and were returning to Singapore (from New York, east Malaysia and Indonesia). However, only three airplanes (with four passengers) had symptomatic cases

A. Wilder-Smith *et al.* **Low risk of SARS transmission on airplanes****Table 1** Airline passengers with SARS on flights arriving to Singapore 25 February 2003 to 31 May 2003

	Arrival in Singapore	Flight from:	Contracted SARS in:	Symptoms on flight	Secondary cases	In-flight transmission
1	25 February	Hong Kong	Hong Kong (Hotel M)	Fever	21	0
2	25 February	Hong Kong	Hong Kong (Hotel M)	Fever	0	0
3	25 February	Hong Kong	Hong Kong (Hotel M)	Asymptomatic	0	0
4	14 March	New York	Singapore	Fever, cough, shortness of breath	2	1
5	18 March	East Malaysia	Singapore	Asymptomatic	0	0
6	23 March	Hong Kong	Guangdong/Hong Kong	Asymptomatic	0	0
7	23 March	Hong Kong	Guangdong/Hong Kong	Asymptomatic	0	0
8	26 March	Beijing	Hong Kong/Beijing	Fever, cough, shortness of breath	0	0
9	22 April	Indonesia	Singapore	Asymptomatic	0	0

of SARS on board, whereas the passengers of the other flights developed symptoms within the first 2 days after arrival in Singapore. Of these three airplanes, two arrived before 24 March, i.e. before airport screening, quarantining and active surveillance was in place.

Transmission

In-flight transmission occurred only in one of the three airplanes with symptomatic SARS patients on board. Transmission was to one person only, and this was to a stewardess who had served and cleaned the tray of a passenger with SARS on the flight from New York to Singapore via Frankfurt (14 March). The passenger was a doctor who had treated the first admitted case of SARS in Singapore at a time when this new disease was not identified and no infection control measures were in place. At disembarkation, the passengers were briefed on symptoms of SARS and advised to seek prompt health care should they develop symptoms. None of the 82 passengers who disembarked in Frankfurt, or the 28 who disembarked in Singapore developed SARS (except for the wife and mother-in-law of the doctor who had close contact prior to the flight and both developed SARS).

Although no active surveillance of passengers and crew members was done for the flight from Hong Kong to Singapore on 25 February with two passengers with early symptoms of SARS, systems were in place in Singapore for detection of SARS, and no cases were linked to this flight.

The third flight with one passenger with severe symptoms of SARS (fever, cough, shortness of breath) arrived after the Infectious Disease Act had been invoked: all crew members and 46 of 47 passengers were contactable and quarantined with active surveillance for 10 days; none developed SARS. Table 1 summarizes these findings. The incidence of transmission of SARS on

airplanes with SARS patients with respiratory symptoms is estimated to be 1 out of 156 exposed passengers.

Discussion

Our limited experience of the three flights to Singapore with symptomatic SARS patients on board suggests that in-flight transmission of SARS is not common. The low incidence of in-flight transmission of SARS is consistent with the findings from mathematical modelling in Hong Kong and Singapore that the SARS coronavirus is only moderately transmissible, and that superspreaders contribute to the epidemic (Lipsitch *et al.* 2003; Riley *et al.* 2003). Although one of the initially imported cases was a superspreader (transmission to 21 household contacts and health care workers) (Hsu *et al.* 2003) at the time of her flight she only had mild prodromal symptoms without cough. It appears that transmission mainly occurs when people have respiratory symptoms. None of the other cases except for the Singaporean doctor (transmission to two household contacts) resulted in secondary transmission. It is highly likely that the risk of in-flight transmission would be enhanced with superspreaders on the plane. This may have been the case on the highly media-publicized flight from Hong Kong to Beijing on March 15 where at least nine other passengers had contracted SARS from one passenger.

The risk of in-flight transmission of SARS appears to be far lower than that reported for influenza. For example, one airplane with one case of influenza was grounded for 3 h and 72% of all passengers developed a clinical syndrome of influenza during the next 3 days (Moser *et al.* 1979). Similarly, a new strain of influenzavirus on a cruise ship had an attack rate of 42% amongst crew members (Earhart *et al.* 2001).

An international collaborative study involving all flights with symptomatic SARS patients on board is needed to

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determine the true incidence of in-flight transmission of SARS. Serological studies are under way to determine the incidence of asymptomatic or subclinical infection with the SARS coronavirus on airlines with a case of SARS on board.

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