JTM 15-033: Supplementary on line material

Appendix S5: Air transport: study characteristics

Author (Year)	Study details	Outcome detail	Limitations
Influenza			
Retrospective cohort studies and reviews investigating in-flight transmission			
Catala (2012)[32]	Mexico – Barcelona flight with 6 cases aboard in a group travelling together	AR within group: 14.1% (12.1-16.1%). AR in rest of plane: 0 AR in contacts post arrival 13.2% (9/68 tested positive)	Only persons reporting symptoms were tested, mild cases could have been missed. Group behaviours are thought to increase risk of transmission, not necessarily transmitted in-flight.
Zhang (2013)[22]	Three flights as part of a trip. One index case aboard	AR on the full trip: 13% AR on short leg: 0% Social contacts (n40) 7.5%	Other sources of infection not included
Han (2009)[59]	Symptomatic case took three flights and was part of a tour group on arrival	No transmission noted on flight 1 and 2. One persons infected on flight 3. 30% AR in tour group	Recall bias. Unclear whether cases were lab confirmed
Foxwell (2011)[16]	Two flights with 2 and 1 symptomatic passengers aboard.	Flight 1: Transmission confirmed to 2 passengers. 1.4% AR within 2 row Flight 2: Transmission confirmed to 1 passenger	None identified
Kim (2010)[17]	Long haul flight with 1 index case, 418 passengers	1 passenger infected in-flight 1 social contact infected post arrival	No statement on follow up time of passengers.
Baker (2009)[18]	13 hour flight with 9 confirmed and 3 suspected cases aboard.	Transmission confirmed to 2 passengers and possible to another 1; AR 1.9% in rear or plane; 3.5% within 2 rows of index cases.	Infection possible prior to boarding in one case. Recall bias. Incomplete laboratory testing.

Young (2013)[20]	Long haul flight with 6 potentially infectious persons aboard	Transmission confirmed to 4 passengers, suspected to another 6 AR 4.3%. No significant association between time spent at airport and transmission risk	Length of follow up not mentioned, cases could have been missed. Other sources of injection not excluded in all cases.
Neatherlin (2000)[21]	Two short haul flights with 1 index case on each	Transmission suspected to 4 passengers (AR of ILI 2.4%)	Other exposures were not excluded. Limited lab confirmation. Recall bias
Ooi (2010)[24]	Long haul flight with 1 index case	Transmission to 6 passengers suspected - AR in economy 4.7%.Risk of infection 22.9time higher in economy then the rest of the plane ($p<0.001$).	Low proportion of passengers followed up. Other sources of infection not excluded.
Marsden (2003)[23]	Domestic Australian flight with 75 passengers & one index case	Transmission suspected to 15 (20%) passengers, 9 were seated within 2 rows, 14 within 5 rows of index case.	Lab confirmation not performed, other exposures not excluded.
Moser (1979)[25]	52 passengers on a grounded plane with no ventilation for 3 hours. One index case aboard	72% AR; this increase significantly with time spent on the aeroplane; <1hr 53%; >3hrs 86%	Flight had no ventilation, in modern aircrafts ventilation is required if aircraft is grounded for >30 minutes
Adlhoch & Leitmeyer (2014) [9]	Systematic review of 15 retrospective cohorts studies	Risk of transmission was noted in studies but limited conclusions could be drawn	Limitations of included studies were recall bias, selection bias, restricted laboratory testing and the inability to exclude other sources of infection.
Leder & Newman (2005)[8]	Review of in-flight transmission of various pathogens, 3 studies on influenza identified.	Limited transmission of influenza occurs when ventilation systems are fully functional	This review was not systematic and did not look into the strengths and weaknesses of included studies. Limited conclusions were drawn.
Mangili & Gendreau (2005)[6]	Review of in-flight transmission of various pathogen, 3 studies on influenza identified.	Limited transmission of influenza occurs when ventilation systems are fully functional	This review was not systematic and did not look into the strengths and weaknesses of included studies. Limited conclusions were drawn.
Modelling studies investigating in-flight transmission			

Guputa (2012)[5]	Modelled the dispersion on of respiratory pathogens in an aircraft cabin.	Risk highest for passengers close to index case & in window seats. Quanta release of 103/hour could result in 3/20 persons infected and 5226/hour could result in 20/20	Model was not validated with real life cases.
Wagner (2011)[27]	Studied air flow in aircraft cabins to look at pathogen transmission.	Transmission is theoretically confined to cabin with index case. Higher levels of transmission in economy cabin and longer flight duration.	Assumes air contamination is uniform & doesn't account for transmission by large droplets.
Wan (2009)[26]	Used aerosol dispersion data to study the risk of transmission in an aircraft cabin	There is risk of pathogen transmission if seated directly in front or in front and to the side of an index case. The risk for all other passengers is very low. The risk of transmission via contaminated seats is $<5.57x10^{-6}$ for all passengers.	Estimated the transfer of pathogens onto hands and the frequency of hands touching mucus membranes.
Guputa (2011)[28]	Used CFD to model the dispersion of aerosol droplets in an aircraft cabin	Passengers in window seats at highest risk of infection from coughing as well as that one row in-front and behind index case. Risk of infection proportional to quanta inhaled	Assumes all droplets are the same size and passengers constantly have closed mouths. Cannot quantify transmission risk as passengers' tolerance dose is unknown.
		Transmission in airport terminals	
Quan (2013)[36]	Modelling transmission of pathogen from infectious terminal workers	Each worker can infect can infect 28.7 people in departures and in 16.7 in arrivals. 1528 infections possible a day in departures & 1528 in arrivals.	Does not describe data sources therefore reliability of results unknown
		Transmission at destination post air travel	
Brownstein (2006)[33]	Studied the correlation between passenger arrivals in the USA and time to the peak of pneumonia and influenza deaths.	Relationship between domestic air travel volumes and influenza spread Is strongly correlated: r^2=-0.69 (p=0.021); with international travel International association: r= -0.66, (p=0.027).	Uses P&I deaths as a proxy for influenza transmission

Khan (2009)[35]	Flight itineraries for passengers leaving Mexico in A(H1N1) pandemic studied in relation to cases of influenza in destination countries	16 of 20 countries with highest passenger arrivals had influenza imported. Countries with >1400 arrivals had a significantly higher risk of infection	2008 air travel data used as a proxy for 2009
Merler (2012)[34]	EUROSTAT air and railway travel data studied in relation to influenza incidence.	In EU27 timing of influenza peak and yearly passenger arrivals is strongly correlated r= -0.59 (p=0.001)	No information of data sources therefore reliability of results unknown.
		SARS-CoV	
		Retrospective cohort studies	
Breugelmans (2004)[60]	Investigation of in-flight transmission on 1 long haul & 7 short haul flights with a symptomatic case on board	10 persons reported symptoms, none tested positive	Selection bias due to difficulties in contacting passengers
Olsen (2003)[49]	Three short haul flights investigated for in-flight transmission	16 confirmed, 5 probable, 1 suspected case identified from one flight, none from others. Relative risk of infection higher (2.9 times) if seated within close proximity to index case	Other sources of infection not excluded
Vogt (2006)[52]	Seven flights inbound to USA investigated (5 with symptomatic passengers aboard, 2 pre-symptomatic)	4 passengers reported symptoms, 3 tested negative 1 refused to test	None noted
Wilder-Smith (2006)[51]	Seven flights inbound Singapore, 3 with symptomatic passengers, 4 with pre-symptomatic	Transmission to 1 air stewardess noted	Cases could have been missed as self-reporting of symptoms was required.
		Modelling study	
Mazumdar (2011)[57]	CFD modelling of SARS-CoV dispersion in an aircraft cabin	A moving person can increase the distance that virus particles disperse to 7 rows from index case,	Specific conditions applied, not generalizable.
		MERS-CoV	
		Retrospective cohort study	

HPA (2013)[54]	1index case on a long haul flight Contact tracing of flight passengers(two rows either side) and social contacts performed. flight passengers n=11/20; household contacts n=20, hospital visitors n=13 & healthcare workers n=59	No flight contacts were confirmed positive. 2 social/hospital contacts confirmed positive	Limited number of passengers were contacted.
		Modelling study	
Coburn & Blower (2014)[53]	Modelling of possible transmission on aeroplanes.	Cross-infection can occur and is related to quanta release/hour and flight duration. Higher number of secondary cases in economy than first class	Model assumptions and suitability not explored.