Travel Medicine and Infectious Disease 33 (2020) 101572

Contents lists available at ScienceDirect

Travel Medicine and Infectious Disease

journal homepage: www.elsevier.com/locate/tmaid

Editorial

What goes on board aircraft? Passengers include Aedes, Anopheles, 2019-nCoV, dengue, Salmonella, Zika, et al

As the world grapples with the swift global spread of the 2019-novel coronavirus (2019-nCoV), it is worth noting that airplane cabins provide a congenial environment for the transmission of viruses as well as an efficient means to convey arthropod vectors and virus-carrying humans to destinations throughout the world [8]. What goes on board affects what happens on board – but may also off load at another place thousands of miles from the origin of the flight.

Airplanes are marvelous machines, transporting people in ever growing numbers to destinations near and far. While travel medicine focuses on exposures and transmission at the origin and destination, less attention is given to in-transit exposures and potential for in-transit transmission of infections. As aircraft grow in size and durations of flights lengthen (can exceed 15 hours), exposures and transmission events inside these metal or composite-materials tubes in the sky will increase. Airplanes can hold hundreds of passengers densely packed into tight seats. As travel becomes more affordable and available, populations with access to air travel have also become more heterogeneous both economically and in geographic origin. Travel to and from low- and middle-income countries has increased rapidly, and most countries are now accessible by air travel.

What elements of the ecosystem of a passenger airplane affect human health? The physical environment may include low humidity, perhaps increased CO_2, and a cabin that is pressurized to the equivalent of an altitude of 5000–8000 feet (1524–2438 m). Air is filtered and recirculated, though circulation may be disrupted when engines are off. Dominant elements inside the aircraft cabin are large numbers of humans in close proximity, occasional pets and other animals (mostly dogs and cats), luggage and whatever it contains, mosquitoes and other mostly flying insects, food intended for feeding the passengers, and waste that is largely contained in toilet areas. The seats, seat belts and buckles, tray tables, pillows, and blankets that have direct contact with passengers are typically not cleaned or changed after each flight for shorter flights. Insecticides are applied in airplane cabins and luggage holds on selected flights.

This issue of *Travel Medicine and Infectious Disease* provides a wealth of information relevant to this important segment of the trip, the time spent on board the aircraft, and potential health consequences. The focus is what goes on board and what happens on board, though relevant exposures may occur at the airport while waiting to board and after disembarking – and it may be hard to disentangle exposures on board from those immediately before and after a flight. For some destinations and types of travel the time in the air may exceed the time at the destination.

An excellent, detailed, informative systematic review examines the safety and applicability of synthetic pyrethroid insecticides for aircraft disinsection [7]. The process involves more than a few sprays of an insecticide as a plane prepares to land. It is compulsory for flights arriving in some countries. If effective, it can prevent the introduction of pathogens, like West Nile virus or malaria parasites, into an area with favorable ecoclimatic conditions. It can also prevent introduction of a new species of mosquito into a geographic area, where it can become established. Although insecticides are effective, the article also describes approaches, like wind curtains, that might be used in the future and would not require use of chemicals. In the meantime, the careful review of potential adverse health effects of aircraft disinfection concludes that there is limited evidence linking use of insecticide to adverse health consequences. Although it is important to prevent air transport of mosquito vectors (whether or not they contain pathogens), humans carried on planes remain the most common source of dengue, Zika and other viruses introduced into new regions [4].

Outbreaks of foodborne infections related to food served on airlines involve multiple species of bacteria (e.g., Salmonella spp., *Staphylococcus aureus*, *Vibrio cholerae*, *E. coli*, and others) and viruses, especially norovirus [3]. Norovirus cases have also been linked to contaminated surfaces after infected passengers have vomited on board. Most foodborne infections related to food eaten on aircraft probably go unrecognized or unreported because symptoms begin after the flight and no follow up occurs. Challenges to serving safe food on board include cramped quarters, densification of space (more seats, less space for galleys), time constraints, lack of handwashing and hygiene facilities (no requirement for crew toilets or handwashing facilities), and general lack of regulation about hygiene requirements, in contrast to the strict oversight of on-ground food settings.

The large biomass of humans dominates the cabin ecosystem. Although tray tables, arm rests, seat buckles and other surfaces may be contaminated with bacteria and viruses [9], breathing and coughing people are the source of most infections transmitted on board. Many are transmitted by respiratory droplets and few are airborne. Common infections, such as measles, tuberculosis, and influenza, have been transmitted on flights. This issue describes two measles clusters in Europe that followed short flights. Two Berlin residents with measles flew while infectious and were subsequently linked to eight cases from three countries. Bitzegeio and colleagues describe obstacles to obtaining passenger details to permit timely contact of those exposed [1].

The current outbreak of 2019-nCoV that started in Wuhan, China is a reminder of how rapidly a virus that is transmitted via the respiratory route can spread globally, dispersed by travelers [8]. The virus, now identified as a betacoronavirus that is genetically similar to the SARS-like coronaviruses found in bats in southwestern China, apparently emerged from the animal-human interface in a market selling multiple

https://doi.org/10.1016/j.tmaid.2020.101572
Received 4 February 2020; Accepted 4 February 2020
Available online 05 February 2020

species of live animals in Wuhan, China [10]. Although bats are thought to be the reservoir hosts for the related coronaviruses that cause SARS (severe acute respiratory syndrome) and MERS (Middle East respiratory syndrome) that emerged within the last 20 years, civets, sold for food may have been the intermediate or amplifying host for SARS-CoV and contact with dromedary camels the immediate source of human infections with MERS-CoV. The SARS-CoV was transmitted on flights [6], which raises concern that the same could occur with the 2019-nCoV. Even when transmission does not occur during flights, airplanes carry infected, pre-symptomatic people to destinations throughout the world. Wuhan is a major transport hub, and many residents and visitors traveled before recent travel restrictions.

Rapid dissemination of the 2019-nCoV is possible because of massive global travel networks. Based on limited data, the case fatality rate from 2019-nCoV appears to be 3–4%, lower than from SARS (about 10%). Global mortality and impact could be enormous if the virus spreads widely [2]. SARS was contained through intensive screening, isolation of those infected and quarantine of those exposed. This was effective because, for the most part, humans developed fever before they could transmit SARS-CoV. It remains to be determined if 2019-nCoV can be transmitted by people who have mild, pre-symptomatic or asymptomatic infections. Many unanswered questions remain. Diagnostics have been developed and work on therapeutics and vaccines is underway.

The characteristics of a receiving country are critical in determining whether a pathogen carried by an arriving passenger is immediately halted or whether it can spread. An indication of this is provided by the Infectious Disease Vulnerability Index, which is a tool that estimates a country's capacity to manage infectious disease threats. It integrates metrics from multiple areas, including demography, health care, public health, political and economic [5]. Where planes disembark and unload their "passengers", be they human, arthropod, viral or bacterial, may influence the shape of global spread.

References

[1] Bitzegeio J, Bukowski B, Hausner M, Sissolak D, Rasmussen LD, Andersen PH, et al. Two measles clusters in connection with short inner-European air travels indicating impediments to effective measles control: a cluster analysis. Trav Med Infect Dis 2020 In this issue.
[2] Chan JF-W, Yuan S, Kok K-H, To KK-W, Chu H, Yang J, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. Lancet 2020 Published online , Accessed date: 24 January 2020.
[3] Grout A, Speakman EM. In-flight transmission of foodborne disease: how can airlines improve? Trav Med Infect Dis 2020 In this issue.
[4] Mier-Y-Teran-Romero L, Tatem AJ, Johansson MA. Mosquitoes on a plane: disinsection will not stop the spread of vector-borne pathogens, a simulation study. PLoS Neglected Trop Dis 217;11:e0005683.
[5] Moore M, Gelfeld B, Okunogbe A, Paul C. Identifying future disease hot spots: infectious disease vulnerability index. Rand Health Quart 2017;6:5.
[6] Olsen SJ, Chang H-L, Cheung TY-Y, Tang AAF-Y, Fisk TL, Ooi SP-L, et al. Transmission of the severe acute respiratory syndrome on aircraft. N Engl J Med 2003;349:2416–22.
[7] Pang AM, Gay S, Yadav R, Dolea C, Ponce C, Velayudhan R, et al. The safety and applicability of synthetic pyrethroid insecticides for aircraft disinsection: a systematic review. Trav Med Infect Dis 2020 In this issue.
[8] Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. Lancet. Published online January 2020;24. https://doi.org/10.1016/S0140-6736(20)30185-9.
[9] Zhao B, Dewald C, Hennig M, Bossert J, Bauer M, Pletz MW. Microorganisms @ materials surfaces in aircraft: potential risks for public health? A systematic review. Trav Med Infect Dis 2019;28:6–14. https://doi.org/10.1016/j.tmaid.2018.07.011.
[10] Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med published online January 24, 2020.

Mary E. Wilson*
Clinical Professor of Epidemiology and Biostatistics, School of Medicine, University of California, San Francisco, USA
Adjunct Professor of Global Health and Population, Harvard T.H. Chan School of Public Health, Boston, MA, USA
E-mail address: mewilson@hsph.harvard.edu.

* 171 Ripley St, San Francisco, CA, 94110, USA.