SUBCOMMITTEE ON SPACE AND AERONAUTICS
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

HEARING CHARTER

R&D to Support Healthy Air Travel in the COVID-19 Era and Beyond

June 23, 2020
11:30 a.m.
Cisco WebEx

PURPOSE

The purpose of this hearing is to examine the status of R&D related to supporting healthy air travel during COVID-19 and future pandemics, and other issues.

WITNESSES

- **Ms. Heather Krause,** Director, Physical Infrastructure Issues, Government Accountability Office
- **Dr. Byron Jones P.E.**, Professor, Alan Levin Department of Mechanical and Nuclear Engineering; Director, National Gas Machinery Laboratory, Kansas State University
- **Dr. Vicki Hertzberg,** Professor and Director, Center for Data Science, Nell Hodgson Woodruff School of Nursing, Emory University

OVERARCHING QUESTIONS

- What is the current scientific understanding of the spread of coronavirus and other communicable diseases in the unique environment of aircraft cabins?
- What, if any, gaps exist in the scientific understanding of the potential risks of coronavirus transmission on aircraft, and what is needed to address them?
- What is the federal government's role, in particular the FAA's, in research and development activities related to understanding and mitigating the spread of COVID-19 and other communicable diseases in aircraft environments and through air travel?
- What planning and actions can be taken to improve the resiliency of the U.S. aviation system and the safety of air travel during the COVID-19 era and for future pandemics, and how can relevant R&D activities best inform those efforts?

BACKGROUND

Until 2020, the number of global air travel passengers was increasing annually; in 2018, more than 4.3 billion people used scheduled air transportation to travel more than 8.2 million kilometers internationally and domestically, according the United Nations' International Civil

Aviation Organization (ICAO).[1] U.S. airlines alone carried an estimated 925.5 million passengers in 2019, the highest total ever recorded.[2] Prior to the onset of the COVID-19 pandemic, the International Air Transportation Association (IATA) predicted that the global number of air travel passengers would nearly double by 2035 from 3.8 billion per year in 2016 to 7.2 billion per year in 2035.[3] As air travel continues to play an increasing role in modern life, the role of the aviation system in the spread of communicable disease is an important global public health concern. Aviation presents a unique confluence of potential risk factors for the spread of communicable diseases, as airport, and especially aircraft, environments feature high densities of people interacting frequently in confined indoor spaces and traveling to and from geographically diverse regions.[4]

In the era of the ongoing COVID-19 pandemic, passenger air travel has drastically decreased. As of June 15, 2020 ICAO is forecasting, "An overall reduction of air passengers (both international and domestic) ranging from 46% to 62% in 2020 compared to 2019."[5] As a result, ICAO estimates airlines are facing a potential loss of revenue of up to $314 Billion.[6] At the peak of the pandemic in the U.S., the Transportation Security Administration (TSA) screened as few as 100,000 people a day nationwide on April 7th, a 96 decrease from the same time a year ago.[7]

The role of commercial aviation in the U.S. economy is significant, and such a decline in passenger air travel could have far-reaching economic implications. The U.S. is the leading aerospace manufacturer in the world, generating over $130 billion in exports, resulting in a $89.5 billion trade surplus, and over 2.5 million jobs in the United States.[8] [9] The decline of air travel has reduced recent airline and aerospace manufacturer revenues, resulting in decreased capacity and employee layoffs.[10] As portions of the U.S. economy begin to reopen, the aerospace industry

[1] ICAO, "The World of Air Transport in 2018," available at: https://www.icao.int/annual-report-2018/Pages/the-world-of-air-transport-in-2018-statistical-results.aspx
[2] Bureau of Transportation Statistics, "Preliminary estimate Full Year 2019 and December 2019 US Airline Traffic Data." January 17, 2020. https://www.bts.gov/newsroom/preliminary-estimated-full-year-2019-and-december-2019-us-airline-traffic-data
[3] International Air Transport Association, "Forecasts Passenger Demand to Double Over 20 Years." October 18, 2016. https://www.iata.org/en/pressroom/pr/2016-10-18-02
[4] National Academies of Sciences, Engineering, and Medicine. 2013. *Infectious Disease Mitigation in Airports and on Aircraft*. Washington, DC: The National Academies Press. Available at: https://doi.org/10.17226/22512.
[5] https://www.icao.int/sustainability/Pages/Economic-Impacts-of-COVID-19.aspx
[6] https://www.icao.int/covid/cart/Pages/CART-Take-off.aspx
[7] Statement by Transportation Security Administration https://twitter.com/TSAmedia_LisaF/status/1247877932917362689
[8] Aerospace Industry Association, Workforce, "The Facts." https://www.aia-aerospace.org/research-center/statistics/industry-data/workforce/
[9] Aerospace Industry Association, "The Facts on Trade." https://www.aia-aerospace.org/research-center/statistics/industry-data/foreign-trade/
[10] Voytko, Lisette. Coronavirus Layoffs: Boeing Lays off 6,770 Workers Amid Pandemic, *Forbes*, May 27, 2020. https://www.forbes.com/sites/lisettevoytko/2020/05/27/coronavirus-layoffs-boeing-lays-off-6770-workers-amid-pandemic/#24e7103645bd

has seen an uptick in demand.[11] Airlines are taking preventative measures to reduce the risk of COVID-19 transmission, though policies and practices among airlines are inconsistent.[12]

Communicable Disease Transmission in Aircraft Environments

Communicable diseases are caused by viruses or bacteria that can be spread through one or more routes, such as direct, person-to-person transmission, indirect transmission via surfaces (fomites), or airborne transmission. Respiratory viruses like the novel coronavirus that causes COVID-19 can be spread by droplets released by an infected person (when, e.g., coughing, sneezing, or talking), but aerosols capable of traveling much farther than droplets ("airborne" transmission) may also play a role.[13] In aircraft cabins, risks of transmission by many of the typical routes may be heightened due to the high occupancy, at a high density, of passengers and crew in an enclosed environment.[14]

Research activities focused on disease transmission risks and mitigation strategies on aircraft have been somewhat limited, but they have often increased in response to historical public health crises and associated concerns over transmission via the aviation system. For example, during the severe acute respiratory syndrome (SARS) outbreak of the early 2000s—caused by a coronavirus strain closely related to the SARS-CoV-2 strain of today—Air China flight 112 from Hong Kong to Beijing carried an infected passenger who ended up infecting 18 other passengers and 2 flight attendants, bringing the virus to multiple locations that previously had no cases. Research found that a majority of the infected passengers were sitting more than two rows away from the originally infected passenger, which raised concerns that distancing passengers during flights may not be enough to prevent disease transmissions.[15]

Research into this case and others explore concerns about airplanes' closed, indoor environments. Most modern plane circulation systems use high-efficiency particulate air (HEPA) filters that can remove over 99 percent of airborne particles and contribute to lowering the threat of the virus once the air passes through the filter.[16] [17] The filtered air is blended in with clean air

[11] LeBeau, Phil. "American Airlines and Other Carries are Adding Summer Flights as Passengers Slowly Return." *CNBC*, June 4, 2020. Available at: https://www.cnbc.com/2020/06/04/american-airlines-and-other-carriers-are-adding-summer-flights-as-passengers-slowly-return.html

[12] Pallini, Thomas. "11 major US airlines have new pandemic rules for keeping passengers safe, but some are doing more than others. Here's how they compare.", *Business Insider*, June 15, 2020. Available at: https://www.businessinsider.com/us-airline-new-coronavirus-travel-rules-comparison-american-united-delta-2020-6

[13] Prateek Bahl, Con Doolan, Charitha de Silva, Abrar Ahmad Chughtai, Lydia Bourouiba, C Raina MacIntyre, "Airborne or Droplet Precautions for Health Workers Treating Coronavirus Disease 2019?," *The Journal of Infectious Diseases*, April 16, 2020. Available at: https://doi.org/10.1093/infdis/jiaa189

[14] Sevilla, Nereyda L. "Germs on a Plane: The Transmission and Risks of Airplane-Borne Diseases." *Transportation Research Record*, October 15, 2018, Vol. 2672(29) 93–102. Available at: https://journals.sagepub.com/doi/full/10.1177/0361198118799709.

[15] Hertzberg, Vicki Stover et al. "On the 2-Row Rule for Infectious Disease Transmission on Aircraft." *Annals of Global Health* vol. 82,5 (2016): 819-823. Doi:10.1016/j.aogh.2016.06.003

[16] Heffernan, Tim. "Can HEPA Air Purifiers Capture the Coronavirus?" *New York Times*, April 7, 2020. Available at: https://www.nytimes.com/wirecutter/blog/can-hepa-air-purifiers-capture-coronavirus/

[17] Aleksandrova, Dayana. "What are airplane HEPA Filters and do they make cabin air safe?" *Matadornetwork*, May 5, 2020. Available at: https://matadornetwork.com/read/airplane-hepa-filters-make-cabin-air-safe/

pulled in through the engines, in most cases creating a roughly a 50-50 mix with a very high exchange rate, which is better airflow than is generally found in many restaurants and other indoor spaces.[18] Other research into the transmission of diseases on aircraft found that the highest risk of infection in an aircraft cabin comes from droplets being passed from passenger to passenger or through surfaces.[19] If small aerosol particles are associated with a given virus, then a further consideration is that such particles have been shown to linger in the cabin air and could transmit the virus before entering into the HEPA filters.[20]

Many airlines have adopted one or more new health safety protocols and policies, such as: screening passengers for COVID-19 symptoms and preventing those with symptoms from flying, requiring passengers and crew to wear masks, leaving seats open to limit the density during flight, and increasing cleaning regimens.[21] Preventing symptomatic customers from boarding flights can reduce some risk of COVID-19 transmission, but presymptomatic and asymptomatic carriers could also present transmission risks.

FAA Research

From 2004 to 2015, FAA supported the National Center of Excellence (COE) Center of Excellence for Research in the Intermodal Transport Environment (RITE) Airliner Cabin Environment Research (ACER), with leadership from Purdue University, Auburn University, and Kansas State University. The ACER COE brought together aircraft cabin environment expertise from academia, industry, and government organizations. The Center's research encompassed health and safety effects of the airline cabin environment on passengers and crewmembers, the efficiency and effectiveness of aircraft environmental control systems, and the study of emerging technologies with the potential to eliminate bleed air contaminants and purify aircraft air supplies. An area of focused research was in understanding the complex physics of the flow of air and contaminants within the cabin, particularly the bleeding of toxic fumes and chemicals from the aircraft engine.

The ACER COE also studied the transmission of disease in aircraft. In 2007, FAA and ACER researchers published a report on disinfecting aircraft cabin contaminated with influenza viruses.[22] In 2012, FAA and ACER researchers reported the findings from a study of the airborne

[18] Laris, Michael. "Scientists know ways to help stop viruses from spreading on airplanes. They're too late for this pandemic." *Washington Post*, April 29, 2020, Available at: https://www.washingtonpost.com/local/trafficandcommuting/scientists-think-they-know-ways-to-combat-viruses-on-airplanes-theyre-too-late-for-this-pandemic/2020/04/20/83279318-76ab-11ea-87da-77a8136c1a6d_story.html
[19] Hertzberg, Vicki Stover et al. "Behaviors, movements, and transmission of droplet-mediated respiratory diseases during transcontinental airline flights." *Proceedings of the National Academy of Sciences of the United States of America* vol. 115,14 (2018): 3623-3627. doi:10.1073/pnas.1711611115
[20] *Ibid*
[21] Editorial Board, "Keep the Middle Seat Empty for Now, Please." *Bloomberg*, June 5, 2020. Available at: https://www.bloomberg.com/opinion/articles/2020-06-05/will-airlines-remove-the-middle-seat-to-prevent-covid-19
[22] Rudnick, Stephen et al. "Inactivating Influenza Viruses on Surfaces Using Hydrogen Peroxide or Triethylene Glycol at Low Vapor Concentration." *Air transportation Center of Excellence for Airliner Cabin Environmental Research*, April 2009.

and surface transport of respiratory virus droplets throughout the cabin.[23] The 2012 study found that the bulk airflow pattern in the cabin played the most important role in transport. The researchers further concluded that passenger and crew movements could have been the primary cause of the 2003 in-flight SARS transmission from an infected passenger to passengers seated as far as seven rows away.

GAO Assessment of Aviation Preparedness to Respond to Communicable Diseases

In 2015, the Government Accountability Office (GAO) reviewed the preparedness of the U.S. aviation system to respond to communicable diseases and released findings and recommendations in the report, "Air Travel and Communicable Diseases: Comprehensive Federal Plan Needed for U.S. Aviation System's Preparedness."[24] The report examined "(1) the extent to which selected U.S. airports and airlines have plans for responding to communicable disease threats from abroad and to which a national aviation-preparedness plan guides preparedness, and (2) the challenges that U.S. airports and airlines have faced when responding to threats and any actions taken to address them."

Through this assessment, GAO found that the U.S. does not have a comprehensive national aviation preparedness plan aimed at preventing and containing the spread of diseases through air travel. This is despite the fact that, according to GAO, the U.S. is obligated as a member state of ICAO to establish a national aviation-preparedness plan for communicable disease outbreaks that pose a public health risk or public health emergency of international concern.[25] Further, neither U.S. airports nor airlines are required to have individual preparedness plans, and no federal agency tracks which airports and airlines have them. GAO also learned from stakeholders of numerous challenges in communicating timely, accurate information—such as response guidance, status of training of workers, sanitation procedures, and information to help coordinate first responders—among and between airlines and airports during active communicable disease threats.

GAO recommended that the Department of Transportation (DOT) and FAA work with relevant stakeholders, such as the Department of Health and Human Services, to develop a national aviation-preparedness plan for communicable disease threats, which could enable the aviation system to respond more rapidly and effectively, potentially improving the health and safety of staff, crew, and the flying public. In responding to the report, DOT agreed that such a plan is needed, but suggested instead that public health agencies should lead the effort, while GAO maintained that "*DOT is in the best position to work with its relevant stakeholders, including those that have the needed public health expertise, to develop a national aviation-preparedness plan*" as DOT is responsible for the aviation sector and has the liaison role for U.S. obligations under ICAO to establish the plan.

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[23] FAA Technical Report RITE-ACER-CoE-2012-01, "Infectious Disease Transmission in Airliner Cabins," February 22, 2012. Available at: https://www.faa.gov/data_research/research/med_humanfacs/cer/media/InfectiousDiseaseTransmission.pdf

[24] GAO-16-127, "Air Travel and Communicable Diseases: Comprehensive Federal Plan Needed for U.S. Aviation System's Preparedness," December 16, 2005. Available at: https://www.gao.gov/products/GAO-16-127

[25] ACI and ICAO, Airport Preparedness Guidelines for Outbreaks of Communicable Disease, Revised (April 2009)