Testimony Provided by Byron W. Jones
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Chairwoman Horn, committee members, staff, guests, I am pleased to be able to offer my comments to this committee today.

First a disclaimer. I speak today as a private citizen and not as an official representative of Kansas State University, the FAA, the CDC nor any other government agency or private institution with which I have worked.

Additionally, I am a mechanical engineer and do not claim to be a disease transmission expert. I have worked extensively with aircraft environmental control systems and I believe I understand how they function, how air contaminants, including virus containing droplets, are carried by the air within the cabin, and how ventilation systems flush these droplets from the cabin. Over the past 20 or so years, sponsors of research conducted by my colleagues and me on these topics have included the FAA through the Airliner Cabin Environment Research Center, CDC-NIOSH, and Boeing. CDC-NIOSH is currently funding some of our research.

Aircraft and air travel play two distinct roles with regard to disease spread during a pandemic. First there is the transport of infected people throughout the country and the world which allows the disease to spread rapidly across large distances. Second, there is transmission of disease between people within the aircraft. While the latter may amplify the spread during a pandemic, we mainly look at this transmission within the cabin from the perspective of the health of the passengers and crew on the aircraft. I will be addressing only the later role, transmission within the cabin.

I would like to address what I believe to be the most critical research needs in the near-term. The airlines, aircraft manufacturers, and flying public need the data and the tools to be able to quantitatively assess the risk of COVID-19 transmission on aircraft to be able to quantitatively assess the effect of various mitigation measures on that risk. Easy to say, challenging to accomplish.

It is unrealistic to expect the risk of COVID-19 transmission in aircraft to be zero in the near future. However, it is realistic to expect that appropriate mitigation measures can be taken so as to ensure the risks are comparable to or lower than exposure risks we face in everyday life. When it is clear what mitigation measures are needed and they are in place, the public can once again fly with confidence regarding their safety. Unfortunately, we simply do not have the data nor the knowledge to confidently make that judgement today. We need these answers today, not in two years or even in six months. Thus, we are not talking about a traditional research project but rather an immediate focused effort. Whether this research should be pursued and funded by industry or government is not for me to say but it would greatly benefit both the flying public as well as the air transportation industry.

The scientific community is slowly learning about how COVID-19 is transmitted and the details of how the virus travels from the host to infect another person. However, when all is said and done, there is a lot more that we do not know than we do know. It is believed that a primary means of transmission is via respiratory droplets that are expelled when an infected person coughs, sneezes, yells, sings, talks, or even breathes. These droplets are then inhaled or otherwise transferred to the respiratory system of an uninfected person. These droplets span a wide range of sizes, from 1 micron, about 1/100 the diameter of a human hair to about 500 micron, the diameter of a small rain drop. The largest droplets will either strike a surface as a projectile upon being expelled or fall out of the air within a few seconds. They do not travel far from the source. However, all but the largest droplets can become partially or fully suspended in the air and can be carried much further by air currents. The smaller ones can stay suspended more-or-less indefinitely and will stay in the air until they are flushed out by the ventilation air or contact a surface and stick to it.

Qualitatively, we can identify the high risk environments, given the droplet nature of the transmission. Those are environments with high occupant density, extended exposure time, and poor ventilation. If an infectious person is present in such an environment, and expelling droplets, the droplet concentration in the air will continue to build and spread due to the poor ventilation; the high occupant density will result in many people being exposed; and the extended time proportionately increases that exposure. In this respect, aircraft cabins are both good and bad. Aircraft cabins are very well ventilated with a combination of outside air and recirculated air. HEPA filtration is nearly universal on the recirculated air which effectively removes viral material. Thus, one can be assured the air supplied to the cabin is virus free. Additionally, the amount of air supplied relative to the volume of the cabin is very high, a number of times higher than typical building environments. This high ventilation rate results in a rapid, exponential decrease in droplet concentration with distance from the source as the ventilation air rapidly flushes the droplets from the cabin as they spread. This exponential decrease has been well characterized through the ACER and CDC funded research. Some small fraction of the smaller droplets will still be carried a number of seats from the source. The exposure risk represented by these droplets is not known.

Additionally, the ventilation system is highly engineered and must meet stringent certification requirements and operational regulatory requirements. When in a commercial airliner, you can be assured that a carefully designed and functional ventilation system is supplying the cabin. Such is not true of many other spaces we occupy where it is difficult to determine if the ventilation is good or even functioning.

The ventilation is good on aircraft but that is not the whole story. The occupancy density is higher than just about any other space we routinely occupy and the occupancy can extend for several hours or more.   Operating aircraft while maintaining six feet personal distancing is not economically feasible. Additionally, there is nothing magic about six feet. Given the high ventilation rate, it may be overkill and given the extended exposure times, it may not be adequate. Any realistic scenario for air travel in the COVID-19 environment will require mitigations other than the standard personal distancing. These mitigations may include universal use of face masks, use of high grade face masks, between the seat barriers, individual enclosures, etc. We understand, qualitatively, how these mitigations work. However, as stated previously, we do not have the information needed to quantitatively assess the risk of transmission in aircraft and assess of the impact of these mitigations. Ultimately, we need this information to be able to confidently say that air travel poses no greater risk of infection than other aspects of our daily life.

One final comment, I have focused on droplet transmission as that appears to be the dominant mode of transmission and it is what I know. However, there are certainly other modes that could be important, for example contact with contaminated surfaces or person-to-person contact. Ultimately we need to be able to quantitatively assess the risk for all likely modes.

Thank you for your attention.

Brief Bio
Byron W. Jones

Byron W. Jones is a Professor in the Alan Levin Department of Mechanical and Nuclear Engineering at Kansas State University and is the Director of the Kansas State University National Gas Machinery Laboratory. He has been a member of the KSU Faculty since 1978. He received his BS degree from KSU and his MS and PhD degrees from Oklahoma State University, all in mechanical engineering. Prior to his current position, he served as the Associate Dean for Research for the KSU College of Engineering. He has also held positions of Head of Mechanical and Nuclear Engineering and Director of the Institute for Environmental Research at KSU. Prior to joining KSU, he was a Sr. Systems Analyst at the Montana Energy and MHD Research and Development Institute.

His current research areas include, aircraft cabin air quality, aircraft environmental control systems, turbomachinery, and aircraft bleed air contamination. Dr. Jones serves as the technical director of the FAA Air Transportation Center of Excellence for Airliner Cabin Environment Research (ACER), a graduated center. He chaired the development of the original ASHRAE Standard 161, Air Quality in Commercial Aircraft. Dr. Jones is a licensed professional engineer and licensed commercial pilot, single engine land. He is a Fellow and Life Member of the American Society of Heating Refrigerating and Air-Conditioning Engineers, a Life Member of the American Society of Mechanical Engineers, and a Member of SAE International.