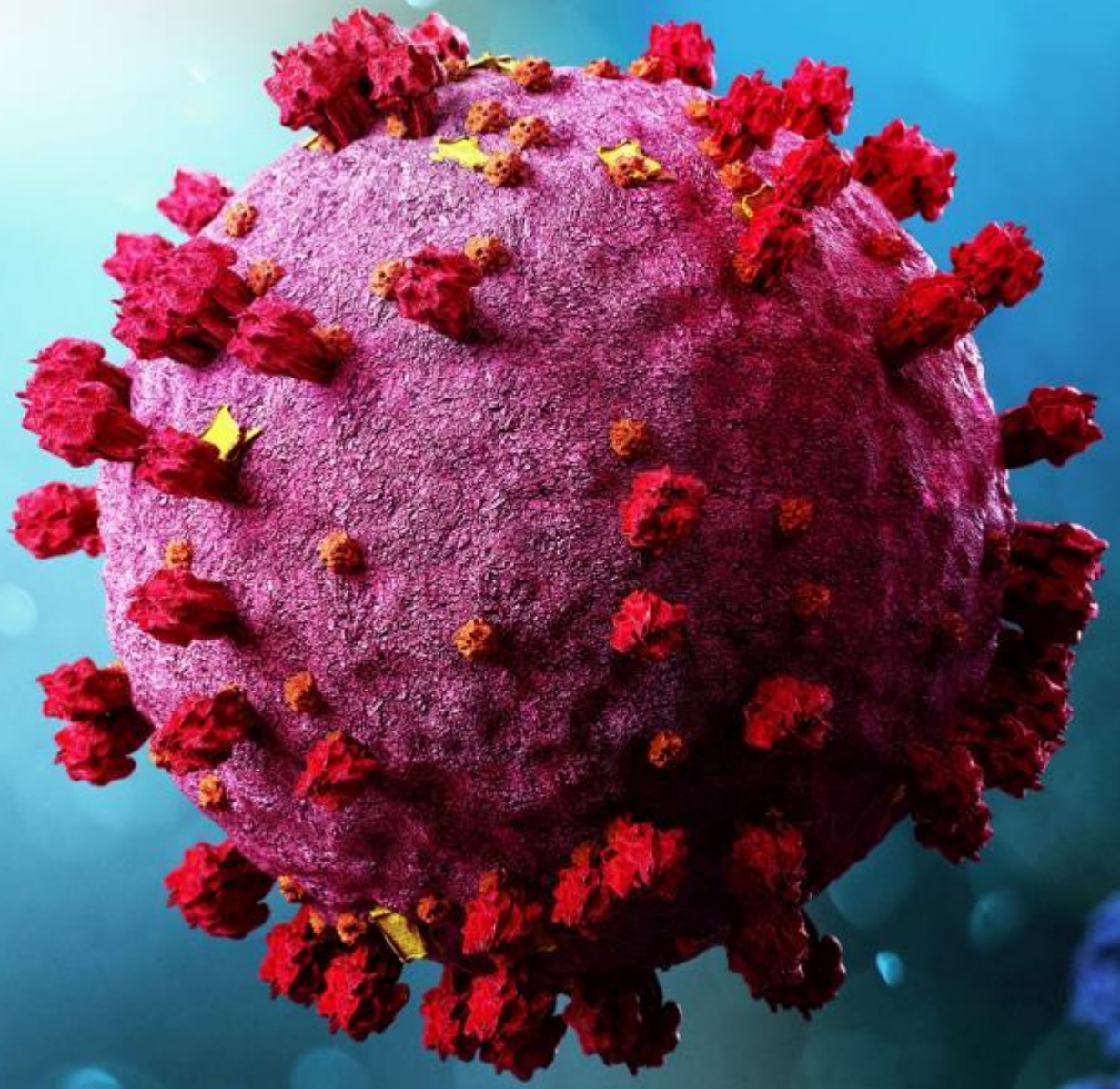
Confident Travel Initiative

Dan Freeman
V.P. Safety Management System

We are all facing a common enemy: COVID-19



Boeing partners in flight

Confident Travel Initiative

One Mission, Three Layers, Three Horizons

One Mission

Leadership in the global effort to provide passengers and crew a safe, healthy and efficient travel experience

Three Layers of Protection

- Prevent the virus from reaching the airplane
- Keep the airplane free of viruses
- Minimize transmission of viruses on the airplane

Three Time Horizons

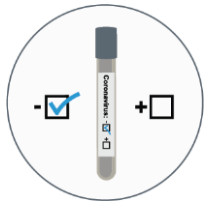
- Near term: ***respond*** to the immediate needs of the industry and ***reassure*** passengers and crews
- Mid term: ***enhance, stabilize and standardize*** guidance, recommendations, and solutions to provide a predictable travel experience
- Long term: continue to ***improve the system***

A Multi-layered Approach to Protect the Air Travel Journey

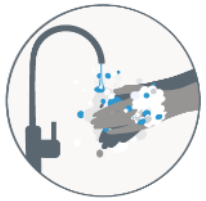
HOME | **DEPARTURE AIRPORT** | **AIRPLANE** | **INFLIGHT** | **ARRIVAL AIRPORT**

CLEAN AIR

CHECK-IN & SELF EVALUATION



ENHANCED PROCEDURES
Superior Air Quality



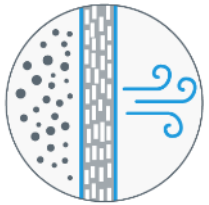
CLEANED AND DISINFECTED

New Technologies

Cabin airflow

2-3 minutes

HEPA



Face mask

ENHANCED PROCEDURES
Superior Air Quality

DATA-DRIVEN OPTIMIZATION

Boeing’s Clean Airplane Program

Helping airlines protect passengers from viruses

TODAY’S SOLUTIONS

CHEMICAL DISINFECTANTS

20 tested, 9 Boeing approved disinfectants

ELECTROSTATIC SPRAYERS

Efficient application for hard to reach areas

CABIN AIRFLOW

Complete air exchange every 2-3 minutes

HIGH EFFICIENCY PARTICULATE AIR (HEPA)

99.9+% effective at removing particulates

ANTIMICROBIAL COATINGS

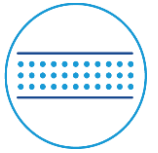
Application of a persistent disinfectant on surfaces that protects against viruses

THERMAL DISINFECTION

Eliminating viruses with heat

TOUCHLESS LAVATORY FEATURES

Reduces touchpoints within the lavatory



UV WAND

Boeing developed and licensed UV Wand operates at 222nm for use in flight deck and cabin

TOMORROW’S POTENTIAL SOLUTIONS

= UNDER STUDY

BOEING ANTIMICROBIAL COATING

Breakthrough antimicrobial with high kill rate, long life

ADDITIONAL TOUCHLESS FEATURES

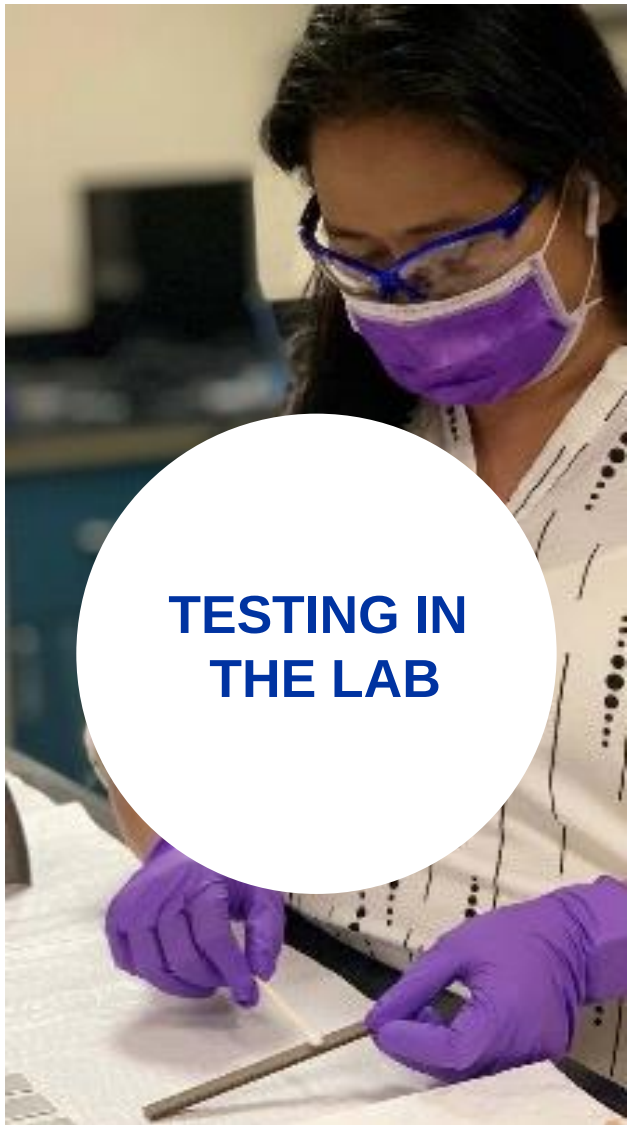
Researching additional touchless features throughout the cabin

UV BUILT INTO THE AIRPLANE

Continuous disinfection through the travel journey

How Boeing knows this is effective

Clean Airplane Program



Clean Airplane Program validated by live virus testing

Boeing partnership with University of Arizona

The Situation

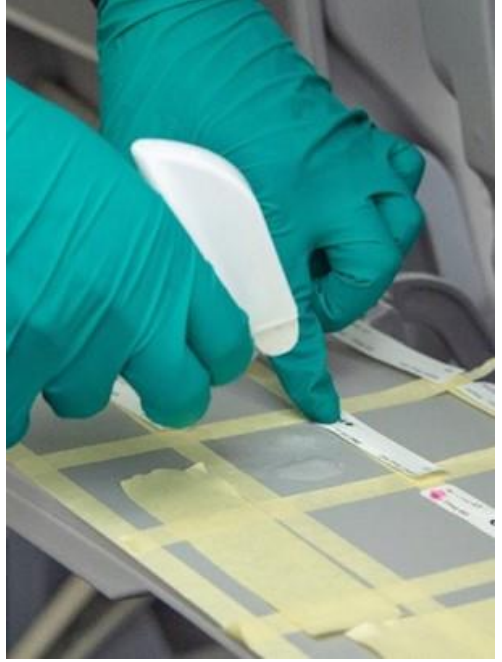
- Boeing implemented an innovative, first-of-its-kind test with the University of Arizona to validate cleaning recommendations against a human-safe live virus (MS2) in a working airplane cabin

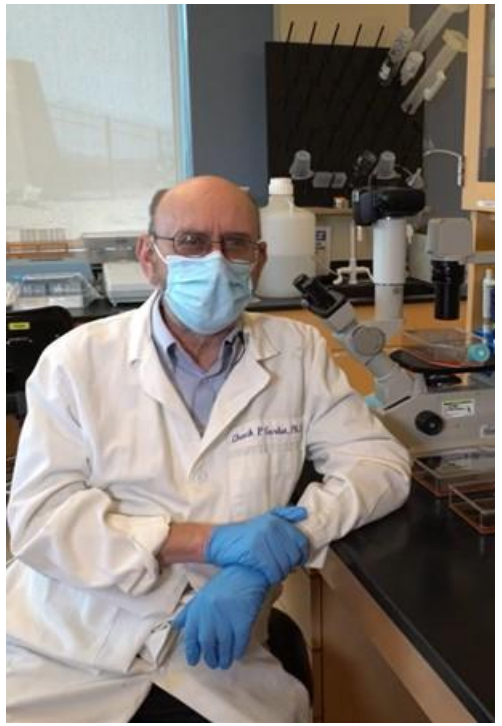
The Method

- The team placed the virus on strategic points throughout the cabin and disinfected using these techniques:
  - Chemical disinfectants
  - Electrostatic sprayer
  - Antimicrobial coatings
  - Ultraviolet wand

The Result

- The University of Arizona found all recommended products, methods, and technologies successfully destroyed the MS2 virus, which is more difficult to kill than COVID-19
- Correlating those results to the virus that causes COVID-19
- Boeing and the University of Arizona continue testing work for new technologies





Airflow and filtration

How does airplane air compare to other places?

Risk of virus spread on airplanes is low

Increased airflow and stronger filters remove more particulates

How often is the air exchanged?

TYPICAL RESIDENCE

ONCE AN HOUR, OR LONGER

OFFICE & BUSINESSES

EVERY 12 – 30 MINUTES

AIRPORTS

EVERY 6 – 10 MINUTES

AIRPLANES

EVERY 2 – 3 MINUTES

What is filtered out of the air?
(Based on typical air filter [MERV] ratings.)

Particulates Removed (MERV 2-6):

- ✓ Dust/Lint
- ✓ Pollen

Particulates Removed (MERV 5-8):

- ✓ Mold
- ✓ Dust Mites
- ✓ Dust/Lint
- ✓ Pollen

Particulates Removed (MERV 13+):

- ✓ Some Viruses
- ✓ Bacteria
- ✓ Allergens
- ✓ Smog
- ✓ Smoke
- ✓ Pet Dander
- ✓ Mold
- ✓ Dust Mites
- ✓ Dust/Lint
- ✓ Pollen

Particulates Removed (MERV 17+):

- ✓ Virus
- ✓ Bacteria
- ✓ Allergens
- ✓ Smog
- ✓ Smoke
- ✓ Pet Dander
- ✓ Mold
- ✓ Dust Mites
- ✓ Dust/Lint
- ✓ Pollen

Air flow & filtration in the airplane cabin is designed to keep passengers and flight crews healthy

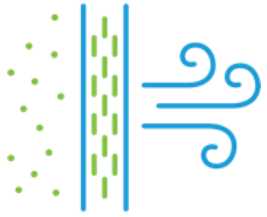
Outside air continuously flows into the cabin

1

Air is supplied to the cabin from overhead outlets. The volume of cabin air is exchanged **EVERY 2 TO 3 MINUTES**.

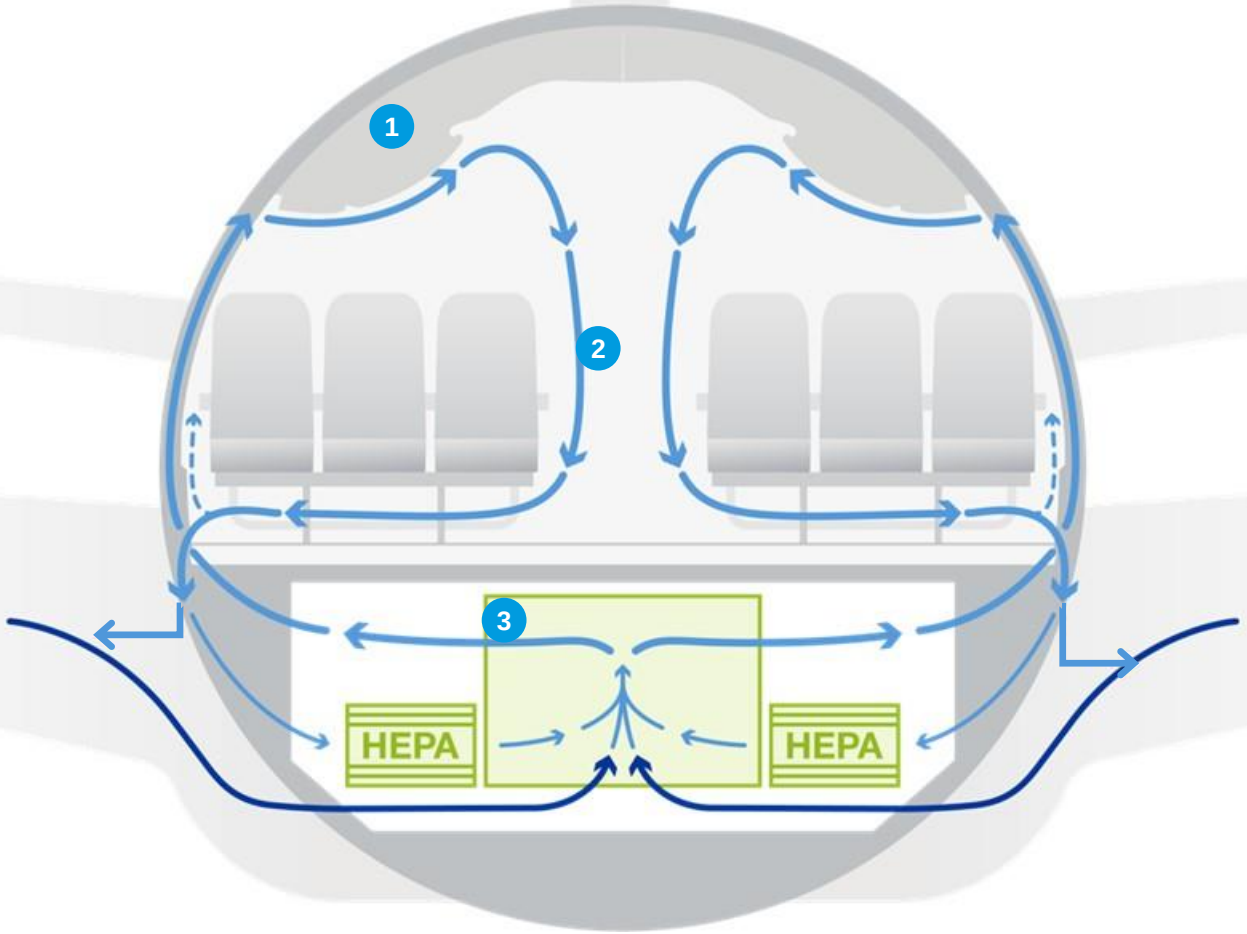
2

Air flows primarily **CEILING TO FLOOR**, not front to back, to minimize the spread of contaminants.

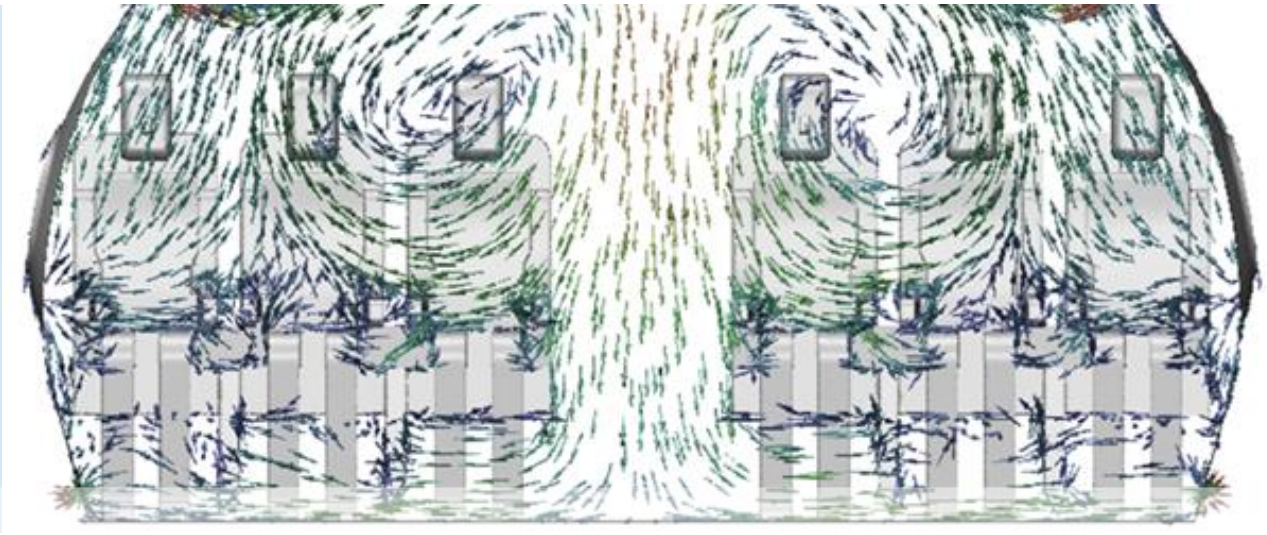


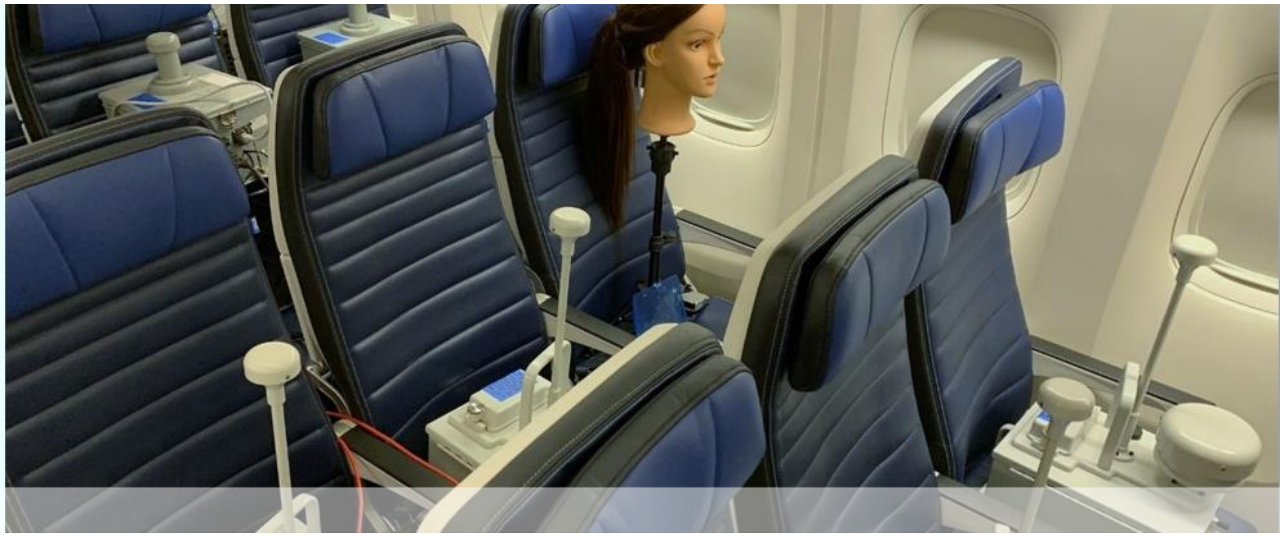
3

Air passes through **HIGH EFFICIENCY PARTICULATE AIR (HEPA)** filters which are **99.9%+** effective at trapping viruses and bacteria.



Analysis and testing on the cabin environment demonstrates how passengers are protected in an airplane





Modeling & analysis

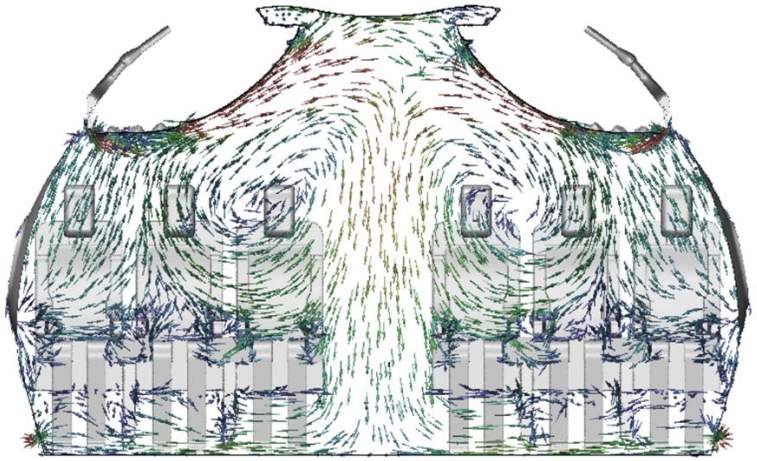
- Cabin airflow modeling to track particle movement
- Single-aisle and twin-aisle airplane models

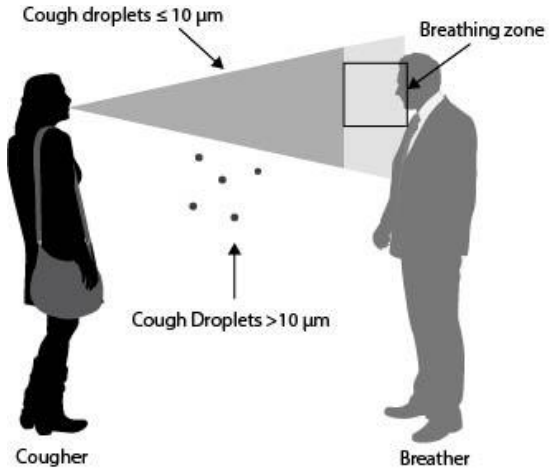
Airplane testing

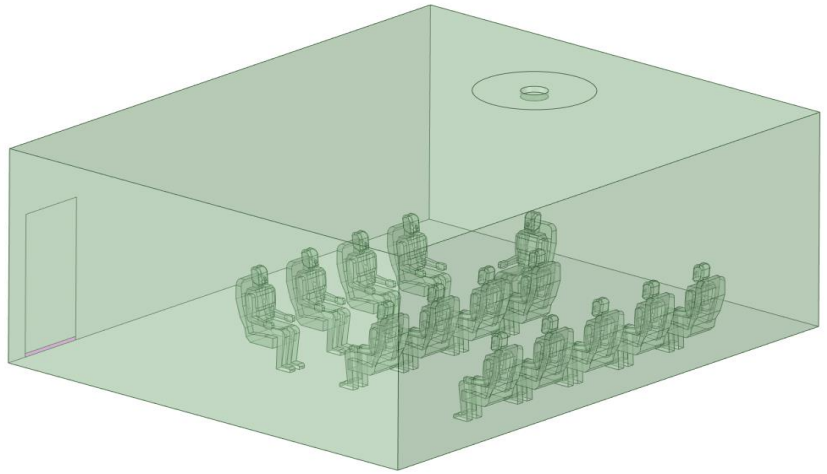
- Validated our modeling efforts through airplane testing in partnership with US TRANSCOM and DARPA
- Tested on 737, 767 and 777 aircraft

The results of the analysis comparing environments

The design of the cabin and airflow system **creates the equivalent of over 7 feet (2m) of physical distance** between every passenger







Airplane Environment

The cougher and breather sitting next to each other on a full flight

=

Indoor Environment

The cougher standing >7 feet away from the breather

=

Conference Room

The cougher seated >7 feet away from the breather

Based on calculating the number of particles in the breathing space

Expanding our scope of industry engagement

Collaborating with industry

- Customers and airline associations
- OEMs and suppliers
- Academic, medical institutions & world organizations
- Industry associations: ICCAIA, IATA, ICAO, ACI and others
- Non-aerospace

Openly sharing technical data

- Published white papers with detailed analysis
- Sharing results of models and lab data

Research

Go behind the stories and see our research on COVID-19 and healthy travel for yourself.

JANUARY 2022
Water-borne Nanocoating for Rapid Inactivation of SARS-CoV-2 and Other Viruses

JUNE 2021
COVID-19 Screening Strategy Comparison

APRIL 2021
Use of Bipolar Ionization for Disinfection within Airplanes

MARCH 2021
Role of Persistent Disinfectants in Reducing Disease Transmission from Contaminated Surfaces

MARCH 2021
Comparison of Cough Particle Exposure for Indoor Commercial and Aircraft Cabin Spaces

FEBRUARY 2021
Thermal Disinfection of SARS-CoV-2 within an Airplane

FEBRUARY 2021
Compatibility of Aircraft Interior Surfaces with 222 nm Far-UV Light Exposure

JANUARY 2021
Engineered Physical Distance Equivalence for a Cough

DECEMBER 2020
Clean Airplane Program Live Virus Validation Testing

DECEMBER 2020
Chemical Disinfectant Evaluation and Approval for the Aerospace Industry

DECEMBER 2020
Safety of 222 nm Band-Pass Filtered Irradiation

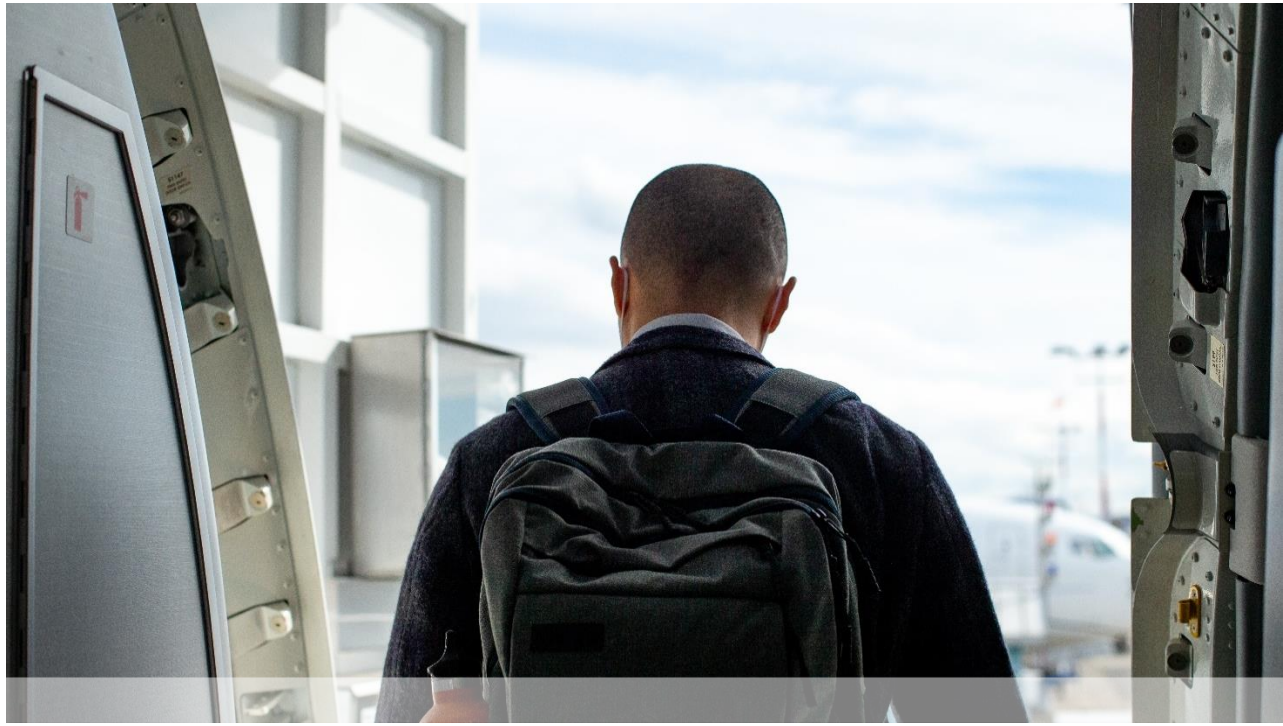
DECEMBER 2020
Disinfection with Far-UV (222 nm Ultraviolet light)

DECEMBER 2020
Selection and Characterization of Semi-Automated Disinfection Devices

NOVEMBER 2020
Computational Fluid Dynamics Modeling and the Transport of Cough Particles in an Aircraft Cabin

NOVEMBER 2020
Probability and Estimated Risk of SARS-CoV-2 Transmission in the Air Travel System

Modeling tools to help inform decisions on safe travel



Screening Air Travelers For Entry (SAFE) Model

Analyze the effectiveness of various screening & quarantine protocols that lower COVID-19 prevalence in travelers

Travel Risk of Infection Prevention (TRIP) Model

Assess effective safety measures and SARS-CoV-2 exposure risk in the aviation ecosystem

The Boeing Screening Air Travelers For Entry (SAFE) Model

What is the model's purpose?

- Analyze the effectiveness of various screening & quarantine protocols that lower COVID-19 prevalence in travelers

How does the model work?

- Compares testing, quarantine, and hybrid testing/quarantine scenarios with COVID-19 prevalence in origin and destination countries
- Considers the disease timeline for COVID-19 and the efficacy of RT-PCR and rapid antigen tests

How can the model be used?

- Aid policy decisions on passenger screening, testing, and quarantines

The Boeing Travel Risk of Infection Prevention Model

What is TRIP's purpose?

- An interactive tool for assessing effective safety measures and SARS-CoV-2 exposure risk in the aviation ecosystem

How does TRIP work?

- Calculates relative risk of exposure at each step of the journey
- Estimates control measure efficacy as well as operational impact
- Represents perspectives of key aviation industry stakeholders: travelers, airports, airlines, OEMs, travel industry, and government

How can TRIP be used?

- TRIP demonstrates the combination of control measures that can provide effective risk reduction to restore full system capacity

Confident Travel Initiative

Key Findings

Risk of transmission in the air travel system is extremely low

Live virus testing validated cleaning methods are effective

Every seat is effectively greater than 7 feet (2 meters) apart

Continuing work on screening and modeling