

Case Study #1 – COVID-19 Research Driven by Public Transit - University Partnerships: Case Study of SEPTA-Drexel Collaboration in Philadelphia

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Drexel University



**NATIONAL
ACADEMIES** *Sciences
Engineering
Medicine*

EHMI Workshop: Indoor Air Management
of Airborne Pathogens: Public Transit

STAR+ Story Format

- S - Situation
- T – Task(s)
- A – Action(s)
- R – Result(s)
- + - Next step(s)

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Acknowledgement:



James Fox

Formerly Assistant General Manager, System Safety
Southeastern Pennsylvania Transportation Authority (SEPTA)

The Situation

- In Spring of 2020...

MARCH 19, 2020

SEPTA reducing transit services, all lines to operate on Saturday schedule because of COVID-19

The public transportation changes affecting Regional Rail, bus, subway and trolley lines goes into effect Sunday, March 22

BY VIRGINIA STREVA
PhillyVoice Contributor



THOM CARROLL/FOR PHILLYVOICE

SEPTA will reduce all transit operations, including buses, Market-Frankford Line, Broad Street Line, trolleys, and Norristown High Speed Line, to a typical Saturday schedule. The new schedule will begin on Sunday, March 22. Ridership on all transit is down by 60%, according to the transit agency.

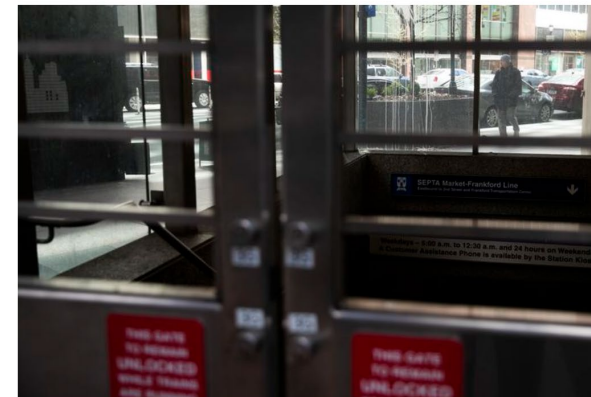
The Philadelphia Inquirer

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Transportation

SEPTA faces an unprecedented financial challenge. A plunge in Pa. Turnpike traffic may make it tougher.

"I don't think any of us know what the new normal is going to look like," said Rich Burnfield, SEPTA's treasurer and deputy general manager.

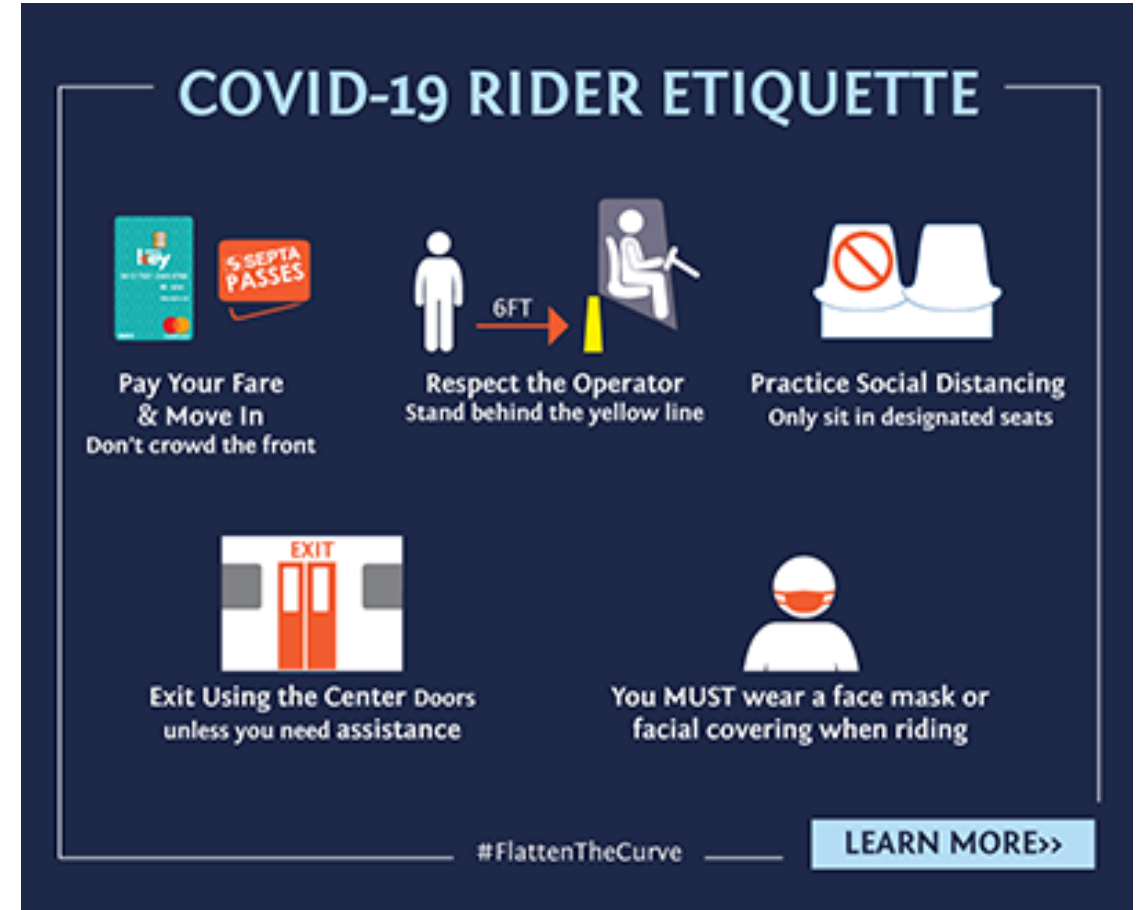


A man is seen walking behind a closed off SEPTA station at 15th and Market in Center City Philadelphia on Wednesday, April 22, 2020.
HEATHER KHALIFA / Staff Photographer



by Patricia Madej
Updated May 4, 2020



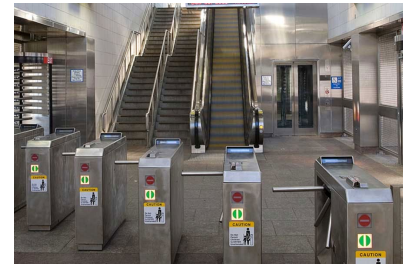


The Task

- May 12, 2020 – First discussion between Drexel, SEPTA, and AAPlasma



- May 27, 2020 – Tour of Frankford Transportation Center in Philadelphia



- July 7, 2020 – Memo for proposed SEPTA-Drexel Partnership



The Task



Development of Public Transit-University Partnership

1. Analysis of customer perceptions that limits their use of public transportation and determination of what factors would reduce their reluctance.
2. Examination of potential exposure scenarios and risks (e.g., airborne transmission, contaminated surfaces) using indoor air (in-cabin) modeling within a quantitative microbial risk assessment framework to determine what the most significant “real” risks might be.
3. Validation of indicators used to assess effectiveness of decontamination processes. This task will be important in providing agencies with methods to generate qualitative and quantitative data as evidence of their efforts to ensure public safety.
4. Development and testing of appropriate and cost-effective disinfection technologies and risk mitigation strategies (e.g., improved ventilation) that will reduce and minimize COVID-19 transmission, that is safe for the public as well as the staff and engineers of SEPTA, and that will be compatible with materials and electrical components housed in their vehicles and facilities.

Action(s)



- July 30, 2020 – First SEPTA-Drexel Partnership Meeting
- October 30, 2020 – MOU for Partnership fully executed
- November 2, 2020 – SEPTA and Drexel applied for COVID-19 funding from DOT/FTA



Funding Opportunity

- **Public Transportation COVID-19 Research Demonstration Grant Program FY2020 (FTA-2020-015-TRI)**

- Due November 2, 2020
- Eligible projects will demonstrate innovative solutions to improve the operational efficiencies of transit systems and enhance mobility for their communities in four major areas:
 - **vehicle, facility, equipment and infrastructure cleaning and disinfection;**
 - **exposure mitigation measures;**
 - innovative mobility such as contactless payments; and
 - measures that strengthen public confidence in transit services. The total funding available for awards under this NOFO is \$10 million. FTA may supplement this amount if additional funding becomes available.

<https://www.transit.dot.gov/notices-funding/public-transportation-covid-19-research-demonstration-grant-program-fy2020-notice>

FTA Award Announcement (1/19/21)

U.S. Department of Transportation Announces \$15.8 Million in Grant Awards to 37 Projects Nationwide to Improve Operational Efficiency of Transit Agencies Affected by COVID-19 Public Health Emergency

Tuesday, January 19, 2021



Federal Transit Administration

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About

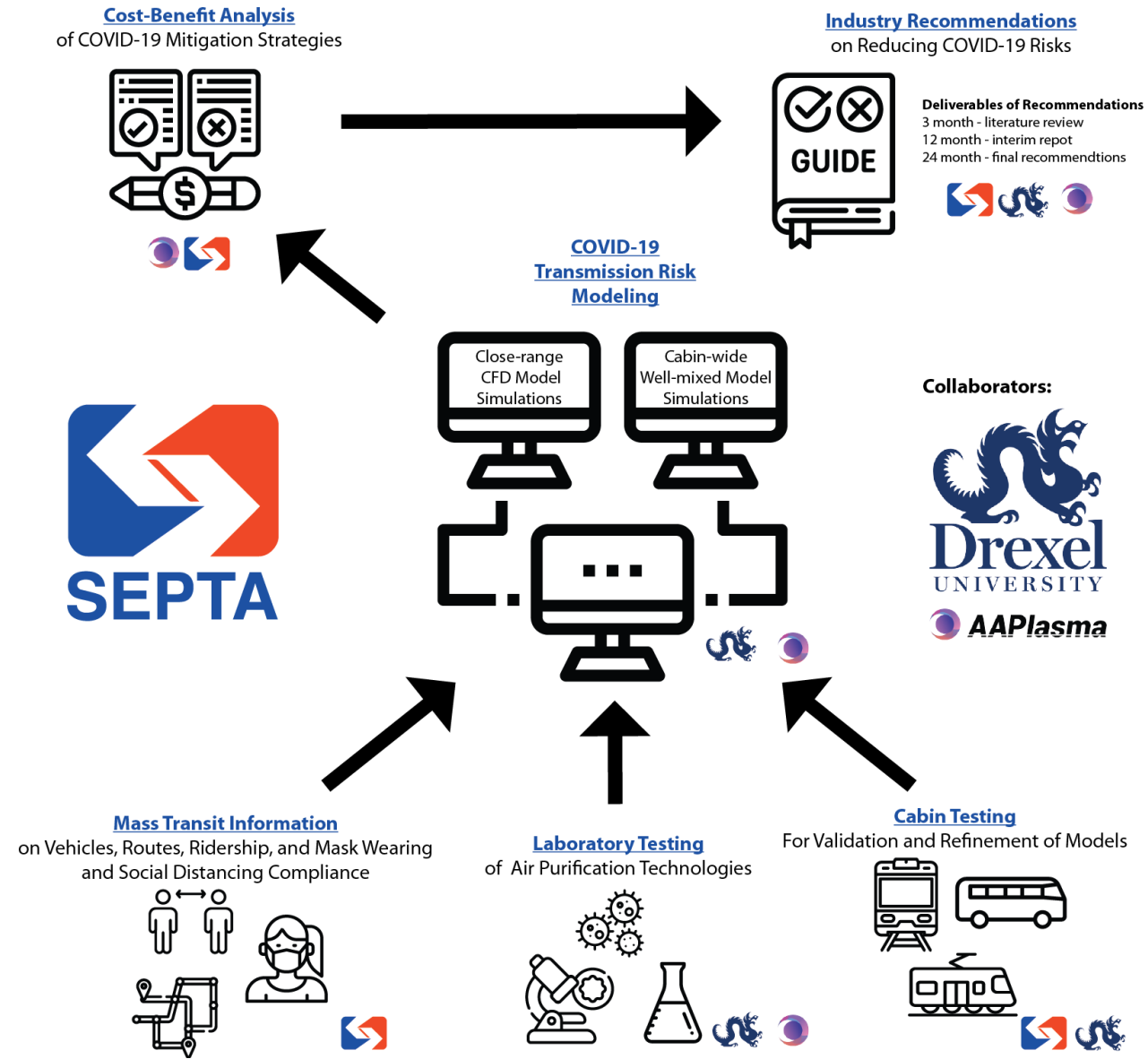
Funding

Regulations & Programs

PA	Southeastern Pennsylvania Transportation Authority (SEPTA)	The Southeastern Pennsylvania Transportation Authority (SEPTA), in partnership with Drexel University, will receive funding to evaluate air ventilation and surface cleaning in preventing the transmission of COVID-19. This project is designed to improve passenger safety and strengthen public confidence to return to mass transit during the COVID-19 public health emergency.	\$584,618
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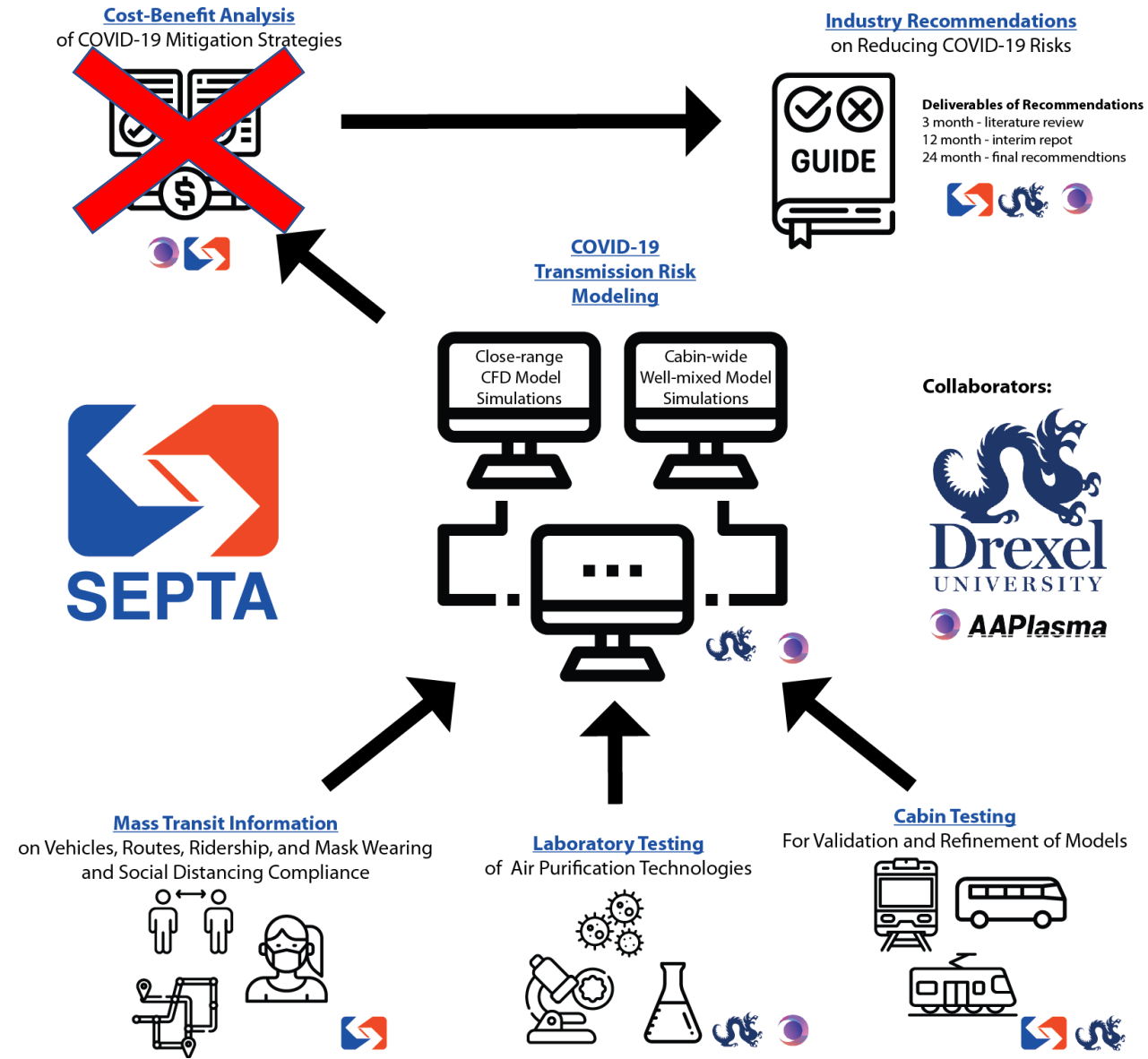
<https://www.transit.dot.gov/research-innovation/public-transportation-covid-19-research-demonstration-grant-program-selected>

Mass Transit Vehicle Air Ventilation and Purification Technologies Evaluation



*Proposed Project Framework:

Mass Transit Vehicle Air Ventilation and Purification Technologies Evaluation



Revised Project Framework:

Result(s) to date

- **Deriving COVID-19 risks on-board SEPTA vehicles**
 - Approach 1: Well-mixed indoor air quality box models
 - Determine volume-average concentrations & estimate risks
 - Simulations can be scaled and adapted to
 - Assess different vehicles/routes & engineering controls
 - Assess evolution of risks **over time** during a trip
 - Useful for a **statistical** examination of outcomes



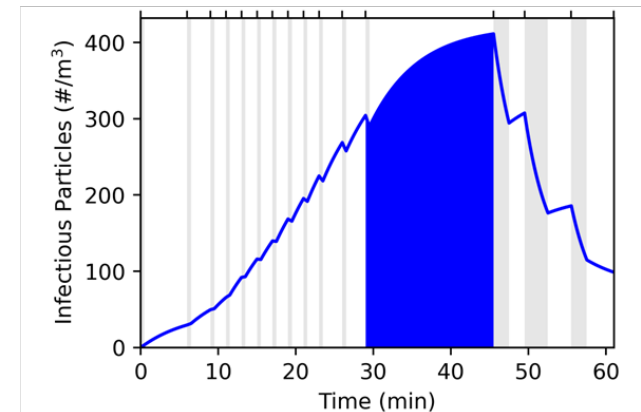
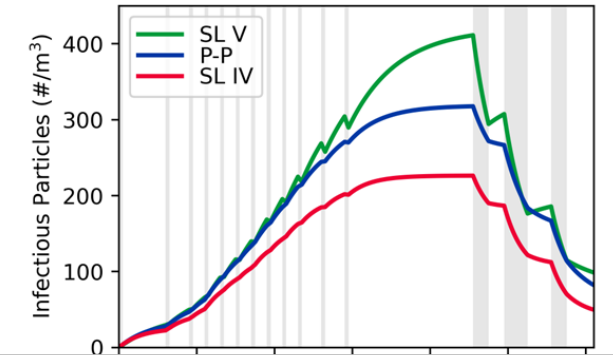
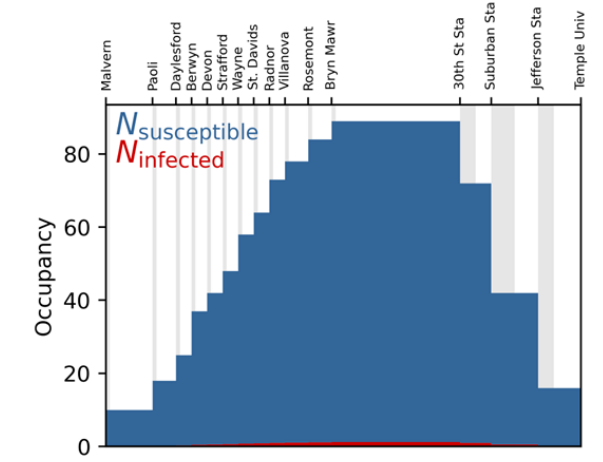
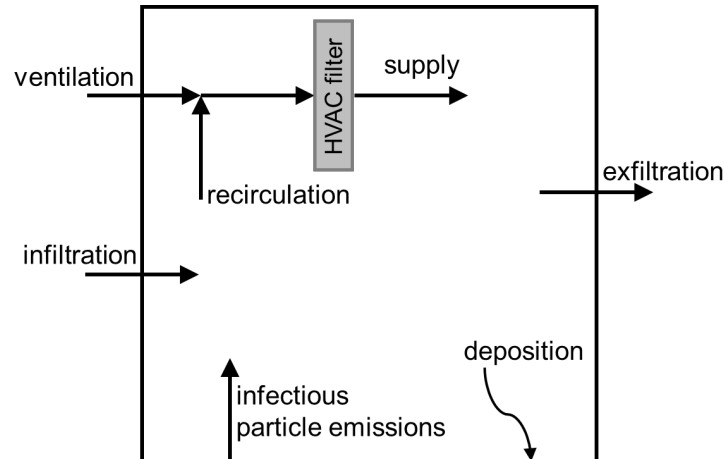
Research Scientist
Bryan Cummings



Professor
Michael Waring

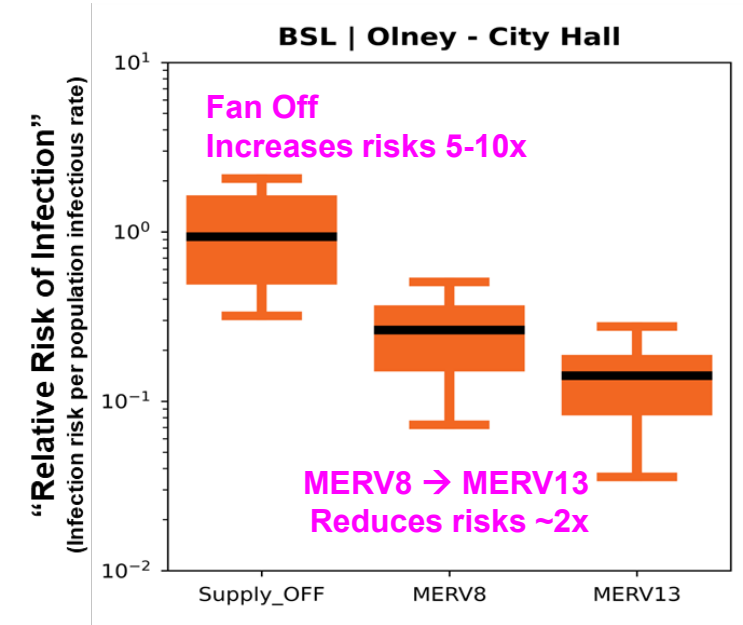
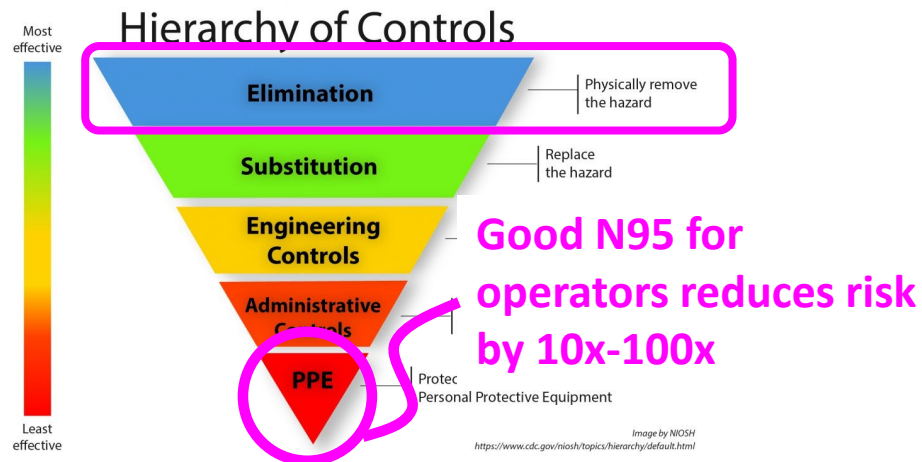


Professor
Charles N. Haas



Result(s) to date

- **Deriving COVID-19 risks on-board SEPTA vehicles**
 - Approach 1: Well-mixed indoor air quality box models
 - **Current Progress**: Simulations have generated large amounts of data
 - e.g., to assess impact of HVAC operation
 - e.g., to perform sensitivity analyses



Predictor	SRC
population infectiousness	0.153
time onboard	0.151
# of pax onboard	0.146
open-door infiltration rate	-0.014
recirculation rate	-0.04
fraction of pax that are masked	-0.054
cabin volume	-0.064
HVAC filter efficiency	-0.064
ventilation rate	-0.075

Result(s) to date

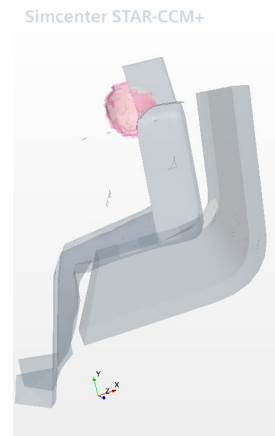
- **Deriving COVID-19 risks on-board SEPTA vehicles**
 - Approach 2: Computation fluid dynamics simulations
 - Used to track distribution of aerosol particles inside vehicles
 - Simulations vary based on ventilation flow rate, number of infectious emitters, and how they are grouped/distribute throughout the vehicle
 - **Current Progress**: Simulations in Buses (New Flyer Xcelsior)



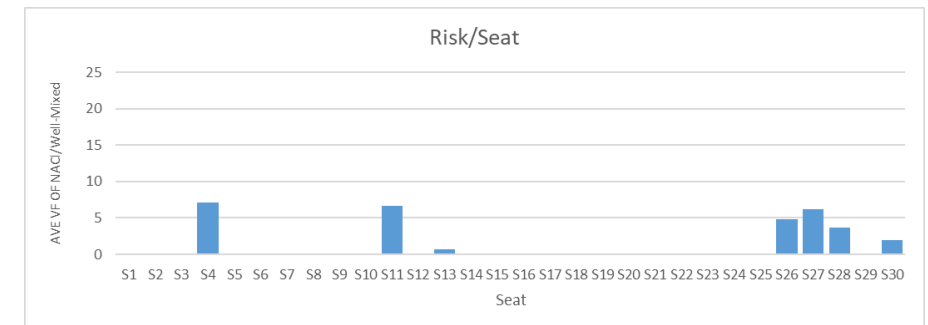
Associate
Professor
James Lo



PhD Student
Zeinab Bahman
Zadeh



Relative Risk in Breathing Zone of Each Seated Passenger



“+” Next Steps

- **Currently halfway through 2-year FTA COVID project**
 - Completion of simulations in buses, trolleys, regional rail cars and subway cars
 - In-vehicle validation testing of cabin ventilation rates
 - Integration and reconciliation of risks predicted by the well-mixed box model and CFD simulations
 - In-duct experiments evaluating different airborne disinfection technologies (UV @ 222nm, 254nm 275nm; bipolar ionization; plasma)
 - Are they really needed? Which technologies are effective and safe to use?



“+” Next Steps

- **Beyond the FTA COVID research project**
 - Effectively share information from scientific studies with public to regain their trust in the safety of using public transit
 - Development of science and industry informed guidelines and standards for ventilation, air filtration, and disinfection technology requirements on mass transit vehicles
 - Implore the government that we cannot wait until next pandemic to fund research to address airborne pathogen transmission risks on mass transit

Thank you!



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