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Numerical Investigations of Virus Transport Aboard a Commuter Bus

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Among the major health concerns arising due to the COVID-19 pandemic is the spread of viruses aboard public transportation systems from infected passengers. The spread of viruses and bacteria due to coughing, sneezing, the sudden release of an agent, or just normal breathing within public transportation systems with high people-to-space concentrations is also of high concern for homeland security. Here we provide results of our unsteady numerical investigations of virus transport when virus particles are released aboard a commuter bus with 37 passengers from an infectious passenger seated in the middle of the bus. The study aimed at understanding the details of the spatial transient concentration of the virus aboard a commuter bus along with passenger exposure to identify the probable number of infections for a specific duration of travel.

Study Methods

Three-dimensional unsteady numerical simulations were performed for a bus with 37 seats fully occupied. Air flows issued from two linear slots through the ceiling at 2,097 CFM and exited the bus in the back. The passenger sitting in the middle were assumed to release 1,267 particles (viruses) per minute. The size of the particles was 2.5 microns, comparable to an aerosolized influenza virus. The simulations included intervals when the bus was in transit as well as at a bus stop when (in the latter case) there was air exchange with the outside during passenger drop-off and boarding.

Findings

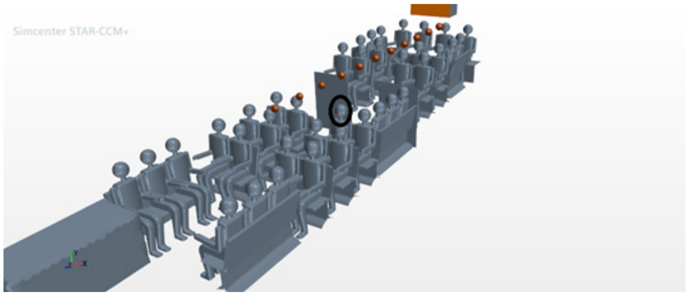
When the bus is in transit, results show high exposure for passengers sitting behind the infectious passenger. Then, at the bus stop, due to air exchange, the viruses were carried to the seats in front of the infectious person, exposing passengers sitting in the front seats. The risk of infection is time-dependent, and with a high rate of ventilation in this bus, the number of infected passengers is expected to be 0.11 per 30 minutes of exposure given the simulation parameters. Increased passenger interaction and concentration will increase the rate of the virus spreading and thus create a higher risk of infection.

These results indicate that an appropriate and effective ventilation system with a high mixing rate could reduce the risk of infection aboard commuter buses.

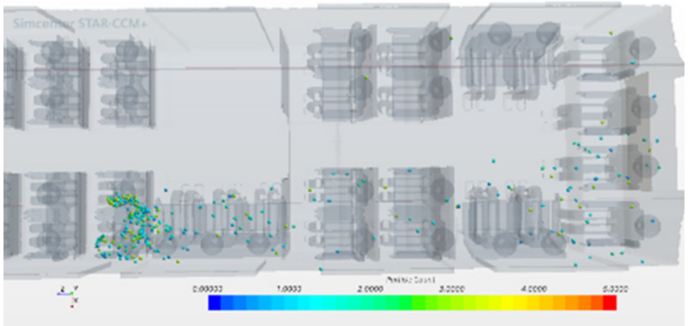
Policy/Practice Recommendations

Our simulation method could be used to optimize the ventilation system in public buses for effective mixing and reduced risk of infection.

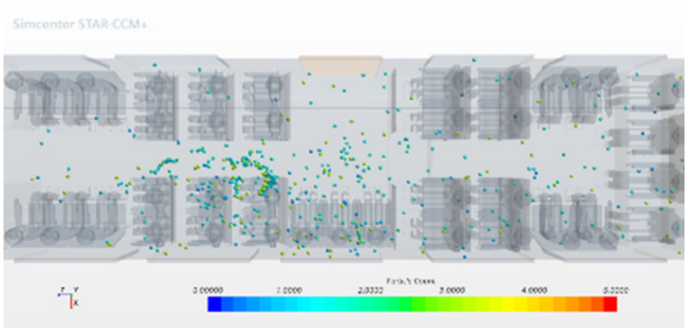
The Bus with Passengers (infected passenger circled)



Virus Distribution from the Infected Passenger after 30 min when the Bus is in Transit



Virus Transport 30 sec after Doors Opened at a Stop



About the Authors

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To Learn More

For more details about the study, download the full report at **transweb.sjsu.edu/research/2048**

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