An adaptable modelling framework for infection risk and control

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Abstract: The COVID-19 pandemic highlighted the vulnerability of air travel to infectious diseases and spurred calls for enhanced federal coordination and integrated research. In response, the Boeing Company, U.S. Federal Aviation Administration (FAA), Centers for Disease Control and Prevention (CDC), and the National Research Council Canada (NRC) assembled a multidisciplinary team to address the challenges of communicable diseases in air travel and facilitate rapid public health responses to emerging threats. This collaboration has led to the development of the Travel Risk In Pandemics (TRIP-X) framework - a modular, multi-model simulation framework designed to simulate infectious disease transmission in a variety of environments. Here we introduce the main components of TRIP-X and discuss how it is used to evaluate risk controls and mitigation strategies in diverse aviation and travel settings.

The TRIP-X framework consists of several interlinked open-source modules, each representing key components of disease transmission: testing and screening, geometry creation, computational fluid dynamics (CFD), agent-based modelling (ABM), pathogen transmission & dispersion modelling, epidemiological exposure and infection dynamics, and analysis and visualisation (**Figure 1**). This modular structure allows for the independent operation of each module which enhances system efficiency, enabling quick evaluations of disease transmission scenarios and risk mitigation using Monte Carlo methods. The framework is able to be run in a systematic way that allows data to be transferred between the different modules at the numerical fidelity required.

This framework was developed in response to the U.S. Department of Transportation National Aviation Preparedness Plan. It provides a quantitative evidence-based disease transmission risk framework and suite of modelling tools needed to improve understanding of disease transmission throughout the global air travel ecosystem and to develop a risk management tool that is scalable to changing complex environments and adaptable to multiple infectious pathogens.

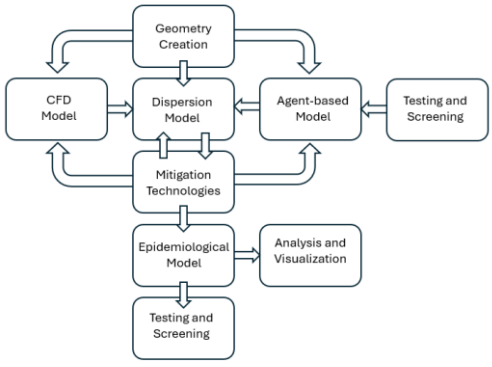

Figure 1: The conceptual TRIP-X framework with the interlinked open-source modules

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