BIO-FI: LEVERAGING THE POWER OF BIOLOGICAL BIG DATA FOR ADVANCED ANALYTICS AND MODELING OF CHEMICAL AND BIOLOGICAL THREATS

A Novel Framework For Modeling Person-to-person Transmission Of Respiratory Diseases

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From the beginning of the COVID-19 pandemic, researchers assessed the impact of the disease in terms of loss of life, medical load, economic damage, and other key metrics of resiliency and consequence mitigation. These studies included estimates of transmissibility, viral survivability, and other components of a disease transmission model at different levels of fidelity, resulting in analyses that were informative but, in many ways, incomplete. Using SARS-CoV-2 as a case study, we present a robust modeling framework that considers disease transmissibility from the source (characterization of the initial environment) through transport and dispersion (the effect the environment has on the initial source), and infectivity (the effect that the presented environment has on the susceptible individual). The framework is designed to work across a range of particle sizes (from sub-micron up to 100 micron) and estimates the aerosol generation, environmental fate, deposited dose, and infection/severity, allowing for end-to-end analysis that can be transitioned to individual and population health models. We demonstrate how such high-fidelity models of disease transmission can advance and prioritize research efforts by conducting numerical simulations within this framework.

We also present new work on an expanded framework that incorporates fomite transmission via contact with contaminated surfaces and tissue to expand the model to other diseases of interest, beginning with a generalized pox model. This expansion will allow researchers to perform risk assessments in the event of a novel contagious disease threat that can spread via close contact and contaminated surfaces.

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