Title:

A SEIR Model of U.S. Influenza Spread Incorporating Interstate Travel Data

Abstract:

SIR is a well-known model for spread of contagions, or other transmissible traits or states, among a population of freely “mixable” individuals. Those susceptible (S) to infection can become infected by contact with infected (I) individuals. Those infected can then transition to a resistant (R) state, where they are resistant to becoming infected. A SEIR model extends this, by having a latent period, where exposed (E) individuals don’t immediately become infected (i.e. contagious). Studies have shown that SEIR models can be useful in modeling influenza, in certain populations/conditions[[1]](#footnote-0). But when other factors, like human behavior patterns, need to be additionally accounted for, modelers often turn to agent-based models of disease spread[[2]](#footnote-1). Here, human-like agents model individual behavior patterns which can result in contact with other agents, and thus model the transmission of a disease through a population. The deterministic SEIR model can be simulated and analyzed relatively quickly and easily. Full agent-based modeling can become complex and computationally difficult due to the interaction, heterogeneity, and adaptivity among agents.

In this study, we aim to take a step towards combining these approaches by introducing an aspect of human behavior, interstate travel patterns, into a SEIR model. Using interstate travel data, we will model the spread of influenza across the United States. Each state will contain a compartmentalized population, behaving under SEIR dynamics. Infected individuals from adjacent states will be allowed to seed these models, and initiate their flu spread. The COPASI[[3]](#footnote-2) simulation and analysis software will be utilized to create, and simulate a 48 compartment (U.S. states) model. COPASI “events” will trigger the periodic movement of individuals between compartments. American Community Survey (ACS) data via the U.S. Census Bureau will used to set the number of humans traveling between adjacent compartments, on a daily basis.

1. "Modeling the initial transmission dynamics of influenza A H1N1 ... - NCBI." 29 Dec. 2012, <https://www.ncbi.nlm.nih.gov/pubmed/23276487>. Accessed 21 Mar. 2018. [↑](#footnote-ref-0)
2. "Using data-driven agent-based models for forecasting emerging ...." 22 Feb. 2017, <https://www.sciencedirect.com/science/article/pii/S1755436517300221>. Accessed 21 Mar. 2018. [↑](#footnote-ref-1)
3. "COPASI." <http://copasi.org/>. Accessed 21 Mar. 2018. [↑](#footnote-ref-2)