Modeling Intervention Strategies for TB Control in the United States

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Introduction

The most common epidemiological models are compartmental models, in which a system of differential equations describes how parts of the population move between different disease states, or *compartments*. The canonical example of such a model is the SIR model, which has three compartments: Susceptible, Infected, and Recovered. The dynamics of a population modeled by this framework are shown in figure 1, with associated system of differential equations 2.

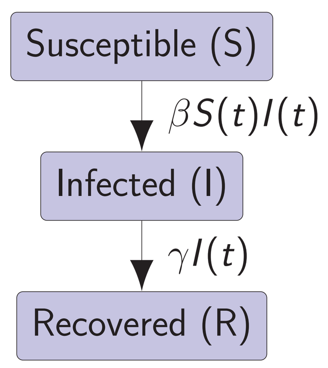

Figure: This flowchart depicts the standard SIR epidemiological model. It is accomponanied by the system of differential equations 2.

$$\frac{dS}{dt} = -\beta S(t)I(t)$$
$$\frac{dI}{dt} = \beta S(t)I(t) - \gamma I(t)$$
$$\frac{dR}{dt} = \gamma I(t)$$

Figure: The system of differential equations governing the SIR model.

The SIR system, though very informative about basic disease dynamics, fails to capture the intricacies of more complicated diseases. This project examines the spread of tuberculosis (TB) in the United States (US) via compartmental models and stochastic, agent-based models. These explorations allow one to explore the impact, both epidemiological and economic, of various intervention strategies. These models are based on a 2012 compartmental model of TB in the US created by A. N. Hill, J. E. Becerra, and K. G. Castro.

The Basic Hill Model

Intervention Analysis

Intervention Analysis

An Agent Based Implementation

Implementing an Agent Based Framework