Modeling the Impact of Immunity Waning in Outbreaks of Infectious Diseases

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Vaccines against COVID-19 have demonstrated high efficacy in preventing symptomatic infections, as has prior infection in providing substantial protection against reinfection. However, a crucial observation is the waning of protection over time following vaccination or infection. Recognizing the significance of asymptomatic and presymptomatic transmission in infectious diseases like COVID-19, our study integrates these dynamics into a comprehensive SVEAIR model. The goal of this project is to understand the impact of immunity waning post-infection and post-vaccination on multi-outbreak scenarios of infectious diseases. We present results on positivity, boundedness, global asymptotic stability of the disease-free equilibrium, and the persistence of infection. Numerical simulations are conducted to reveal the impact of parameters such as the duration of post-vaccination or post-infection immunity on infectious disease transmission dynamics.

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