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Modeling Adaptive Behavior in Influenza Vaccination Decisions

Classic game-theoretic approaches, whereby individuals are assumed to evaluate their options deductively based upon available information and perceptions, have previously been used to model vaccination-related decision making. However, for the case of influenza, individuals may rely on their memories and past experiences of having vaccinated. They thus use adaptation by evaluating their vaccination options inductively. We explore this concept by constructing an individual-level model of adaptive-decision making. Here, individuals are characterized by two biological attributes (memory and adaptability) that they use when making vaccination decisions. We couple this model with a population-level model of influenza that includes vaccination dynamics. The coupled models allow individual-level decisions to influence influenza epidemiology and, conversely, influenza epidemiology to influence individual-level decisions. By including the effects of adaptive-decision making within an epidemic model we show that severe influenza epidemics could occur due to the behavioral dynamics in vaccination uptake without the presence of a pandemic strain. These severe epidemics can be prevented if vaccination programs offer incentives. We find that when a family-based incentive is offered, the frequency of severe epidemics is increased. Instead, this frequency could be reduced if programs provide several years of free vaccines to individuals who pay for one year of vaccination. We conclude that individuals memories and flexibility in adaptive decision-making can be extremely important factors in influenza and voluntary vaccination determining the success of influenza vaccination programs. Finally, we discuss the implication of our results in success of a universal flu vaccine and for the case of a pandemic, and discuss some extensions of the model.

References

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