Mathematical Biology Seminar

Monday, November 18, 2024
3 pm MDT - 457 CAB (in person)

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Meeting ID: 976 2471 8507

Frédéric Hamelin

Professor in Quantitative Plant Disease Epidemiology
L'Institut Agro
Rennes, France

Wearing face masks to protect oneself and/or others: Counterintuitive results from a simple epidemic model accounting for selfish and altruistic human behaviour

We study a simple SIS epidemic model accounting for human behaviour. Individuals can decide at each instant of time whether or not they adopt prophylactic (hereafter protection) measures such as mask wearing or social distancing. These measures decrease susceptibility and/or transmission. We consider a situation in which individuals are unaware of their current health status (infected or not), but can perceive disease prevalence at the population level. This assumption fits situations in which tests are not widely available. Individual decision dynamics depend both on disease prevalence, as a proxy for the risk of being infected or infecting others, and the fraction of the population complying to the protection measure, which people can observe in their every day life. Specifically, human behaviour is assumed to be driven by imitation dynamics. When the disease does not naturally die out, the model has three types of endemic equilibria: no-protection, mixed-protection, and full-protection. Which endemic equilibrium is stable depends on the parameter values. We assume that the efficiency of the protection measure is positively correlated to its cost at the individual level. Increasing the efficiency of the protection measure and therefore its individual cost can make the system switch from full protection to mixed-protection. This way, increasing the efficiency of a protection measure may increase disease prevalence at equilibrium. In other words, disease prevalence is minimized for intermediate efficiency and individual cost of the prophylactic measure. This is because when the prophylactic measure is too effective and therefore costly, part of the population free-rides on the effort of others and drops protection, resulting in increased prevalence. Altogether, our results show that the interplay between epidemiology and human behaviour may lead to counter-intuitive but nevertheless intelligible outcomes, which should be anticipated when designing public health policies.

This is joint work with Hugo Martin and François Castella.