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Poster Title: Novel Theory of “Synergistic Disadvantage” - How do Clustered Interactions impact Epidemic Models?

Abstract

Understanding the dynamics of infectious disease transmission within populations is essential for implementing effective public health interventions. Mechanisms to prevent or control the spread of infectious diseases include treatments and vaccination, and the use of non-pharmaceutical interventions (NPIs) that change social and behavioural patterns and aim to reduce transmission by reducing interactions and risk of infection from those interactions. The existing work on epidemic modelling does not fully capture some individual factors which contribute to the force of infection (FOI). Specifically, whilst some models include mobility, number and duration of contacts between people, the different clustering during these interactions (e.g. do people repeatedly see the same people each day?) is not included and this can affect the quantitative analysis of the impact of individual NPIs. In this study, we introduce a novel theory of *Synergistic disadvantage* to incorporate cluster interactions which is characterised by the formation of smaller groups where local interactions take place in epidemic modelling, offering a way to capture household and non-household interactions in epidemic modelling. We combine this concept with the movement-interaction-return (MIR) modelling approach, the classic “Susceptible-Infected-Recovered” (SIR), and the “Susceptible-Exposed-Infected-Recovered” (SEIR) transmission models to evaluate infectious disease dynamics both analytically and numerically. This approach allows us to capture household contribution even in the simple epidemic models in the spread of infectious diseases, to disentangle the social constituents that contribute to the FOI from the biological infectiousness of pathogens. This gives a more detailed approach to analysing the potential effect of NPIs in outbreaks, by understanding the roles of different factors including the clustering of people during work and at home.