

Projecting the effectiveness of control interventions during infectious disease epidemics

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Mathematical models are used routinely to guide interventions during infectious disease epidemics [1]. A key challenge is to assess the effectiveness of current public health measures, and to determine the likely effectiveness of proposed future interventions. By projecting the effects of different possible control measures, the deployment of interventions can be optimised.

Epidemiological models are currently being used to project future numbers of cases, hospitalisations and deaths for different COVID-19 vaccine roll-out strategies [2]. Approaches that involve targeting individuals of different ages and different timings of vaccine doses are being considered. However, vaccines often provide incomplete protection against infection, and pathogens mutate. While most mutations are minor and have little effect, some mutations may reduce the immunity offered by vaccines. If they occur, these so-called “vaccine escape” mutations will lead to a reduction in the effectiveness of control interventions [3].

In this project, mathematical models will be developed to explore how different vaccination strategies affect epidemic outcomes, including numbers of cases and deaths and the risk of vaccine escape. Since vaccine escape is most likely to arise during an infection of a vaccinated individual, there is a trade-off in which widespread vaccination provides more hosts in whom vaccine escape can occur (increasing the vaccine escape risk) yet leads to reduced case numbers (lowering the vaccine escape risk). This trade-off will be explored for different vaccination strategies, allowing interventions to be planned in which case numbers are reduced with only a limited vaccine escape risk.

Since projecting the effects of control interventions, such as different vaccination strategies, is a key current challenge, this project has the potential to lead to results with significant positive public health impacts.

References

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3. The Lancet Infectious Diseases. An exceptional vaccination policy in exceptional circumstances. *Lancet Infect Dis*. 2020;21: 149.