Title: **Waning and boosting of immunity - challenges in modelling, analysis and numerics**

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Abstract:

A challenging problem in mathematical immuno-epidemiology is to incorporate the within host processes of waning of immunity and immune system boosting (upon repeated exposure to the same pathogen) into population level disease dynamics. Since the frequency of boosting events depend on the density of infected individuals in the population, there are reciprocal feedbacks between the individual and the population levels.

We construct a dynamical model expressed by a structured PDE, and show that for particular boosting mechanisms it can be reduced to delay differential equations.

In the DDE formulation, analytical and numerical stability analysis is possible, and we can identify stability switches of the endemic steady state due to boosting, generating a complicated bifurcation diagram.

We systematically investigate (both in PDE and DDE settings) the temporal evolution of immunity distributions in the population under different assumptions on the biology of the boosting mechanism, connecting these processes to the qualitative nature of periodic disease outbreaks.