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Virus dynamics and the immune system

The outcome of viral infection ultimately depends on the efficacy of interactions between the pathogen and different components of the immune system. In this talk I will discuss our recent work in modelling HIV and influenza infections where one or more activated component of the immune system is explicitly included in the model structure. Briefly, depending on model assumptions (i.e. killing of infected cells, virus loss term), we find that a model of CD4 T-cell activation and memory generation in HIV infection can produce one or more backward bifurcations and one or more Hopf bifurcations at low viral load. We will discuss these outcomes in the context of HIV viral clearance and viral blips. In collaborative work, we have found that mathematical models of influenza infection that include the innate and/or adaptive immune response can generate similar viral hierarchy infection outcomes as those observed in laboratory studies of influenza cross-reactivity. Finally, we will discuss extensions of in-host models of virus and immune system dynamics to a multi-scale study of the effects of immunity on susceptibility and transmissibility at the population level.