Next generation matrices and the type reproduction number - beyond $R_0$

December 14, 2009

Abstract

There are many advantages to analysing epidemics in terms of ‘infection generations’ instead of (or as well as) chronological time. For structured populations the basic reproduction number, $R_0$, may be defined as the spectral radius of the next generation matrix (NGM). The construction of the NGM will be explained in two ways: by following a linear algebra recipe and by thinking about the epidemiology. Although $R_0$ is the fundamental quantity that determines the qualitative dynamics of an infectious disease, there exist type reproduction numbers, $T$, that give more insight into control policies and reservoirs of infection. Infection generations may overlap in chronological time, but in defining $T$ we use information from all potential future generations. Implications for the control of infectious diseases will be discussed, with a variety of examples.