

The Reproductive ratio: at macro and micro levels

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Abstract

The basic reproduction ratio, R_0 , is one of the fundamental concepts in mathematical biology defined as “the average number of secondary infections caused by a single infectious individual during their entire infectious lifetime”, however, “secondary” depends on context For both in vivo and epidemiological models of pathogen dynamics, the basic reproductive ratio, R_0 , is a powerful tool for gauging the risk associated with an emerging pathogen, or for estimating the magnitude of required control measures. Techniques for estimating R_0 , either from incidence data or in-host clinical measures, often rely on estimates of mean transition times, that is, the mean time before recovery, death or quarantine occurs. In many cases, however, either data or intuition may provide additional information about the dispersal of these transition times about the mean, even if the precise form of the underlying probability distribution remains unknown. In this paper we elucidate common situations in which R_0 is sensitive to the dispersal of transition times about their respective means both at macro and micro levels. We then provide simple correction factors that may be applied to improve estimates of R_0 when not only the mean but also the standard deviation of transition times out of the infectious state can be estimated.