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After the Honeymoon, the Divorce: Unexpected Outcomes of Disease Control Measures

Abstract

Mathematical models have provided much insight into the control of infectious diseases and are now routinely used during epidemics caused by emerging pathogens (e.g. ebola, Zika, ...). We lack effective vaccines for many infections, so disease control measures often instead attempt to directly reduce transmission. As an example, the main control measure for the mosquito-borne dengue virus has been mosquito control, e.g. by spraying insecticide aimed at adult insects. In this talk we discuss counter-intuitive behavior that can result when such control measures are employed for a transient period against an endemic infection. Building on an observation in a recent study of Okamoto et al., we demonstrate the epidemiologically-troubling result that there can be time windows over which the total number of disease cases can exceed the number that would have occurred if no intervention had been employed: accumulation of susceptibles during the control can lead to a large outbreak following the end of the control. This outbreak can be so severe that all the benefit accrued during control can be overcome. We show that this phenomenon can occur in a broad class of infection models and discuss public health implications, including for clinical trials of proposed control measures.