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Environment, Host and Pathogen Diversity on Probability of Disease Extinction

Linda Allen

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Environment, Host and Pathogen Diversity on Probability of Disease Extinction

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ABSTRACT: Intervention and control strategies are designed to prevent or to shorten the course of an infection or an epidemic. One of the key model parameters in control of within-host and between-host spread of infection is the basic reproduction number R_0. The value of R_0 depends on a multitude of factors, including pathogen and host diversity and the environment. Control measures must reduce R_0 to a value below unity to prevent an outbreak or an infection. In this investigation, we apply stochastic within-host and between-host models and branching process approximations to study the infection or epidemic dynamics when R_0 is greater than unity. We apply branching process theory to obtain additional measures for the effectiveness of control such as the probability of disease extinction. We investigate how pathogen or host diversity and the environment affect the probability of disease extinction. Some applications to zoonotic infectious diseases are discussed.

One Population:

Between-Host SEIR: R0 (population density, heterogeneity in susceptibility, longevity of infection, multiple populations)

Probability of an outbreak depends on E or I

One Pathogen:

Within-Host: HLIV R0

Probability of an infection depends on L I V

Multiple Populations

Multiple Pathogens

Environment survival in the environment

Population Size or Density Time and Location

Wesley

SIR-

Environment: Zoonotic Disease –time of year, and location
Close contact with the Reservoir host-mixing patterns
Host Diversity: Different Species, Different susceptibilities or transmission potential (superspreaders)
Pathogen Diversity: Virulent and avirulent strains of bacteria