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Modeling of Early SIV/HIV Infection

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Modeling of Early SIV/HIV Infection

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Although HIV has infected over 20 million people worldwide, it is a rather poorly transmitted virus since less than 1 out of 100 to 1,000 acts of sexual intercourse results in virus transmission. The factors that could potentially explain why the probability of transmission is so small are poorly understood. It is nearly impossible to study HIV replication in the first 2-3 weeks of infection because the virus is undetectable until after that duration. By using stochastic simulations of mathematical models of early virus replication, we investigate how the duration of the eclipse phase prior to virus production (eclipse stage) affects the probability of infection of the host and time to the detectable virus load for simian immunodeficiency virus (SIV) infection of monkeys. The probability of infection strongly depends on the dose of the infectious agent and the viral production mechanism that is used, and there are significant differences in times to infection between the deterministic and stochastic models. We show that our model consistently predicts the time to virus detection in macaques infected with a low dose of SIV. However, the model fails to accurately predict the dependence of the probability of SIV infection on the initial viral dose in monkeys. Our results suggest that additional mechanisms must be considered for understanding early virus dynamics, in particular, spatial distribution and the turnover of CD4+ T cells, which are primary targets for the virus.

Information about the Authors:
Krista Schaefer participated in a REU project at the National Institute of Mathematics and Biological Synthesis at the University of Tennessee, Knoxville. Her collaboration team met there with adjunct professors from the university and peer researchers from St. Olaf and Scranton University. She enjoys math modeling of biological systems.

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