Pair Approximation for a Model of Vertical and Horizontal Transmission of Parasites

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We apply Stochastic Dynamics method for a differential equations model, proposed by Marc Lipsitch and collaborators (Proc. R. Soc. Lond. B 260, 321, 1995), for which the transmission dynamics of parasites occurs from a parent to its offspring (vertical transmission), and by contact with infected host (horizontal transmission). Herpes, Hepatitis and AIDS are examples of diseases for which both horizontal and vertical transmission occur simultaneously during the virus spreading. Understanding the role of each type of transmission in the infection prevalence on a susceptible host population may provide some information about the factors that contribute for the eradication and/or control of those diseases. We present a pair mean-field approximation obtained from the master equation of the model. The pair approximation is formed by the differential equations of the susceptible and infected population densities and the differential equations of pairs that contribute to the former ones. In terms of the model parameters, we obtain the conditions that lead to the disease eradication, and set up the phase diagram based on the local stability analysis of fixed points. We also perform Monte Carlo simulations of the model on complete graphs and Erdős-Rényi graphs in order to investigate the influence of population size and neighborhood on the previous mean-field results; by this way, we also expect to evaluate the contribution of vertical and horizontal transmission on the elimination of parasite. Pair Approximation for a Model of Vertical and Horizontal Transmission of Parasites.