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A Model of the Transmission of Dengue Fever with an Evaluation of the Impact of Ultra-Low Volume (ULV) Insecticide Applications on Dengue Epidemics

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We have developed a deterministic susceptible, exposed, infectious, resistant or removed (SEIR) model of dengue fever transmission that enables us to explore the behavior of an epidemic, and to experiment with vector control practices. Populations of both host and vector are divided into compartments representing disease status (susceptible, exposed, infectious, and, for humans, resistant), and the flow between compartments is described by differential equations. Examination of the equilibrium points leads to a formulation of the basic reproduction rate (z_0) of the disease. With a base set of parameters, $z_0 = 1.9$ and the model realistically reproduces epidemic transmission in an immunologically naive population. Control of adult mosquitoes by ultra-low volume (ULV) aerosols is simulated by an abrupt decrease in vector densities, followed by gradual recovery of the vector population. The model indicates that ULV has little impact on disease incidence, even when multiple applications are made, although the peak of the epidemic may be delayed. Decreasing the carrying capacity of the environment for mosquitoes, and thus the basic reproduction rate of the disease, by source reduction or other means, is more effective in reducing transmission.