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Global analysis of a viral infection model with cell-to-cell transmission and immune chemokines

In this talk, we study a viral infection model incorporating both cell-to-cell infection and immune chemokines. Based on experimental results in the literature, we make a basic assumption that the cytotoxic T lymphocytes (CTL) will move toward the location with more infected cells, while the diffusion rate of CTL is a decreasing function of the density of infected cells. We first establish the global existence and ultimate boundedness of the solution via a priori energy estimates. Next, we define the basic reproduction number of viral infection R_0 and prove by uniform persistence theory, Lyapunov functional technique, and LaSalle invariance principle that the infection-free steady state E_0 is globally asymptotically stable if $R_0 < 1$. When $R_0 > 1$, then E_0 becomes unstable, and another basic reproduction number of CTL response R_1 becomes the dynamic threshold in the sense that, if $R_1 < 1$, then the CTL-inactivated steady state E_1 is globally asymptotically stable; and if $R_1 > 1$, then the CTL-activated steady state E_2 is globally asymptotically stable.