An ImmunoEpidemiological Model for HIV/AIDS Incorporating Viral and Cellular Transmission with Antiretroviral Treatment Applied Mathematical Sciences, Vol. 13.

Abstract

In this paper an immuno-epidemiological model for HIV and AIDS incorporating viral and cellular transmission with antiretroviral treatment is formulated. Using ordinary di_erential equations, the two transmission subsystems are coupled in which the transmission rate at the population is expressed as a function of the viral load, while the within-host infection rates are modelled as functions of the number of infectives. The basic reproduction number, $R_{0C}$ of the coupled model is found to be a maximum of the two reproduction numbers $R_{0B}$ and $R_{0W}$ corresponding to the between host and within host subsystems respectively. Stability analysis reveals that the disease free equilibrium is globally asymptotically stable whenever $R_{0B} < 1$ and $R_{0W} < 1$. Theoretically this means that the disease is wiped out. Using the center manifold Theorem, the endemic equilibrium is found to be locally asymptotically stable if $R_{0C} > 1$ and unstable otherwise. This reveals that the high transmissibility of HIV caused by high viral load at the within host level will lead to disease persistence in the population. Numerical simulation shows that an increase in viral load at the within host level leads to proportional increase in the number of infectives at the population level.

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