A Mathematical Model of Herpes and Chlamydia Co-infection In Humans

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A mathematical model was formulated to investigate the co-interaction of *Chlamydia trachomatis* (*C. trachomatis*) and herpes simplex virus (HSV) in human beings; taking into account the HSV-induced persistence in *C. trachomatis*. The *C. trachomatis* only and the HSV only sub-systems are first explored, whereby analytic expressions for the threshold parameters are obtained in each sub-model and the global dynamics are investigated. Global dynamics of the co-infection shows that the infections die out whenever the threshold parameters for the respective sub-systems and co-infection model is less than unity. On the contrary, *C. trachomatis* cannot invade the population provided that the herpes reproduction number is larger than unity. We further investigate the impact of HSV in the *C. trachomatis* stable system, and vice versa. The analysis shows that herpes invades uniformly in an entirely susceptible population as well as in a *C. trachomatis* stable population. However, the analysis of the reverse case demonstrates the two infection co-exists only when the reproduction numbers of *C. trachomatis* computed at the HSV equilibrium exceeds unity. The theory of asymptotically autonomous systems with limiting systems is used to show the existence of an endemic equilibrium when all the reproduction numbers are larger than unity, where all the state variables are positive. Numerical simulations are carried out to graphically illustrate the asymptotic stability of the different equilibria of the system and the existence of a positive endemic equilibrium.