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Dynamics of the threshold-delay model of the HIV infection of infants through breastfeeding: control implications.

It is known that the breast milk of HIV infected women contains HIV. And therefore, while breastfeeding contributes significantly to optimization of nutrition and protection against a number of childhood infections, it can also lead to HIV infection of infants. It is important to evaluate the threshold of breastfeeding duration, which can lead to an in-host HIV infection and, subsequently, affect an epidemic in a population. Authors extended a general immuno-epidemiological threshold-delay model given by Qesmi et al. (2015) which incorporated in-host virus dynamics and views the infection process as a series of exposures. The new model depicts an intrinsic virus growth rate as a function of the number of infected females in the population. This allows for a simpler modelling framework which operates in a population of susceptible, exposed and infected infants and infected breastfeeding women, without having to explicitly account for the dynamics of other healthy and infected individuals in the population. The model is reduced to an equivalent state-dependent delay equation model, which is analyzed using stability and numerical bifurcation analysis. One of the most biologically important features of the model is a backward bifurcation, as the result of which a bi-stability between an endemic and the disease-free equilibrium is possible, when the basic reproductive ratio R_0 is less than one. Additionally, from the numerical simulations and bifurcation analysis, it is evident that the in-host dynamics parameters determine whether a backward bifurcation is possible.