Stability analysis of an epidemic model with boosting of immunity

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We revisit a classical epidemic model formulated by Aron [1]. In the model it is assumed that individual immunity wanes and is boosted by natural exposure to infected individuals, thus the immunity period is variable depending on the number of infected individuals. Assuming that the force of infection depends on the number of infected individuals, differently from the assumption in [1], we reformulate a nonlinear Aron epidemic model by a system of delay differential equations (see also [2]) and analyze qualitative aspects of the mathematical model. We deduce a characteristic equation to study asymptotic stability of the endemic equilibrium. We visualize stability boundaries of the endemic equilibrium in a parameter plane, which shows that the equilibrium can be unstable. We discuss the disease transmission dynamics, paying attention to cyclic outbreaks induced by boosting of immunity.

References

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