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Backward bifurcation for some general recovery functions

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Abstract

We consider an epidemic model for the dynamics of an infectious disease that incorporates a nonlinear function $h(I)$, which describes the recovery rate of infectious individuals. We show that in spite of the simple structure of the model, a backward bifurcation may occur if the recovery rate $h(I)$ decreases and the velocity of the recovery rate $\frac{dh(0)}{dI}$ is below a threshold value in the beginning of the epidemic. These functions would represent a weak reaction or slow treatment measures because, for instance, of limited allocation of resources o sparsely distributed populations. This includes commonly used functionals, as the monotone saturating Michaelis–Menten, and non monotone recovery rates, used to represent a recovery rate limited by the increasing number of infected individuals. We are especially interested in control policies that can lead to recovery functions that avoid backward bifurcation. Copyright © 2016 John Wiley & Sons, Ltd.

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