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Diseases with chronic stage in a population with varying size. (English) Zbl 1012.92024
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Summary: An epidemiological model of hepatitis C with a chronic infectious stage and variable population size is introduced. A non-structured baseline ODE model which supports exponential solutions is discussed. The normalized version where the unknown functions are the proportions of the susceptible, infected, and chronic individuals in the total population is analyzed. It is shown that sustained oscillations are not possible and the endemic proportions either approach the disease-free or an endemic equilibrium. The expanded model incorporates the chronic age of the individuals.

Partial analysis of this age-structured model is carried out. The global asymptotic stability of the infection-free state is established as well as local asymptotic stability of the endemic non-uniform steady state distribution under some additional conditions. A numerical method for the chronic-age-structured model is introduced. It is shown that this numerical scheme is consistent and convergent of first order. Simulations based on the numerical method suggest that in the structured case the endemic equilibrium may be unstable and sustained oscillations are possible. Closer look at the reproduction number reveals that treatment strategies directed towards speeding up the transition from acute to chronic stage in effect contribute to the eradication of the disease.

MSC:

- 92C60 Medical epidemiology
- 34D23 Global stability of solutions to ordinary differential equations
- 92C50 Medical applications (general)
- 34D05 Asymptotic properties of solutions to ordinary differential equations
- 34C60 Qualitative investigation and simulation of ordinary differential equation models
- 92-08 Computational methods for problems pertaining to biology

Cited in **25** Documents

Keywords:

chronic stages; variable infectivity; disease-age structure; hepatitis C; variable population size; difference scheme; numerical methods; sustained oscillations

Full Text: [DOI](#)

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