Thieme, Horst R.

Epidemic and demographic interaction in the spread of potentially fatal diseases in growing populations. (English) Zbl 0782.92018

Math. Biosci. 111, No. 1, 99-130 (1992).

Summary: The spread of a potentially fatal infectious disease is considered in a host population that would increase exponentially in the absence of the disease. Taking into account how the effective contact rate $C(N)$ depends on the population size N, the model demonstrates that demographic and epidemilogical conclusions depend crucially on the properties of the contact function C. Conditions are given for the following scenarios to occur:

(i) the disease spreads at a lower rate than the population grows and does not modify the population growth rate; (ii) the disease initially spreads at a faster rate than the population grows and lowers the population growth rate in the long run and the following three subscenarios are possible: (iia) the population still grows exponentially, but at a slower rate; (iib) population growth is limited, but the population size does not decay; (iic) population increase is converted into population decrease.

MSC:

92D30	Epidemiology	Cited in **1** Review
34D05	Asymptotic properties of solutions to ordinary differential equations	Cited in **45** Documents

Keywords:

demographic interactions; exponential growth; population-size dependent contact rates; spread of a potentially fatal infectious disease; population growth rate

Full Text: DOI

References:

[1] Anderson, R.M., Parasite pathogenicity and the depression of host population equilibria, Nature, 279, 150-152, (1979)

[2] Anderson, R.M., Transmission dynamics and control of infectious diseases, (), 149-176

[3] Anderson, R.M.; May, R.M., Population biology of infectious diseases, Nature, 280, 361-367, (1979), Part I

[4] Anderson, R.M.; Gupta, S.; May, R.M, Potential of community-wide chemotherapy or immunotherapy to control the spread of HIV-1, Nature, 350, 356-359, (1991)

[5] Brauer, F., Models for the spread of universally fatal diseases, J. math. biol., 28, 451-462, (1990) · Zbl 0718.92021

[6] Brauer, F., Models for the spread of universally fatal diseases, (), 57-69, Part II · Zbl 0737.92014

[7] Busenberg, S.; Cooke, K.L.; Thieme, H.R., Demographic change and persistence of HIV / AIDS in a heterogeneous population, SIAM J. appl. anal., 51, 1030-1052, (1991) · Zbl 0739.92014

[8] Busenberg, S.; van den Driessche, P., Analysis of a disease transmission model in a population with varying size, J. math. biol., 29, 257-270, (1990) · Zbl 0725.92021

[9] Busenberg, S.; Hadeler, K.P., Demography and epidemics, Math. biosci., 101, 63-74, (1990) · Zbl 0751.92012

[10] Castillo-Chavez, C.; Cooke, K.L.; Huang, W.; Levin, S.A., On the role of long incubation periods in the dynamics of acquired immunodeficiency syndrome (AIDS). part I: single population models, J. math. biol., 27, 373-398, (1989) · Zbl 0715.92029

[11] Castillo-Chavez, C.; Cooke, K.L.; Huang, W.; Levin, S.A., On the role of long incubation periods in the dynamics of acquired immunodeficiency syndrome (AIDS). part II: multiple group models, (), 200-217

[12] Cowen, R., Mathematical model stirs AIDS controversy, Science news, 189, 199, (1991)

[13] Hadeler, K.P., Modeling AIDS in structured populations, Proceedings of the 47th session of the international statistics institute, book 1, Paris 1989, Bull. inst. internat. statist., 53, 83-99, (1989)

[14] Hadeler, K.P.; Waldstätter, R.; Wörz-Busekros, A., Models for pair formation in bisexual populations, J. math. biol., 26, 635-649, (1988) · Zbl 0714.92018

[15] J. A. P. Heesterbeek and J. A. J. Metz, The saturating contact rate in marriage- and epidemic models (preprint). · Zbl 0770.92021

[16] Holling, C.S., The functional response of invertebrate predators to prey density, Mem. ent. soc. Canada, 48, (1966)

[17] May, R.M.; Anderson, R.M.; McLean, A.R., Possible demographic consequences of HIV / AIDS: part I. assuming HIV infection always leads to AIDS, Math. biosci., 90, 475-505, (1988) · Zbl 0673.92008

[18] May, R.M.; Anderson, R.M.; McLean, A.R., Possible demographic consequences of HIV / AIDS. part II. assuming HIV infection does not necessarily leads to AIDS, (), 220-245 · Zbl 0697.92018

[19] Pugliese, A., Population models for diseases with no recovery, J. math. biol., 28, 65-82, (1990) · Zbl 0727.92023

[20] A. Pugliese, An \textit{S} $\to$ E $\to$ I epidemic model with varying population size (preprint). · Zbl 0735.92022

[21] H. R. Thieme, Persistence under relaxed point-dissipativity (with applications to an epidemic model) \textit{SIAM J. Math. Anal.} (to appear).

[22] H. R. Thieme and C. Castillo-Chavez, How may infection-age dependent infectivity affect the dynamics of HIV / AIDS? (preprint). · Zbl 0811.92021