Bull Math Biol (2016) 78:2427–2454
DOI 10.1007/s11538-016-0227-4

Society for Mathematical Biology

ORIGINAL ARTICLE

A Network Epidemic Model with Preventive Rewiring: Comparative Analysis of the Initial Phase

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Received: 22 March 2016 / Accepted: 17 October 2016 / Published online: 31 October 2016

Abstract This paper is concerned with stochastic SIR and SEIR epidemic models on random networks in which individuals may rewire away from infected neighbors at some rate ω (and reconnect to non-infectious individuals with probability α or else simply drop the edge if $\alpha = 0$), so-called preventive rewiring. The models are denoted SIR-ω and SEIR-ω, and we focus attention on the early stages of an outbreak, where we derive the expressions for the basic reproduction number R_0 and the expected degree of the infectious nodes $E(D_I)$ using two different approximation approaches. The first approach approximates the early spread of an epidemic by a branching process, whereas the second one uses pair approximation. The expressions are compared with the corresponding empirical means obtained from stochastic simulations of SIR-ω and SEIR-ω epidemics on Poisson and scale-free networks. Without rewiring of exposed nodes, the two approaches predict the same epidemic threshold and the same $E(D_I)$ for both types of epidemics, the latter being very close to the mean degree obtained from simulated epidemics over Poisson networks. Above the epidemic threshold, pairwise models overestimate the value of R_0 computed from simulations, which turns out to be very close to the one predicted by the branching process approximation. When exposed individuals also rewire with $\alpha > 0$ (perhaps unaware of being infected),

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