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## *Pathogenic-dynamic* epidemic agent model with an epidemic threshold

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### Abstract

An agent model of epidemic spreading is proposed. When a susceptible agent is exposed to pathogen levels above its specified infection-tolerance threshold  $F$ , its state changes to infected, where a pathogen is a virus, microparasite, or any other disease-causing organism or material. The spreading sources of pathogens are the agents that are in the infected state. The growth and decay of a pathogen in an infected host obeys a given function,  $f(t)$ . This function increases linearly in the early period of infection  $t_1$ , and then decreases linearly to zero in the latter period  $t_2$ . The simulation results show that as the agent density increases, the model undergoes a phase transition from a local epidemic phase to a pandemic phase. For immobile agents, transition density  $\rho_C$  equals transition density  $\rho_P$  of the corresponding site percolation model. For random-walking agents, the transition density decreases as  $\rho_C(U) \approx \rho_P \times U^{-0.3}$ , where  $U$  denotes the average path length of the walking agent during the period  $(t_1 + t_2)$ . This model provides a reliable alternative to the standard SIR model, which is a simple compartmental model of susceptibility, infection, and pathogen removal. Moreover, it can predict epidemic phenomena using fact-based parameters.

*Keywords:* Attack rate; pathogen shedding; sojourn time of disease; super-spreading.

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### 1. Introduction

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