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Herd Immunity Estimation of Flu-like Disease Spreading in SEIR Population: The Sociophysics Modelling via Monte Carlo Simulation on Discrete-spin model

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In this work, the disease spreading under SEIR framework (susceptible-exposed-infected-recovered) and agent-based model was investigated via discrete magnetic spin and Monte Carlo simulation. The defined systems were two-dimensional square-lattice-like, where the spins (representing susceptible, exposed, infected, and recovered agents) were allocated on lattice sites. Taking flu-like disease as a case study, the latent period was fixed at a quarter of infectious period. Then, the system size, the spin population density, and the infectious period were varied to observe its influence on uninfected population. In the simulation, each spin was randomly allocated on the lattice and interacted with its first and second neighbouring spins for disease spreading. The magnetization profiles, representing normalized agents in each state, were recorded. From the results, good agreement between the simulation and real spreading results was qualitatively evident. The uninfected susceptible (survivor) results can be categorized into 2 distinct phase depending on the values of infectious periods. The critical infectious period, which separates low and high survivor phases, was then extracted and power-law scaled with the population density. With this scaling formalism, one can use for specifying the overcrowd situation that conveys epidemic to pandemic, which may benefit epidemiologists and government for future health related policies issuance and deployment.

Authors: Dr LAOSIRITAWORN, Yongyut; Dr LAOSIRITAWORN, Yongjua (Bureau of Epidemiology, Department of Disease Control, Thailand Ministry of Public Health); Dr LAOSIRITAWORN, Wimalin

Presenters: Dr LAOSIRITAWORN, Yongyut; Dr LAOSIRITAWORN, Yongjua (Bureau of Epidemiology, Department of Disease Control, Thailand Ministry of Public Health); Dr LAOSIRITAWORN, Wimalin

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