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The SIS model for assessment of epidemic control in a social network

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The model of the spreading of an epidemic in the population with a three-level hierarchical structure of interpersonal interactions has been described and investigated numerically [1]. In our model, the influence of routine preventive vaccinations on the spreading of an epidemic was investigated. We found the critical coverage of preventive vaccination , sufficient for suppression of an epidemic. However, the vaccine coverage is very high and strongly increases with infectivity of a disease. Moreover, in the case of broad dispersal of pathogens (*e.g.* as a result of a bio-terrorist attack) the magnitude of the epidemic remains relatively large, even if almost whole population is vaccinated.

Contrary to routine preventive vaccination, target vaccination can give much better results with little demand for vaccines (or antiviral agents [2]), *i.e.* when only the nearest neighbors of ill individuals are vaccinated. An epidemic can be suppressed with a relatively small number of vaccines if new ill individuals are identified quickly enough. Particularly good results can be obtained if the target vaccination starts just after the appearance of the very first cases of infection, *i.e.* in initial stage of an epidemic.

In our model we also investigated the influence of sick leave (which can be treated as a simple method of isolating ill individuals from a part of the population) on the process of an epidemic spread [3]. It turns out that for a critical value of the probability of going on sick leave there is an abrupt decrease in the magnitude of the epidemic. The number of individuals who do not work necessary to suppress the epidemic is very low.

Routine preventive vaccination can be effective only in the case of well-known pathogens (*e.g.* in the case of childhood diseases such as measles). If there is a new pathogen in a susceptible population (as a result of mutation or a bio-terrorist attack), only a quick public health response can provide good results. In such case, the efficiency of target vaccination of the nearest neighbors of ill individuals is high. Removing interpersonal interactions with spatially distant individuals by isolating an ill individual (*e.g.* at home) decreases significantly the number of new sources of the epidemic and is helpful in suppressing the epidemic spread.

Our model provides an opportunity to study the influence of absences from work including preventive closing of workplaces and schools as well as targeted vaccinations on the spread of an epidemic. This is of particular interest since these measures are frequently implemented in practice.

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