

Modelling of healthcare-associated infection spread in networks of healthcare facilities

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A hybrid network/differential model is used for simulations of healthcare-associated infection spread in a regional healthcare systems. The pathogen spread within individual facilities is simulated with a susceptible-infectious-susceptible (SIS) model. These facilities are then coupled by a network model, accounting for admissions, discharges and transfers, which are operated on discrete manner. Such model mimics well the features of the considered system and allows for parallelization of computations. From a mathematical standpoint, such model may be treated as a system of ordinary differential equations with impulses.

In this presentation, two aspects will be discussed. First, there are simulations of the pathogen spread in selected German regions. The network models of these regions are built by analysis of anonymized health-insurance datasets from German insurance companies. With the network structures derived from the data, selected network-level countermeasures for limiting the pathogen prevalence are compared. On the other hand, the model is analyzed by analytical methods on different levels. The basic reproduction numbers are derived and stationary solutions are discussed. In particular, it is the conditions when the disease-free state is stable are determined. The analysis gives some tools, which allows for better understanding of the considered system and which can be used for the network-level strategies for decreasing the prevalence of considered pathogens.