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INVESTIGATION OF THE EFFECTIVENESS OF PREVENTION STRATEGIES AGAINST DRUG-RESISTANT BACTERIA IN THE HEALTHCARE NETWORK

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ABSTRACT

Multidrug-resistant bacterial infections are a problematic kind of healthcare-associated infections (HAI), which spread within the healthcare system due to favorable conditions to develop. Each year over 3.8 million patients acquire HAIs and over 90,000 people lose their lives due to HAIs in the European Economic Area only. Thus, our aim is to propose HAI preventive strategies and evaluate them by the means of numerical simulations. It is the extension of our previous work [1]–[5].

In this study, a few qualitatively different strategies are considered to determine whether it is beneficial to target specific groups of patients in specific hospitals, like patients highly susceptible to HAIs, from the standpoint of lowering the prevalence in the whole healthcare system. This is a theoretical research, based on numerical simulations of a regional network of healthcare facilities. The simulations are based on the deterministic mathematical model of a pathogen spread within a healthcare network. The model includes patient transfers, patient readmissions and stratification of patients into risk groups. Simulations are performed with an open-source library developed within this study, and they use a computer model of Lower Saxony healthcare network, created by the analysis of anonymized insurance records. The simulations are performed under the assumption that individual hospitals have preventive means to reduce HAI transmission, which are not

explicitly stated, but the available funds are insufficient to introduce those means at a sufficient scale to simply eradicate HAIs.

The considered strategies aim at selecting individual hospitals and risk groups to impose those means to effectively reduce healthcare system-level prevalence for the smallest possible cost. If additional funds are low, the efficiency of many strategies is similar, with risk group stratification or not. If funds are very high, then even basic strategies are sufficient to lower the prevalence to a negligible level. Targeting individual groups is more sophisticated, and if the additional costs are moderate, then it is possible to obtain a considerably larger decrease in prevalence for the same cost in comparison to targeting all groups. In addition, targeting only highly susceptible patients does not allow for reducing prevalence to negligible levels. Other groups must also be targeted to reach such a goal.

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