

Optimal control of vaccination rate in an epidemiological model of *Clostridium difficile* transmission

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Abstract The spore-forming, gram-negative bacteria *Clostridium difficile* can cause severe intestinal illness. A striking increase in the number of cases of *C. difficile* infection (CDI) among hospitals has highlighted the need to better understand how to prevent the spread of CDI. We begin by first extending a compartmental model of nosocomial *C. difficile* transmission to include vaccination. From there, we apply optimal control theory to determine the time-varying optimal vaccination rate that minimizes a combination of disease prevalence and spread in the hospital population as well as cost, in terms of time and money, associated with vaccination. Various hospital scenarios are considered, such as times of increased antibiotic prescription rate and times of outbreak, to see how such scenarios modify the optimal vaccination rate. By comparing total costs with a constant vaccination rate to those with a time-varying optimal vaccination rate, we determine in which scenarios a time-varying rate of vaccination would be preferred over a constant one.