The economic burden of *Clostridium difficile*

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Abstract

Although *Clostridium difficile* (*C. difficile*) is the leading cause of infectious diarrhoea in hospitalized patients, the economic burden of this major nosocomial pathogen for hospitals, third-party payers and society remains unclear. We developed an economic computer simulation model to determine the costs attributable to healthcare-acquired *C. difficile* infection (CDI) from the hospital, third-party payer and societal perspectives. Sensitivity analyses explored the effects of varying the cost of hospitalization, *C. difficile*-attributable length of stay, and the probability of initial and secondary recurrences. The median cost of a case ranged from $9179 to $11 456 from the hospital perspective, $8932 to $11 679 from the third-party payor perspective, and $13 310 to $16 464 from the societal perspective. Most of the costs incurred were accrued during a patient's primary CDI episode. Hospitals with an incidence of 4.1 CDI cases per 100 000 discharges would incur costs ≥$3.2 million (hospital perspective); an incidence of 10.5 would lead to costs ≥$30.6 million. Our model suggests that the annual US economic burden of CDI would be ≥$496 million (hospital perspective), ≥$547 million (third-party payer perspective) and ≥$796 million (societal perspective). Our results show that *C. difficile* infection is indeed costly, not only to third-party payers and the hospital, but to society as well. These results are consistent with current literature citing *C. difficile* as a costly disease.

Keywords: Burden, *Clostridium difficile*, cost, economics, stochastic model
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Introduction

Although *Clostridium difficile* (*C. difficile*) is a major nosocomial pathogen and leading cause of infectious diarrhoea in hospitalized patients [1–3], its economic burden has not been fully characterized. Several retrospective studies and one prospective study have examined the healthcare costs of *C. difficile* [1,4–10]. However, these studies explored specific cases or types of patients (e.g. IBS patients, surgical patients, intensive care unit (ICU) patients, or adults in tertiary care hospitals) and therefore may not be generalizable to other hospitals and circumstances. Moreover, their methodologies and included costs varied, as cost evaluation was not a priority for most. Separate systematic reviews by Dubberke *et al.* and Ghantoji *et al.* cite the limitations of these studies and call for a more accurate and comprehensive report of the true economic burden of *C. difficile* infection (CDI) [1,6].

Better understanding of the economic burden of *C. difficile* can assist various decision makers. Hospital administrators, infection control practitioners and policy makers could use this information to determine how much to invest in *C. difficile* prevention and control measures. This information can help policy makers and third-party payers to make insurance coverage and reimbursement decisions. These reimbursement decisions may change as Centers for Medicare and Medicaid Services rules evolve. Manufacturers and drug companies can use such information to develop and price *C. difficile* tests and treatments. We developed an economic computational simulation model to determine the cost of

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healthcare-acquired CDI (for the duration of hospitalization) from the perspective of various decision makers and determine the annual United States (US) burden. Sensitivity analyses varied the key parameters of attributable length-of-stay (LOS), probability of first and second recurrences, and hospitalization cost.

Methods

Using TreeAgo Pro 2009 (Williamstown, MA, USA) we constructed a stochastic computer simulation model to determine the additional costs associated with healthcare-acquired CDI from the hospital, third-party payer and societal perspectives. We also determined the annual burden of hospital-acquired *C. difficile* in US hospitals and across the country. Fig. 1 shows the basic model structure. Patients were the typical age of CDI patients (≥65 years old) [2,11]. An infected patient could have either mild or severe CDI. All patients had a probability of having recurrent CDI over the course of a year. Patients with severe CDI could progress to fulminant *C. difficile*, which required hospitalization in the ICU. Those with fulminant CDI could undergo surgery (i.e. total colectomy) or not undergo surgery, each accompanied with its own probability of death. This first CDI occurrence was experienced by all patients in the model. Recurrences could be either mild or severe, resulting in rehospitalization. Up to two CDI recurrences could occur in 1 year for a total of three possible episodes per patient, resulting in a progressively smaller fraction of patients that experienced any recurrence.

Treatment options differed by disease severity, prior treatments and number of recurrences. Patients with mild

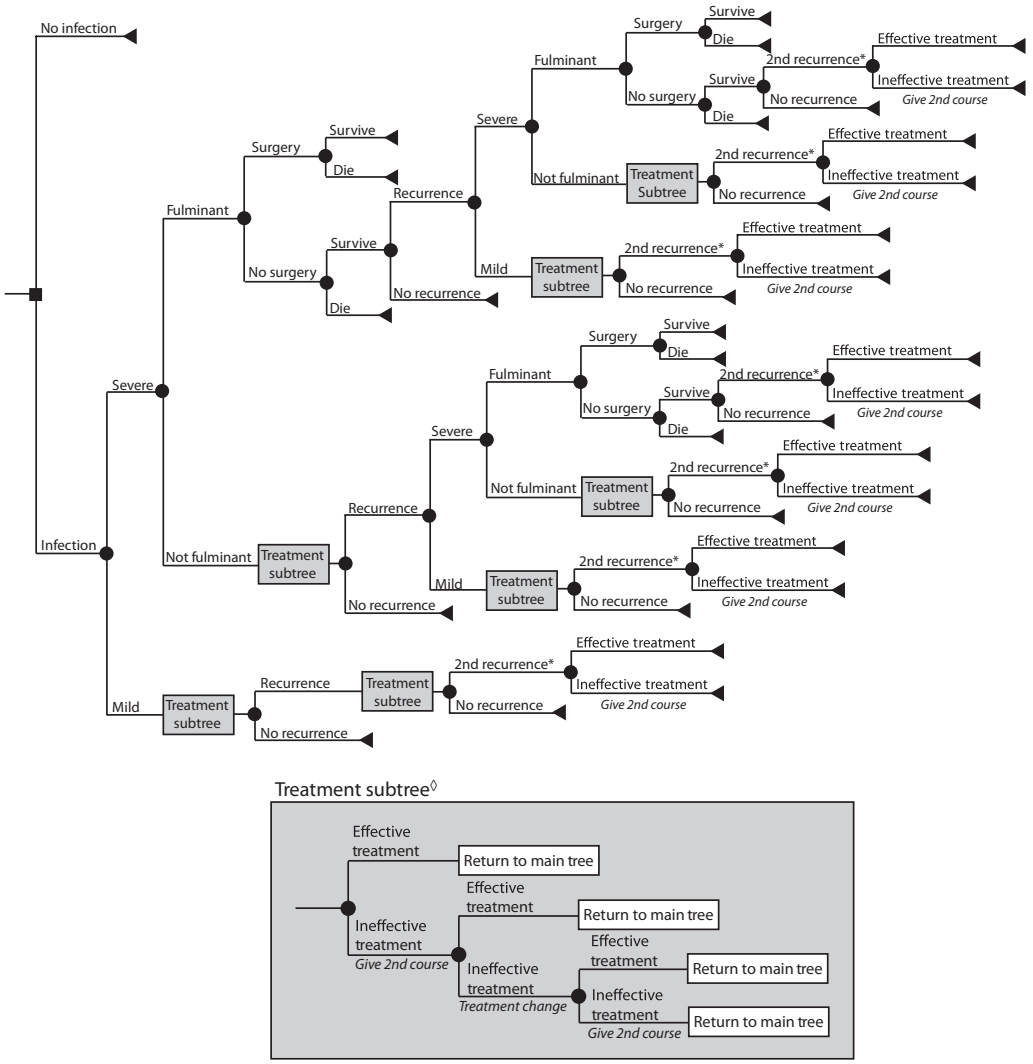

FIG. 1. General decision model tree structure. *Give Tapered Vanomycin. ◊Use treatment strategy that was effective for prior episode. Treatment change: from metronidazole to vancomycin; no treatment change for vancomycin.

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