Excess Length of Stay Attributable to Clostridium difficile Infection (CDI) in the Acute Care Setting: A Multi-State Model

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Background
- Clostridium difficile infection (CDI) is one of the leading hospital acquired infections and is associated with 10 to 25% of all cases of antibiotic-associated diarrhea1.
- Incidence of CDI has been increasing over the last decade, coinciding with the expansion of healthcare resource use attributable to infection.
- Studies that do not account for the timing of infection overestimate attributable length of stay (LOS).

Objective
- The purpose of this study was to evaluate the excess LOS due to CDI using a multi-state model.

Methods

Study Design
- Retrospective cohort study of all patients hospitalized within the US Department of Veterans Affairs (VA) health care system between January 1, 2005 and December 31, 2012.
- Inclusion criteria: All patients between the ages of 18 to 89 years who were admitted to a VA hospital and had a CDI infection (defined as the day of positive CDI test) during the study period.

Study Data
- A diagnosis of CDI was based on a positive laboratory result by enzyme immunoassay, cytotoxin test, or PCR. Only the first CDI during each hospitalization was included.
- Information was collected on patient age at admission, gender, year of admission, any ICU stay, census region and facility characteristics such as teaching status, and VA location.

Methods
- A multi-state approach, implemented through the etm package in R, was used to estimate the excess LOS attributable to CDI while accounting for the timing of infection (defined as the day of positive CDI test).
- 95% confidence intervals (CI) were obtained using bootstrapping techniques.
- A composite outcome of death or discharge was used.
- More than 150 Beds: 2.97 (2.62 – 3.38)
- Northeast US Census Region: 2.26 (2.14 – 2.40)
- Female: 1.98 (1.43 – 2.75)
- Age at Admission: <65 Years: 2.38 (2.14 – 2.61)
- Randomized Controlled Trial

Results
- During the study period, 3.89 million Veterans were followed for more than 2005 and 2012 patient-days of observation.
- One or more CDIs were observed in 1.1% (43,540) of hospitalizations.
- During the study period, 3.96 million Veterans were followed for more than 21 million patient-days of observation.
- One or more CDIs were observed in 1% (43,540) of hospitalizations.
- The excess LOS attributable to CDI was 2.27 days (95% CI 2.14 – 2.40) overall.
- The crude difference (i.e., difference between medians) in LOS between patients with CDI and those without was 8.0 days (p < 0.0001).
- The attributable excess LOS near 14.0 days.
- Comparing the timing of infection in a multi-state model, the attributable LOS was estimated to be 2.7 days (95% CI 2.14 – 2.40).

Conclusions
- CDI is a significant contributor to LOS in the acute care setting.
- Methods that account for the timing of infection result in substantially smaller estimates of excess LOS.
- Future studies of CDI should be based on more accurate measures of attributable LOS to avoid overstating the cost of CDI and the benefits of interventions to reduce CDI.

References
5. Emerging infectious diseases.