Rhode Island *Clostridium difficile* Infection Trends and Laboratory ID Events Ranking

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In January 2013, the Centers for Medicare & Medicaid Services [CMS] began requiring acute-care hospitals to submit any laboratory-identified (“LabID”) *Clostridium difficile* cases to the Centers for Disease Control and Prevention’s surveillance system, the National Healthcare Safety Network [NHSN].\(^1\) By collecting data from acute-care hospitals across the nation, Medicare was able, for the first time, to systematically assess the burden of *C. difficile* nationwide and to publicly report LabID incidence on Hospital Compare.\(^2\)

CMS’s requirement to collect *C. difficile* surveillance data reflects the fact that *C. difficile* infection (CDI) is a high public health priority—both because of the impact on patients, who suffer diarrhea due to mucosal inflammation and damage\(^3\) and because it is the most common healthcare-associated infection [HAI].\(^1,4,5\) In 2011, there were 383,498 cases of CDI at hospital discharge in just 36 states with available data.\(^6\)

The cost of an inpatient CDI is more than $35,000 and estimates of annual medical costs exceed $3 billion nationally.\(^1\)

The recent inclusion of CDI LabID data in Hospital Compare provides an opportunity to assess Rhode Island’s performance. The objectives of this analysis were to: [1] describe RI’s longitudinal trends in CDI using available historical data, and [2] compare RI’s performance to neighboring states and the nation, using the newly-available LabID events data.

**METHODS**

**Data sources**

We used two data sources: [1] Healthcare Cost and Utilization Project (HCUP) data from 2002 to 2012, which includes CDI, and [2] Hospital Compare data for the first quarter of 2013, which includes LabID events. Of note, these two data sources use different measures of *C. difficile*: CDI is based on clinical diagnosis, whereas LabID events do not distinguish between *C. difficile* colonization and infection. As a result, LabID events overestimate the true CDI infection rate.\(^7\)

HCUP databases are sponsored by the Agency for Healthcare Research and Quality and include longitudinal administrative data [inpatient, ambulatory surgery, and emergency department] for all patients, regardless of payer.\(^8\)

Hospital Compare includes data on care processes and outcomes for selected conditions, and patient experience with care.\(^2\) CMS requires the acute-care hospitals that participate in the Inpatient Prospective Payment System [IPPS] to submit select data, including *C. difficile* LabID event, and penalizes facilities that fail to comply. We downloaded the most recently available data [Q1 2013], which includes standardized infection ratios [SIRs]\(^2\) comparing each hospital’s and state’s observed number of infections to the predicted number of infections, estimated using regression models based on data from 2010-2011.\(^2\) SIRs are summary measures used to track and compare HAIs at the facility, state and national levels. If the upper limit of the SIR 95% confidence interval [CI] is less than 1.0, the infection rate is better than predicted; if the 95% CI includes 1.0, it is the same as predicted; if the lower limit of the 95% CI is greater than 1.0, it is worse than predicted.

**Statistical Analyses**

We used HCUP to query the number of CDIs by primary or secondary *C. difficile* diagnosis [ICD-9-CM code 008.45] and the number of hospital discharges. We calculated CDI rates (the number of infections per 1,000 hospital discharges) from 2002-2012 for Rhode Island, the two neighboring states with available data [Massachusetts and Vermont] and the U.S. as a whole, and then graphed these results. We also downloaded *C. difficile* LabID event SIRs from Hospital Compare and used Geographic Information System 10.2 [Environmental Systems Research Institute, Inc., Redlands, CA] software both to rank the 50 states and D.C. and to map the rankings.

**RESULTS**

HCUP data reveal that the rate of CDI [listed as any diagnosis in administrative data] in Rhode Island increased more than three-fold over the past decade [5.21 per 1,000 discharges in 2002 vs. 18.87 per 1,000 in 2012], outpacing national trends and neighboring states [Figure 1]. In comparison, CDI slightly increased in Massachusetts, Vermont, and U.S. between 2002 and 2011.

In the first quarter of 2013, RI ranked 51st among the 50 States and Washington, D.C., for *C. difficile* LabID SIRs [Figure 2]. There were 19 states with upper limits of 95% CI of the SIR below 1.0 [i.e., better than the U.S. average], 22 states with 95% CI of the SIR crossing 1.0 [i.e., same as U.S. average]; and 10 states, RI, AZ, NM, MD, NV, NJ, VA, NY, CA, and MA with lower limits of 95% CI of the SIR above 1.0 [i.e., worse than U.S. average].
The SIRs display some region clustering, with the highest (worst) SIRs in the Northeast (VA, MD, D.C., DE, NJ, NY, RI) and West (NV, AZ, NM, CO) (Figure 3). The states with the 10 lowest (best) rankings were more widespread and included states in the Midwest (ID, SD, NE), South (LA, MS, AL) and elsewhere (VT, ME, AK, HI). In New England, VT and ME were better than the U.S. as a whole; NH and CT were same as U.S.; and MA and RI were worse than U.S. (Table 1), first quarter of 2013.

**DISCUSSION**

Between 2002 and 2012, CDI increased throughout the U.S., but the increase was greater in RI compared to other New England states (MA and VT) and the U.S. as a whole. In the first quarter of 2013, RI ranked 51st among the 50 States and D.C. for *Clostridium difficile* LabID SIRs. The highest (worst) *C. difficile* LabID SIRs are in the Northeast and West.

CDI is spread by the fecal-oral route and is strongly associated with antibiotic overuse; widespread use of broad-spectrum antibiotics is a likely contributor. A resistant strain of *C. difficile* (BI/NAP1/027) appeared in 2004. This strain is associated with more severe clinical outcomes and may be contributing to the rapid global spread of CDI and the increasing trends we noted between 2002 and 2012. Robust antibiotic stewardship programs can reduce CDI risk. Although all RI hospitals have antibiotic stewardship programs in an effort to reduce targeted antibiotic use, none have a full-time physician or infectious diseases-trained pharmacist whose sole responsibility is to manage an antibiotic stewardship program, as is done in some hospitals around the country. It may be that the thin profit margin of hospitals in RI compared to other states has limited the resources needed to further control CDI.

Elderly patients and those with comorbidities are the most affected by CDI. Over two-thirds of patients with CDI are 65 years of age or older and nearly 90% of CDI deaths are in elderly persons. This may partially explain the regional trends we noted because the Northeast has the highest proportion of the population at least 65 years of age (14.1%) and at least 85 years of age (2.2%) in the U.S. based on 2010 census data. More specifically, RI has a higher proportion of the population 65 years of age and older (14.4% in RI vs. 13.0% on average in the U.S.), and a higher proportion of those 85 years of age and older (2.5% in RI vs. 1.8% on average in the U.S.).

Although the CDC uses a regression model to risk-adjust the Hospital Compare data based on numerous factors, including hospital bed size, medical school affiliation, admission prevalence rate of community-onset *C. difficile* LabID events, and the test type used to detect *C. difficile* in stool, HCUP does not adjust for the diagnostic test type and it is important to note that the various tests have differing sensitivities. Possibly unlike any other states, 100%...
of RI hospitals currently use the most sensitive CDI diagnostic testing method, nucleic acid amplification test (NAAT) testing. Ten of 11 hospitals in RI switched to NAAT from other test types over the past few years and, if these changes occurred more rapidly and uniformly than in other states, this may partially account for some of the difference in rates of CDI or C. difficile LabID events in RI compared to other states or national benchmark data. Although the CDC risk adjusts for diagnostic test method used, it is unclear if this is robust enough to address what is likely a statewide difference from other states or to account for facilities’ changes in tests over time.

We note several additional limitations. First, HCUP uses administrative data that is collected for billing purposes and may not accurately measure HAIs. Second, HCUP data cannot distinguish community-onset CDI from hospital-onset CDI, so we are unable to attribute infections to hospital care. Third, HCUP data for CDI are limited to 37 states and some states are missing data for one or more years. There is no CDI data for CT, precluding us from comparing RI against both adjacent states [MA and CT]; ME does not have data for 2004 and 2005, and NH does not have data for 2002 and 2010-2012. Finally, we have only a single quarter of Hospital Compare data (Q1 2013) and are therefore unable to assess longitudinal trends or to compare CDI and C. difficile LabID estimates for the same time period.

These findings highlight the need to focus additional financial and human resources on reducing CDI. Although wearing gowns and gloves when entering the room of a patient with CDI and rigorous environmental cleaning of their room can decrease C. difficile transmission by 20%, such interventions require sufficient staffing [e.g., to perform rigorous daily and discharging cleaning] and, in some cases, costly adjunctive measures [e.g., the use of portable robotic ultraviolet lights and hydrogen peroxide vapor to disinfect rooms when terminally cleaned]. In RI hospitals, infection preventionists are now responsible not only for providing education and leading multi-disciplinary interventions across the hospital, but also for conducting surveillance and reporting results to the CDC and elsewhere. Additional resources may help to improve our state’s C. difficile performance relative to past trends and our peers.

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**Disclosure**

The authors have no financial interests to disclose.

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