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Brief Report

Using public health surveillance data to measure *Clostridium difficile* infection population burden in Massachusetts

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A B S T R A C T

Clostridium difficile occurs both inside and outside of health care facilities, but surveillance has been traditionally limited to the hospital setting. To measure the population-based burden of *C difficile* infection (CDI), we used multiple routine sources of data. We found an overall rate of CDI in Massachusetts in 2016 of 132.5 per 100,000 population, with mortality in 2014 of 6.4 per 100,000 population. Population-based measurement of CDI burden appears feasible without conducting a special study.

Clostridium difficile is an anaerobic, spore-forming, toxin-producing, gram-positive bacillus. *C difficile* infection (CDI) is a leading health care–associated infection in the United States.[1] In both community and hospital settings, CDI is costly: the mean CDI-attributable costs per case were $21,448 with community onset and $42,316 with hospital onset.[2]

Public health authorities need measures of burden of disease to guide prioritization of limited resources. However, resources for conducting special studies are limited. Using surveillance data from multiple sources—the Massachusetts Virtual Epidemiologic Network (MAVEN) for electronic 2016 laboratory reports,[3] 2016 National Healthcare Safety Network (NHSN) data, and 2014 mortality records, anchored by the NHSN as the gold standard source—we describe the burden of CDI in Massachusetts.

METHODS

We used 3 sources of data. The first was MAVEN, a fully integrated infectious disease surveillance and case management system, which receives all available laboratory tests to detect evidence of the presence of *C difficile* and its toxins (nucleic acid amplification test, enzyme immunoassay, glutamate dehydrogenase assay, cytotoxin neutralization, and culture results).

Individual disease events are automatically created from real-time electronic laboratory feeds, with more than 96% of hospital clinical laboratories reporting directly into MAVEN. We defined a "case" of CDI as a positive *C difficile* toxin assay or a positive *C difficile* molecular assay (eg, polymerase chain reaction) from a stool specimen collected between January and December 2016 from a resident of Massachusetts. For cases with more than 1 laboratory test result, we counted the first test result reported during 2016. In this case, we selected the nucleic acid amplification test.

Second, we used NHSN data to measure CDI in 2016. NHSN is a national reporting system used by all acute care hospitals in Massachusetts to track health care–associated infections using standardized protocols and case definitions. One of the methods used by NHSN to monitor CDI is through reported laboratory events (LabID).[4] We used the NHSN LabID results from community-onset and health care–onset infections in 2016 regardless of onset setting and counted individuals once. Neither MAVEN nor NHSN include clinical evaluation of patients, but both count events at the person level for a calendar year.

Finally, using 2010 census data, all deaths in Massachusetts were reported to the Massachusetts Registry of Vital Records. The mortality data were obtained from death certificates by using the multiple cause of death file from 2014 using the ICD-10–A04.7 code (enterocolitis owing to *C difficile*).

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RESULTS

In 2016, there were 12,911 laboratory results for any of the *C difficile* tests reported to MAVEN. Of all tests reported, polymerase chain reaction was the most common, followed by enzyme immunoassay and glutamate dehydrogenase; the remaining 2 tests (neutralization and culture) totaled less than 1% (Table 1).

In 2016, 8,679 unique people were reported with CDI laboratory results. The overall rate of public health surveillance–ascertained CDI in Massachusetts during 2016 was 132.5 cases per 100,000 population (Table 2). Overall, the rate was higher among women than men and highest among people 75 years and older. Furthermore, there was variability by sex within age groups. Among people 75 years and older, the rate was higher among men than women. Among all other age groups, rates were higher among women.

In NHSN, 7,728 *C difficile* laboratory-based events were reported. Of these, 55.6% (4,298) were women; the median age was 67 years (25% = 53 years; 75% = 80 years). Most (81.5%) were identified as inpatients.

In Massachusetts during 2014, 293 deaths were reported with CDI listed among the causes of death, for an overall crude mortality rate of 6.4 per 100,000 population. Rates were highest among people 75 years and older (45.2 per 100,000), followed by people 55-74 (5.7) and 25-54 (0.5) years of age. Mortality rates were similar between women and men.

DISCUSSION

We found that in 2016, nearly 9,000 people in Massachusetts may have had CDI and that the rate of CDI would then be 132.5 per 100,000 population. This rate is consistent with the estimated national rate from 2011 of 147.2 per 100,000 population[5]; applied to the population of Massachusetts, this would yield about 9,600 cases. Our study indicates that the routine laboratory reporting infrastructure (electronic laboratory reporting and NHSN LabID reporting) for surveillance can accurately measure population burden of CDI with limited surveillance resources.

Routine measurement of the burden of CDI can help target prevention programs and evaluate their effect. Long-term care (LTC) providers receive patients with CDI and face the challenge of preventing transmission in their facilities.[6,7] In addition to conducting education of LTC staff, Massachusetts will use surveillance data to evaluate antibiotic stewardship and CDI prevention.[8]

It is likely that the number of cases measured by MAVEN exceeded those in NHSN because MAVEN includes more outpatient testing as well as cases tested in LTC facilities. Our use of vital records to measure the burden of CDI-related mortality might have underestimated the burden. Applying the national rate for combined community-associated and health care–associated CDI deaths from Lessa et al[5] to the population of Massachusetts would yield an expected 629 deaths. Our vital records identified under half of these, even though we included primary or contributing causes of death, suggesting that an evaluation of underascertainment of deaths is warranted.

Surveillance data and definitions may not match results of clinical studies and diagnoses of CDI. In addition, we used laboratory results, which, without clinical data, might represent colonization and overestimate disease. The NHSN protocol requires testing unformed stools, but MAVEN does not. Finally, we did not determine whether infections were health care associated or community associated. Our objective was to use routinely reported laboratory tests to understand the burden of disease in the population. Continued monitoring and reporting will support antibiotic stewardship efforts.

Not unexpectedly, CDI represents a significant burden on the Massachusetts health care system, and routine, relatively low-cost surveillance methods can be useful in measuring CDI burden. Future studies should describe frequencies of recurrent CDI, distinguish health care–associated and community-associated CDI, quantifying and providing feedback reports of CDI to LTC facilities, investigate comorbidities, and determine indirect costs from a societal perspective. Additional health-economic studies for CDI preventive intervention are needed, and population-based data can inform such studies.

Table 1
Number and percentage of *Clostridium difficile* infection–related tests reported in the Massachusetts Virtual Epidemiologic Network by test (Massachusetts, 2016)

Test	No. reported	Percentage reported
NAAT assay (PCR)	7,757	60.08
EIA	4,405	34.12
GDH assay	657	5.09
Cytotoxin neutralization	58	0.45
Culture	34	0.26
Total	12,911	100.00

EIA, enzyme immunoassay; *GDH*, glutamate dehydrogenase; *NAAT*, nucleic acid amplification test; *PCR*, polymerase chain reaction.

Table 2
Number and rate of *Clostridium difficile* infection by sex and age group (Massachusetts, 2016)

Age group	No. female sex	No. male sex	Total
	(rate per 100,000)	(rate per 100,000)	(rate per 100,000)
<5 y	62 (78.01)	60 (31.99)	122 (33.24)
5-24 y	221 (25.86)	154 (17.62)	375 (21.68)
25-54 y	1,217 (86.80)	855 (63.69)	2,072 (75.50)
55-74 y	1,825 (274.02)	1,519 (255.81)	3,344 (265.44)
≥75 y	1,662 (596.22)	1,102 (657.89)	2,764 (619.37)
Total	4,987 (147.51)	3,690 (116.53)	8,679 (132.53)

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