

TECHNICAL NOTES

Clostridium difficile Infections in California Hospitals, 2014

Introduction

Clostridium difficile (*C. difficile*) is a common cause of diarrhea in health care settings, resulting in longer hospital stays and higher hospital costs [1-4]. Morbidity and mortality rates due to *Clostridium difficile* infection (CDI) have increased over the past several years as a result of the emergence of *C. difficile* strains that are more infectious and more virulent [5-8]. Infection control precautions including hand hygiene and environmental cleaning are essential in preventing transmission. Most patients with CDI received antibiotics between two weeks and three months prior to the infection; therefore, judicious use of antibiotics is also important in decreasing and preventing CDI [5-7, 10].

California Health and Safety Code section 1288.55(a)(1) requires general acute care hospitals to report to the California Department of Public Health (CDPH) all cases of CDI identified in their facilities. CDPH produces these *Technical Notes* to describe the definitions, methods, and limitations associated with the release of CDI data for the reporting period January through December 2014. CDI data were submitted by California hospitals to the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN) and accessed by CDPH to produce this report.

Methods

Reporting hospitals

In 2014, CDPH identified 392 licensed general acute care hospitals representing 419 physical campuses with active acute care beds that operated continuously (for the full 12 months) during the reporting period. Of these, 25 reporting entities had more than one campus associated with its license and 367 reported separately. In total, there were 392 reporting entities, hereafter referred to as hospitals.

Table A. General Acute Care Hospitals with Active Beds, 2014

| | Reporting Entities | Number of Campuses |
|------------------------------------|---------------------------|---------------------------|
| Hospitals that reported separately | 367 | 367 |
| Hospitals that reported together | 25 | 52 |
| Total | 392 | 419 |

Data sources

California hospitals submitted CDI data into NHSN using the surveillance and reporting protocols described in the Multidrug Resistant Organism (MDRO) Laboratory-Identified (LabID) Event Module [11]. Hospitals provided CDPH with electronic permission to access these data. On May 04, 2015, we accessed the NHSN CDI data for the reporting period January 1, 2014 through December 31, 2014. The data included NHSN-produced files including the number of CDI LabID events, the number of inpatient days (excluding NICUs and well-baby nurseries), CDI predicted and standardized infection ratio and rates (SIR and rate files), and the CDI test type as reported quarterly (March, June, September, and December) and yearly on the annual survey.

Missing data

In some cases, hospitals did not report CDI LabID events and the corresponding monthly counts of inpatient days for 12 months. We excluded from this analysis hospitals that reported CDI LabID events and inpatient days for less than 12 months. Also, excluded were data from one hospital that misreported their inpatient days as 0 for most months of the year, and one hospital that failed to report their CDI test type quarterly, both of which resulted in SIR calculations based on less than 12 months of data. Therefore, 6 of 392 (1.5%) hospitals were defined as incomplete reporters with less than 12 months of complete data. The six hospitals are shown in CDI Table 4.

Definitions

CDPH requires hospitals to comply with NHSN surveillance and reporting protocols, including NHSN standardized definitions. Key definitions are defined here.

- A **C. difficile LabID event** is a positive result for a laboratory assay for *C. difficile* toxin A and/or B or a toxin-producing *C. difficile* organism detected in stool sample. This included laboratory tests positive for *C. difficile* from all available inpatient locations, excluding neonatal intensive care units (NICUs) and well-baby nurseries.
- **Community-onset (CO)** is a LabID event specimen collected as an outpatient or an inpatient less than or equal to 3 days after admission to the facility (i.e., days 1, 2, or 3 of admission).
- **Hospital onset (HO)** is a LabID event that occurs more than three days after admission to the facility (i.e., on or after day four), excluding NICUs and well-baby nurseries.
- **Inpatient days** are the cumulative numbers of patients hospitalized each day during the reporting period, excluding NICUs and well-baby nurseries.
- **Polymerase chain reaction (PCR)** is a type of nucleic acid amplification test that detects *C. difficile* toxin gene(s); it is commonly referred to as a molecular test method. Advantages for this laboratory test method are the high sensitivity (the ability of the test to detect *C. difficile* when present) and short turn-around time compared to other methods [7].
- A **long-term acute care (LTAC)** is a hospital defined by the Centers for Medicare & Medicaid Services (CMS) as a licensed general acute care hospital providing care for patients with medically complex conditions requiring an average length of stay for all patients of greater than 25 days [12]. California LTAC hospitals were identified through CMS and assessments by HAI Program staff.
- A **rehabilitation hospital** is a hospital with inpatient wards for evaluation and restoration of function to patients who have lost function due to acute or chronic pain, musculoskeletal problems, stroke, or catastrophic events resulting in complete or partial paralysis. These hospitals were self-identified through NHSN.
- The **reporting period** was January 1, 2014 through December 31, 2014.

Quality assurance and control

Hospital personnel were solely responsible for the quality and completeness of their CDI data. In September and November 2014 and March and April 2015, CDPH distributed quality assurance and control reports that identified missing, incomplete, or potentially aberrant data for the reporting period. CDPH made available to hospitals the assistance of data managers, epidemiologists, and regional infection prevention staff to help resolve NHSN enrollment or reporting issues. Additionally, in March and April 2015 we emailed hospitals with fewer than 12 months of data or with missing or incomplete Annual Hospital Survey to notify them of missing or incomplete data in NHSN. We encouraged hospitals to conduct a final review of their data and complete all corrections and changes before the final data download on May 04, 2015.

Validation

In 2014, CDPH validation efforts helped hospitals assess and improve case-finding and evaluate completeness in identifying and reporting CDI. Smaller volume hospitals performed a self-review process using a validation workbook and reported results electronically to CDPH. In smaller volume hospitals, 578 out of 629 identified CDI were reported, for a sensitivity of 92% (89%, 94%). Validation at larger volume hospitals consisted of onsite visits by HAI Program Liaison Infection Preventionists. In larger volume hospitals, 3460 out of 3731 identified CDI were reported, for a sensitivity of 93% (92%, 94%).

Data presentation and statistical analyses

A. General acute care hospitals (other than LTAC and rehabilitation hospitals):

In Table 1, we present hospital specific CDI Standardized Infection Ratios (SIRs) and 95% confidence interval (CI) for general acute care hospitals other than LTAC and rehabilitation acute care hospitals. The NHSN SIR compares the reported number of HO incident cases with the predicted (expected) number based on the national baseline data, adjusting for the significant risk factors such as quarterly CDI test type, CO admission prevalence rate, facility bed size, and medical school affiliation [13]. Quarterly reports of CDI test type are used in the SIR risk adjustment beginning with 2014 data [14]. Adjusting for these factors provides for a more fair comparison of hospitals' infections to the predicted. For more precise comparisons, NHSN provides a SIR only when at least one infection is predicted. National baseline data was defined as the CDI data reported from hospitals as in-plan data in each month's Patient Safety Monthly Reporting Plan during 2010-2011. If an SIR was generated for a hospital, the calculated 95% confidence interval determines if the observed number of infections was significantly different from predicted. If the confidence interval includes the value of one, then the SIR is not statistically significant. Based on the 95% confidence intervals, we labeled each SIR as indicating either: N (no difference in number of observed and predicted infections), H (more infections than predicted), or L (fewer infections than predicted). The 95% confidence interval is a range of values that includes the estimated SIR, knowing that the reported SIR in Table 1 is the most likely value.

B. LTAC and rehabilitation hospitals:

In Table 2 and 3, we report the following primary CDI measures: number of HO CDI LabID events, inpatient days, unadjusted HO CDI rates per 10,000 inpatient days, and 95% confidence intervals assuming an exact Poisson distribution [15] for LTAC and rehabilitation hospitals. Confidence intervals provide a measure of the precision of each CDI rate. We also report

whether a hospital uses a PCR method to detect CDI, as these hospitals may have higher rates resulting from use of a more sensitive laboratory test. CDI testing type was reported to NHSN quarterly and on the annual survey. In Table 2 and 3, we present the CDI testing method reported in the annual survey. We do not group or stratify the LTAC and rehabilitation hospitals by PCR use versus other testing methods. Hospital comparisons within each group might be misleading due to differences in laboratory testing methodology between individual hospitals.

We performed the following calculations on data submitted to NHSN during 2014 for LTAC and rehabilitation hospitals. The numerators for the CDI rates were all LabID events categorized as HO. The denominators for the CDI rates were total inpatient days for all available inpatient locations, excluding NICUs and well-baby nurseries. For each hospital we calculated the HO Incidence Rate. The equations for the rate calculations are:

$$HO \text{ Rate per } 10,000 \text{ inpatient days} = \frac{\text{Number of HO Cases}}{\text{Total Inpatient Days}} \times 10,000$$

We used 10,000 as the multiplier to yield whole numbers or large fractions because CDI rates generally are low, and current clinical practice guidelines for CDI surveillance recommend that CDI rates should be expressed as the number of cases per 10,000 patient days [5]. Hospitals summed and entered into NHSN all denominator data (inpatient days). We calculated HO incidence rate for each LTAC and rehabilitation hospital that reported data into NHSN for 12 months of the reporting period.

For each incidence rate, we calculated exact 95 percent confidence intervals using the Poisson distribution [15]. We calculated the statewide pooled mean (average) rate for LTAC and rehabilitation hospitals by dividing the sum of all HO CDI LabID Events by the sum of all inpatient days and multiplying 10,000.

A confidence interval is a range of values that quantifies the random variation of a rate; it does not provide information about systematic errors or bias. The wider the interval, the greater the uncertainty associated with the rate. The width of the confidence interval is in part related to the reported number of inpatient days. Smaller facilities with fewer inpatient days have the least precision associated with their rates and the widest confidence intervals.

Limitations and Context

To account for the differences in laboratory method and other significant risk factors, an NHSN risk-adjustment method was available beginning with the 2012 data for general acute care hospitals [13]. LTAC and rehabilitation hospitals were excluded from the CDI SIR analyses because too few of these hospital types reported CDI data during the baseline period (2010-2011.) The LTAC and rehabilitation hospital-specific rates presented here have not been risk adjusted and may not be comparable.

The SIR adjusts for significant risk factors that influence CDI rates in hospitals: CDI laboratory testing methodology, community onset admission prevalence rate, facility bed size, and medical school affiliation. Hospital CDI rates also may also differ due to other factors not included in the NHSN risk adjustment model, such as different patient populations with different risks for infection.

The rates for LTAC and rehabilitation hospitals are not risk-adjusted. Differences in rates for LTAC and rehabilitation hospitals can result from differences in laboratory testing methodology,

patient populations, infection and transmission prevention practices, antibiotic utilization, and/or community onset rates of CDI. Rates from LTAC and rehabilitation hospitals using different types of laboratory tests are not comparable, as there can be as much as a two-fold difference in test sensitivity. Hospital CDI rates also may differ due to patient populations with different risks for infection such as age. The rate of community onset cases has also been shown to affect the rate of HO infections, perhaps reflecting higher admission rates of patients already at increased risk for CDI, such as patients from skilled nursing facilities.

Laboratory-based reporting depends on appropriate clinician test ordering and laboratory processing. Some facilities may have changed laboratory testing methodology during the reporting period. Facilities may have falsely lower rates if patient days from NICUs and well-baby nurseries were not excluded from denominator data.

References

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