Abstract

Data reported to the Centers for Disease Control and Prevention’s National Healthcare Safety Network (NHSN) were analyzed to understand the potential impact of the COVID-19 pandemic on central line-associated bloodstream infections (CLABSI) in acute care hospitals. Descriptive analysis of the Standardized Infection Ratio (SIR) was conducted by locations, location type, geographic area, and bed size.
Background

The United States’ Centers for Disease Control and Prevention’s (CDC) National Healthcare Safety Network (NHSN) is the nation’s surveillance system for healthcare-associated infections (HAI). Hospitals and public health organizations track HAIs using the Standardized Infection Ratio (SIR), and the Centers for Medicare and Medicaid Services (CMS) require submission of data on HAIs to NHSN for payment programs such as the Hospital Acquired Conditions Reporting Program (HACRP). From 2015 to 2019, there was a 31% decline in the national SIR for central line-associated bloodstream infections (CLABSI). However, in the face of the pandemic of SARS-CoV-2, the virus that causes coronavirus disease 19 (COVID-19), HAIs in hospitals may have increased. To understand the impact of the early months of the COVID-19 pandemic on CLABSI nationally, SIRs for 2020 quarter 2 (Q2: April, May, June) were compared to those from 2019 Q2.

Methods

Reporting on CLABSI to NHSN should occur in any inpatient location where data on central lines can be collected, including intensive care units (ICU), specialty care areas (SCA), neonatal intensive care units (NICU), and wards. This analysis included data as of January 1, 2021 from acute care hospitals (ACHs) for April, May, and June of 2019 and 2020. Only locations that had continuous and consistent reporting, defined as ACHs reporting all three months of CLABSI data for the same location in both 2019 Q2 and 2020 Q2, were included. SIRs were calculated by dividing the number of observed infections by the predicted number determined from the logistic regression model generated from national data during a baseline time period. A mid-p exact test
was preformed to compare the 2020 Q2 SIRs to the baseline of 1 and to the 2019 Q2 SIRs. Device utilization ratios were calculated by dividing central line days by patient days. Regions were defined by the United States Department of Health and Human Services (HHS).  

Analysis was restricted to the units included in CMS’ HACRP and location-types that had at least 20 reporting locations nationwide. Because CMS suspended the HACRP reporting requirement for HAIs during 2020 Q2, the number of reporting hospitals in 2020 Q2 was compared to 2019 Q2.

Percent change in the SIR was calculated as [(SIR for 2020 Q2 – SIR for 2019 Q2) / SIR for 2019 Q2 x 100]. A mid-p exact test was performed for estimating 95% confidence intervals around SIR percent change values. The percentile distribution of 2020 Q2 SIRs included those facilities that had a denominator of the SIR (i.e., number predicted CLABSI) greater than one. Percentile distributions were shown for strata with >20 facility-level SIRs.

Results

The analysis included 13,136 inpatient units from 2,986 ACHs. 936 facilities had at least one predicted CLABSI and an SIR calculated. A 28% increase (95% CI 20.0, 33.6) was observed in the national SIR, from 0.68 in 2019 Q2 to 0.87 in 2020 Q2 (Table 1). Device utilization increased nationally from 0.21 in 2019 Q2 to 0.23 in 2020 Q2 (data not shown).
Critical care units had the greatest percentage increase (39%) in SIR, from 0.75 in 2019 to 1.04 in 2020. Ward locations experienced the second highest increase (13%). Critical care locations had the highest number of CLABSIs in 2020 Q2, with 1,911 events. Hospitals in all bed size categories experienced an increase in SIR.

In 2020 Q2, reporting of CLABSI surveillance dropped by 17% nationally, in contrast with 2019 Q2. The greatest decrease in reporting (48%) occurred in the Middle Northeast. Regional analysis showed significant percent changes in the SIR from 2019 to 2020 in 7 regions (Upper Northeast, Lower Northeast, Southeast, Great Lakes, Northern Plains, West, and Northwest, regions). The highest regional 2020 Q2 SIR was 1.07 and occurred in the Upper Northeast, representing a 45% increase compared to 2019 Q2.

Evaluating by ward-type, pediatric medical-surgical wards contributed 4% of the national central line days from ward locations in 2020 Q2 and had the greatest change in their SIR (118% increase) (Table 2). Statistically significant increases in the SIR also occurred in: medical critical care (60%), medical-surgical critical care (59%), and neurosurgical critical care (108%). In addition, the device utilization ratio increased in pediatric medical-surgical wards from 0.14 (2019) to 0.18 (2020) (data not shown).
Conclusion

The national SIR for CLABSI increased significantly by 28% in 2020 Q2 versus 2019 Q2. During that same time, hospitals were faced with managing the emerging pandemic of COVID-19 which may have played a role in the increase.

Infection control practices changed in many healthcare settings during the pandemic to accommodate increasing numbers of patients and to mitigate shortages of personal protective equipment, supplies, and staffing. Reducing the frequency of contacts with patients and of maintenance activities for central catheters (e.g. chlorhexidine bathing, scrubbing the hub, site examinations) as well as alterations to processes of care (such as risking disrupting catheter dressings when placing patients in a prone position) all have the potential to contribute to an increase in CLABSI. Consistent with the concern that high-acuity care for patients with COVID-19 posed heightened challenges for preventing device-associated infections, CLABSI - in critical care locations occurred relatively frequently in the 2020 data. The number of CLABSI in those locations exceeded CLABSI in ward locations by 1,100 events for the quarter; in prior years, the number of CLABSI identified in ward locations would typically exceed the number reported from ICUs. NHSN data do not enumerate the specific type of ICU location of patients with COVID-19; but among all ICUs, increases CLABSI were highest in the medical-surgical critical care units. The significant 59% increase in the 2020 SIR highlights the likely burden that was placed on these units.
The reporting of data on CLABSIs decreased across all regions with 609 fewer hospitals reporting in 2020 Q2. This drop in reporting may have impacted the regional-level analyses since alterations in reporting may have occurred disproportionally in regions that experienced more patients with COVID-19. In particular, even though New York and New Jersey experienced increased hospitalizations during this time period, the Middle Northeast region did not demonstrate a significant increase in SIR, and this region had the largest decline in reporting of CLABSIs by 48%. In contrast, the Southeast region had only a 12% drop in reporting of data on CLABSIs to NHSN, and the analyses were able to discern an increase in CLABSI SIR against the backdrop of an increase in hospitalizations due to COVID-19 during June 2020.

The analysis had several limitations. Results were restricted to locations for which data were consistently reported in both 2019 and 2020 Q2. New locations that may have been created in 2020 in response to patient surge due to the pandemic were not included since they were not present in 2019 for comparison analysis. Restricting the analyses to those units required by CMS HACRP may have excluded other units that were used by hospitals for COVID-19 patients (e.g., pulmonary wards.)

The findings of this paper highlight a substantial increase in CLABSIs in hospitals throughout the United States coinciding with the COVID-19 pandemic. The results of this analysis can be used to understand the increase in HAI burden being placed on the nation’s healthcare system and to prioritize ongoing efforts to prevent infections and to drive patient safety.
References

1. CMS Website: FY 2021 IPPS Final Rule Home Page.  
   https://www.cms.gov/medicare/acute-inpatient-pps/fy-2021-ipps-final-rule-home-page.  
   Updated January 2021. Accessed February 18, 2021.

2. Centers for Disease Control and Prevention (CDC). 2019 National and State Healthcare- 
   Associated Infections Progress Report. https://www.cdc.gov/hai/data/portal/progress-
   report.html. Published 2020. Accessed February 2, 2021.

3. Kumar G, Adams A, Hererra M, et al. Predictors and outcomes of healthcare-associated 
   infections in COVID-19 patients. Int J Infect Dis. 2020 Nov 15;104:287-292. doi: 
   10.1016/j.ijid.2020.11.135

4. McMullen KM, Smith BA, Rebmann T. Impact of SARS-CoV-2 on hospital acquired 
   infection rates in the United States: Predictions and early results. Am J Infect Control. 
   2020 Nov; 48(11): 1409–1411. doi: 10.1016/j.ajic.2020.06.209

5. NHSN Website: Bloodstream Infection Event (Central Line-Associated Bloodstream 
   Infection and Non-central Line Associated Bloodstream Infection) NHSN Protocol.  
   Centers for Disease Control and Prevention (CDC). 
   https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf. Updated January 2021. 
   Accessed February 3, 2020.

6. Centers for Disease Control and Prevention (CDC). NHSN Guide to the SIR.  
   https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf. Updated March 
   2019. Accessed February 2, 2020.

7. Regional Offices. U.S. Department of Health & Human Services website. 
   https://www.hhs.gov/about/agencies/iea/regional-offices/index.html. Updated 2014. 
   Accessed February 4, 2021.

8. Sapiano MRP, Dudeck MA, Soe MM, et al. Impact of coronavirus disease 2019 
   (COVID-19) on US Hospitals and Patients, April–July 2020. Infect Control Hosp 
   Epidemiol. 2021 Feb 19:1-28. doi: 10.1017/ice.2021.69.
Table 1: Preliminary national central line-associated bloodstream infection (CLABSI) Standardized Infection Ratios (SIRs) in U.S. acute care Hospitals during the early months of the COVID-19 pandemic, April 2020 – June 2020

| Characteristic          | Reporting Hospitals in 2020 Q2 | Total Reporting Hospitals in 2019 Q2 | Observed CLABSI | Predicted CLABSI | Central line days | 2020 Q2 SIR | 2019 Q2 SIR | SIR Percent Change | 95% Confidence Interval for the SIR Percent Change | Facility-level distribution of the Standardized Infection Ratio (SIR) for 2020 Q2 |
|-------------------------|-------------------------------|--------------------------------------|-----------------|-----------------|------------------|-------------|-------------|------------------|------------------------------------------------|------------------------------------------------|
| All Hospitals           | 2,986                         | 3,594                                | 2,887           | 3,334.17        | 3,302,324        | 0.87^      | 0.68^       | 28.0%^           | (20.0, 33.6)                                           | 0.00 0.00 0.68 1.17 1.96 6.72                  |
| Location Type           |                               |                                      |                 |                 |                  |             |             |                  |                                                   |                                               |
| CC                      | 2,513                         | 3,070                                | 1,911           | 1,836.02        | 1,707,981        | 1.04        | 0.75%^      | 38.7%^           | (29.2, 48.5)                                           | 0.00 0.00 0.78 1.51 2.31 6.49                  |
| CC_ONC                  | 19                            | 21                                   | 10              | 10.93           | 10,706           | 0.91        | 1.08        | -15.7%^          | (-63.2, 89.6)                                         | .     .     .     .     .                      |
| NICU                    | 812                           | 1,035                                | 162             | 305.93          | 219,115          | 0.53^      | 0.65^       | -18.5%^          | (-33.4, 0.5)                                          | 0.00 0.00 0.00 0.80 1.26 2.56                  |
| Ward^                  | 2,852                         | 3,478                                | 804             | 1,181.29        | 1,364,522        | 0.68^      | 0.60^       | 13.3%^           | (2.3, 23.9)                                            | 0.00 0.00 0.51 0.99 1.81 7.89                  |
| Bed Size                |                               |                                      |                 |                 |                  |             |             |                  |                                                   |                                               |
| < 100 Beds              | 1,117                         | 1,341                                | 114             | 124.46          | 180,626          | 0.92        | 0.66^       | 39.4%^           | (4.2, 82.7)                                            | .     .     .     .     .                      |
| 100-199 Beds            | 774                           | 921                                  | 418             | 429.09          | 520,542          | 0.97        | 0.74^       | 31.1%^           | (14.2, 52.7)                                           | 0.00 0.00 0.77 1.56 2.42 6.24                  |
| 200-299 Beds            | 474                           | 553                                  | 505             | 594.21          | 612,958          | 0.85        | 0.66^       | 28.8%^           | (13.0, 46.7)                                           | 0.00 0.00 0.62 1.08 2.01 6.72                  |
| 300-499 Beds            | 426                           | 536                                  | 820             | 1,030.37        | 956,115          | 0.80^      | 0.62^       | 29.0%^           | (15.6, 41.5)                                           | 0.00 0.00 0.64 1.20 1.99 4.76                  |
| 500-699 Beds            | 123                           | 156                                  | 549             | 620.14          | 557,211          | 0.89        | 0.68^       | 30.9%^           | (15.7, 48.3)                                           | 0.14 0.39 0.73 1.11 1.74 4.31                  |
| > 700 Beds              | 72                            | 88                                   | 481             | 535.91          | 474,872          | 0.90        | 0.80^       | 12.5%^           | (-0.8, 27.9)                                           | 0.30 0.50 0.85 1.14 1.70 2.17                  |
| IHS Region              |                               |                                      |                 |                 |                  |             |             |                  |                                                   |                                               |
| 1 - Upper northeast     | 116                           | 147                                  | 137             | 128.45          | 133,833          | 1.07        | 0.74^       | 44.6%^           | (11.3, 88.4)                                           | 0.00 0.00 0.92 1.19 2.72 4.48                  |
| 2 - Middle northeast    | 131                           | 254                                  | 111             | 159.39          | 162,136          | 0.70^      | 0.67^       | 4.5%             | (-20.0, 36.6)                                          | 0.00 0.00 0.42 1.31 1.86 3.46                  |
| 3 - Lower northeast     | 286                           | 336                                  | 357             | 379.91          | 368,526          | 0.94        | 0.70^       | 34.3%^           | (14.4, 56.3)                                           | 0.00 0.00 0.70 1.14 1.99 3.83                  |
| 4 - Southeast           | 694                           | 786                                  | 660             | 802.99          | 786,484          | 0.82^      | 0.72^       | 13.9%^           | (2.0, 26.9)                                            | 0.00 0.12 0.65 1.07 1.89 6.72                  |
| 5 - Great Lakes         | 460                           | 576                                  | 498             | 525.58          | 514,927          | 0.95        | 0.71^       | 33.8%^           | (16.7, 51.7)                                           | 0.00 0.00 0.67 1.40 1.97 4.82                  |
| 6 - South Central       | 494                           | 597                                  | 366             | 442.18          | 442,148          | 0.83^      | 0.76^       | 9.2%             | (-6.2, 25.4)                                           | 0.00 0.31 0.71 1.16 1.83 2.90                  |
| 7 - Middle Plains       | 163                           | 188                                  | 134             | 160.40          | 157,863          | 0.84^      | 0.68^       | 23.5%^           | (-4.1, 56.1)                                           | 0.00 0.00 0.75 1.11 1.91 2.62                  |
| 8 - Northern Plains     | 135                           | 143                                  | 107             | 107.02          | 106,249          | 1.00        | 0.62^       | 61.3%^           | (19.9, 121.2)                                          | 0.00 0.45 0.81 1.54 2.18 2.83                  |
| 9 - West                | 400                           | 454                                  | 434             | 508.19          | 505,247          | 0.85^      | 0.57^       | 49.1%^           | (30.2, 74.7)                                           | 0.00 0.00 0.63 1.20 2.28 4.64                  |
| 10 - Northwest          | 105                           | 112                                  | 82              | 119.25          | 123,656          | 0.69^      | 0.45^       | 53.5%^           | (10.3, 114.6)                                          | 0.00 0.00 0.61 1.17 1.90 2.70                  |