Concise Communication

Pathogens attributed to central-line–associated bloodstream infections in US acute-care hospitals during the first year of the coronavirus disease 2019 (COVID-19) pandemic

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Epidemiology

During 2020, hospitals saw unprecedented increases in critically ill patients as coronavirus disease 2019 (COVID-19) spread across the United States. In response, hospitals were often required to modify their operations, services provided, and patient care practices.1 Several studies have documented an alarming increase in device utilization and healthcare-associated infections (HAIs) in the United States during 2020, particularly in intensive care units (ICUs)2–4; however, studies evaluating changes in HAI pathogens during the pandemic have been limited to a small number of facilities. To assess changes in the common pathogens reported from central-line–associated bloodstream infections (CLABSIs) at the national level between 2019 and 2020, we examined data reported to the National Healthcare Safety Network (NHSN) by acute-care hospitals.

Methods

For each CLABSI, hospitals are required to report 1–3 pathogens and select antimicrobial susceptibility results to NHSN.5 CLABSI pathogens identified in adult ICUs and wards in 2019 and 2020 were analyzed. “Wards” included all adult non–critical-care units such as step-down and mixed-acuity units, excluding inpatient rehabilitation units.

The 15 pathogens most frequently associated with CLABSIs in 2019 and 2020 were identified, and their frequencies and ranks within each location type were calculated. Pathogen distributions were also reviewed among the subset of hospitals that performed continuous HAI surveillance in both 2019 and 2020, with no difference in results observed. Although COVID-19 patient status was an optional field for data entry in NHSN, the distribution of pathogens among COVID-19 ICU patients was assessed. Vancomycin resistance among Enterococcus (VRE) and methicillin resistance among Staphylococcus aureus (MRSA) were measured by calculating the percentage of tested pathogens that were resistant. A mid-P exact test result ≤.05 was used to identify significant differences.

Results

Most CLABSIs in 2019 (89.4%) and 2020 (89.1%) had a single pathogen identified, with no substantial change in the proportion of CLABSIs that were polymicrobial.

ICUs

In total, 7,675 ICU CLABSI pathogens were reported from 1,560 hospitals during 2019. The most common pathogens were Candida (29.3%), coagulase-negative staphylococci (CNS) (13.3%), and Enterococcus faecium (8.1%) (Table 1). In 2020, 12,635 pathogens were reported by 1,906 hospitals, and Candida (27.8%), CNS (18.2%), and Enterococcus faecalis (15.0%) were the 3 most frequently reported species.

A large increase in the proportion of ICU CLABSI pathogens identified as CNS and E. faecalis were noted in 2020 compared to 2019. The increase in absolute number of E. faecalis CLABSIs was widespread; 388 hospitals reported at least 1 E. faecalis ICU CLABSI pathogen in 2019, compared to 848 hospitals in 2020 (data not shown). The reporting of E. faecalis varied by month in 2020, with the proportion of pathogens identified as E. faecalis ranging from 8%–9% (January–March) to 17%–18% (November and December). Little variation by month was observed in 2019, when
In 2019, 5.9% of tested *E. faecalis* were resistant to vancomycin; the resistance percentage was significantly lower in 2020, at 3.0% (Table A1).

### Wards

In total, 1,821 hospitals reported 14,508 CLABSI pathogens from wards in 2019, of which *Candida* (12.1%), *S. aureus* (11.8%), and *Escherichia coli* (11.5%) were the most frequently reported (Table 2). In 2020, 1,848 hospitals reported 13,943 pathogens, and *Candida* replaced *S. aureus* to become the third most common pathogen (11.1%). Increases were observed in the proportion of pathogens among COVID-19 ICU patients, with 2,787 (65.9% of those with data) occurring in patients with confirmed or suspected COVID-19 (Table A2). *Candida* (28.9%), *E. faecalis* (21.1%), and CNS (19.7%) were the 3 most frequently reported CLABSI pathogens among ICU patients with COVID-19.

### CLABSIs in COVID-19 ICU patients

Data on COVID-19 patient status were available for 4,232 (33.5%) of ICU CLABSI pathogens, with 2,787 (65.9% of those with data) occurring in patients with confirmed or suspected COVID-19 (Table A2). *Candida* (28.9%), *E. faecalis* (21.1%), and CNS (19.7%) were the 3 most frequently reported CLABSI pathogens among ICU patients with COVID-19.

### Discussion

This paper describes the CLABSI pathogens commonly isolated during the first year of the COVID-19 pandemic, using data from almost all US hospitals. Our results showed that the common pathogens among COVID-19 ICU patients at a national level, particularly *E. faecalis* and CNS, were consistent with results from local studies.

Even though the stark increase in *E. faecalis* pathogens reported in 2020 was unexpected, an increase in *Enterococcus* BSIs in 2020, compared to 2018–2019, was also observed in a hospital in northern Italy. These results, along with substantially higher proportions of *E. faecalis* identified in November and December 2020, during which a large number of COVID-19 hospitalizations occurred in the United States, suggest that COVID-19 patients and/or patients hospitalized during times of heightened COVID-19 burden may be particularly susceptible to CLABSIs caused by *E. faecalis*. The reasons for this are unclear, but several local studies from the United States and Italy identified *Enterococcus* as a common BSI pathogen among COVID-19 patients.

In addition to host factors, changes in the amount and overall pattern of antibiotic use for hospitalized patients in 2020 could have contributed to a rise in *E. faecalis*. Giacobbe et al. reported...
that almost all COVID-19 patients in their 1,200-bed hospital were treated with a cephalosporin, and an increase in antibiotic use, especially ceftriaxone, was observed in 2 large US hospital cohorts during 2020. The additional antibiotic use in 2020, or especially ceftriaxone, was observed in 2 large US hospital treated with a cephalosporin, and an increase in antibiotic use, that almost all COVID-19 patients in their 1,200-bed hospital were

CNS was the second most reported pathogen for ICU CLABSIs in 2019 and 2020, with a marked increase in 2020. Due to the surge of case load and relative scarce healthcare resources early in the pandemic, inadequate adherence to aseptic blood culture collection technique may have resulted in some increases in CNS isolates. However, the NHSN CLABSI definition includes stipulations to reduce the impact of contamination by offering separate criteria for common commensals and known pathogens; thus, the increase in CNS CLABSIs during 2020 is unlikely to have been caused by contamination alone.

This study had several limitations. All data from adult locations were analyzed, including data from pediatric patients housed in adult locations at the time of their infection. The CMS granted a reporting exception for the first half of 2020, leading some hospitals to pause HAI reporting to the NHSN. Any underestimation in the number of pathogens during 2020 is assumed to be minimal due to the high volume of reporting that continued throughout the year. It was optional for hospitals to report patient COVID-19 status to the NHSN. Given the limited responses available, we acknowledge that the pathogen distribution among COVID-19 ICU patients is not representative of all COVID-19 ICU patients who experienced an HAI.

Compared to the pre–COVID-19 period, we identified national increases during 2020 in the proportion of CLABSIs caused by E. faecalis and CNS. Infection prevention professionals are encouraged to review the common pathogens and antimicrobial resistance patterns in their hospitals and jurisdictions to identify opportunities to strengthen HAI prevention and antimicrobial stewardship efforts.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2022.16

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**APPENDIX**

**Table A1.** The Percentage of CLABSI Pathogens Resistant (%R) to Vancomycin (VRE) or Methicillin (MRSA) in 2019 and 2020, by Location

| Location, Pathogen | 2019 | 2020 |  |  |  |  |  |  |  |
|--------------------|------|------|---|---|---|---|---|---|---|
|                    | No.  | %    | % R<sup>a</sup> | No.  | %    | % R<sup>a</sup> | P     |     |     |
| Adult ICUs         |      |      |               |      |      |               |       |     |     |
| Enterococcus faecalis | 525  | 90.0 | 5.9           | 1,681| 88.7 | 3.0           | .004  |     |     |
| E. faecium         | 574  | 92.3 | 81.5          | 713  | 90.6 | 77.7          | .091  |     |     |
| Staphylococcus aureus | 531  | 86.6 | 47.8          | 758  | 85.9 | 47.6          | .941  |     |     |
| Adult Wards<sup>b</sup> |      |      |               |      |      |               |       |     |     |
| E. faecalis        | 854  | 89.2 | 7.6           | 939  | 86.9 | 5.2           | .039  |     |     |
| E. faecium         | 811  | 92.2 | 72.5          | 713  | 88.1 | 70.3          | .336  |     |     |
| S. aureus          | 1,498| 87.6 | 46.2          | 1,432| 85.2 | 48.3          | .249  |     |     |

Note. ICU, intensive care unit; CLABSI, central-line–associated bloodstream infection; VRE, vancomycin-resistant Enterococcus; MRSA, methicillin-resistant *Staphylococcus aureus*.

<sup>a</sup>Percent resistance (%R) is measured for VRE or MRSA, as appropriate. VRE is defined as Enterococcus resistant to vancomycin. MRSA is defined as *S. aureus* resistant to methicillin, oxacillin, or cefoxitin.

<sup>b</sup>Includes all non-critical-care unit types, including specialty care areas, step-down units, and mixed-acuity units.

**Table A2.** Frequency and Distribution of the CLABSI Pathogens Most Frequently Reported Among Adult ICU Patients With Confirmed or Suspected COVID-19

| Pathogen                  | No.   | %    | Rank |
|---------------------------|-------|------|------|
| All Candida spp.          | 806   | 28.9 | 1    |
| Enterococcus faecalis     | 589   | 21.1 | 2    |
| Coagulase-negative staphylococci | 550 | 19.7 | 3    |
| Staphylococcus aureus     | 186   | 6.7  | 4    |
| Enterococcus faecium      | 148   | 5.3  | 5    |
| Selected Klebsiella spp<sup>a</sup> | 77  | 2.8  | 6    |
| Pseudomonas aeruginosa    | 60    | 2.2  | 7    |
| Escherichia coli          | 48    | 1.7  | 8    |
| Yeast, not specified      | 42    | 1.5  | 9    |
| Other Enterococcus spp<sup>b</sup> | 37  | 1.3  | 10   |
| Serratia spp              | 29    | 1.0  | 11   |
| Acinetobacter spp         | 20    | 0.7  | 12   |
| Enterobacter spp          | 19    | 0.7  | 13   |
| Viridans group streptococci | 16  | 0.6  | 14   |
| Stenotrophomonas maltophilia | 14  | 0.5  | 15   |
| Other pathogen            | 146   | 5.2  |      |
| Total                     | 2,787 | 100.0|      |

Note. ICU, intensive care unit; CLABSI, central-line–associated bloodstream infection; COVID-19, coronavirus disease 2019.

<sup>a</sup>Includes *K. oxytoca*, *K. pneumoniae*, and *K. aerogenes*.<n>sup>b</sup>The group ‘other Enterococcus spp’ combines enterococci identified to the species level, excluding *E. faecium* and *E. faecalis*, and enterococci for which the species was not reported.