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Assessing burden of central line–associated bloodstream infections present on hospital admission

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Abstract

Few data exist on the incidence of central line–associated bloodstream infection present on hospital admission (CLABSI-POA), although the practice of patients maintaining central lines outside of hospitals is increasing. We describe patients presenting to an academic medical center with CLABSI-POA over 1 year. Of the 130 admissions, half presented from home infusion (47%), followed by oncology clinic (22%), hemodialysis (14%), and skilled nursing facility (8%). Efforts to reduce CLABSIs should address patients across the entire health care system.

Keywords

Home infusion therapy; healthcare associated infection; ambulatory bloodstream infections; central venous catheter complications; ambulatory healthcare associated infection

BACKGROUND

In recent years, acute care central line–associated bloodstream infections (CLABSIs) have been a focus of regulation and quality improvement work, resulting in a 46% decrease in acute care CLABSIs nationwide between 2008 and 2013.¹ However, central lines are increasingly maintained outside of acute care hospitals. We have limited knowledge regarding the burden of bloodstream infections (BSIs) associated with central lines outside of the acute care setting. As it is likely that most non-hospitalized patients who develop BSIs would be admitted to acute care hospitals, understanding the extent of CLABSIs present on admission (CLABSI-POAs) would help us understand where BSIs associated with central lines outside acute care develop.

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Conflicts of interest: None to report.

METHODS

Our study took place at a 1,177-bed academic medical center in Baltimore, MD, from September 1, 2017, to August 31, 2018. We adapted the National Healthcare Safety Network (NHSN) acute care CLABSI definition to CLABSI-POA by including patients with a positive blood culture within 72 hours before and after admission, using routine surveillance practices through the local electronic health record system's surveillance modules.¹ Specifically, the study included adult and pediatric patients with a central line documented at the time of hospital admission (including an accessed port) and a positive blood culture in the medical record system 72 hours prior to and after admission.

We validated this approach by comparing the hospital admissions identified in this manner to a subset of patients admitted to the hospital who had been identified as having CLABSI-POA by an affiliated home infusion agency that provides home infusion and home nursing services for many patients discharged from the hospital. This agency employs an infection preventionist (IP) who performs active CLABSI surveillance for all patients receiving services from the agency. A combination of surveillance techniques are used including voluntary patient safety event reports to an electronic system by staff, messages sent directly to the IP by staff, electronic medical record readmission reports, and blood culture report reviews. This agency uses the same modification of the NHSN acute care CLABSI definition.¹

We used descriptive statistics to describe the preadmission care location of all patients who presented to the hospital with CLABSI-POAs (determined through chart review), as well as information about their central lines and culture data. This study was considered to be exempt by the institutional review board due to its quality improvement activities.

RESULTS

Two hundred forty-eight admissions had a central line and positive blood cultures within 72 hours before and after admission. After exclusion of patients with bloodstream infections that did not meet the NHSN CLABSI definition because they were secondary to other sources (n = 80) or contaminants (n = 38), 130 admissions had CLABSI-POAs (Table 1). Most presented from home infusion agencies (n = 61; 46.9%), followed by oncology clinics (n = 29; 22.3%), hemodialysis facilities (n = 18; 13.8%), and skilled nursing facilities (n = 11; 8.5%). Several patients had been transferred from outside hospitals (n = 9; 6.9%) and had positive blood cultures within 72 hours of hospital admission. Interestingly, half (n = 67; 51.5%) had Gram-negative rods as the causative organism.

Twenty-five patients admitted with CLABSI-POAs based on the modified NHSN surveillance methodology had received services from both the internal home infusion and home nursing agency; 15 of these infections (60.0%) were also identified by the home infusion agency IP as CLABSIs. Eighteen patients identified by the home infusion agency IP as having a CLABSI were admitted to the hospital. Of these, 15 were identified by the academic medical center using the modified NHSN surveillance definition (83.3%). Of the 3 CLABSI admissions identified by the home infusion agency but not the academic medical

center, 1 was admitted under observation status only, 1 was admitted with a port accessed for <2 days and placed during an earlier hospitalization, and 1 should have been included in our surveillance but inappropriately had not been recorded as having a central line on admission.

DISCUSSION

CLABSI-POAs occurred 130 times over a year at an academic medical center. In comparison, over the same time period, our medical center had 90 CLABSIs. Surveillance performed in the outpatient setting may miss some CLABSI-POAs. Integrating outpatient CLABSI surveillance with acute care CLABSI-POA data may aid in understanding the burden of CLABSIs throughout the health care system.

Professionals in health care epidemiology, home infusion therapy, and infusion nursing use varying definitions of home infusion therapy CLABSI.² We adapted the acute care NHSN CLABSI definition for CLABSI-POA to include patients with positive blood cultures within 72 hours before and after admission.¹ A definition for home infusion therapy CLABSI as well as for CLABSI outside of hospitals could similarly be adapted.

Efforts to reduce CLABSI-POAs deserve further investigation. Collaborative projects to reduce CLABSIs have been implemented in outpatient hemodialysis facilities and in oncology clinics.³⁻⁵ However, a more comprehensive and coordinated approach is needed.⁶ In particular, health care settings outside of acute care hospitals are severely under-resourced for surveillance activities. Regulatory agencies and research support should be invested in reducing the burden of CLABSIs outside of acute care hospitals.

We found that 6.9% of our identified CLABSI-POAs came from outside hospitals. These infections could have been missed by the outside hospitals, suggesting that national point prevalence data may be underestimating the burden of acute care CLABSIs. We also found that half of the CLABSI-POAs were caused by Gram-negative rods. Future work should investigate the causes of CLABSI-POAs to emphasize appropriate prevention strategies.

Few studies have looked at CLABSIs outside of acute care settings or focused on CLABSI-POAs. One study found that bloodstream infections were present in 1.7% of admissions to 3 New York hospitals.⁷ The overall incidence of bloodstream infections at hospital admission ranges from 81.6 to 189 per 100,000 person-years.⁷⁻⁹ The CLABSI-POA rate has not been previously studied.

We chose to use 72 hours for inclusion in the study rather than 2 calendar days¹ to increase our sensitivity. Frequently, blood cultures may be drawn on a febrile patient in the home on a Monday afternoon, results of the cultures would be available Wednesday afternoon, and the clinician would then ask the patient to go to the emergency department, but the patient might not actually arrive until early Thursday morning. Therefore, using 72 hours of data allowed us to capture more CLABSI-POAs.

Our study is limited in that it is a single-center study. In addition, we were unsure of the actual prevalence of CLABSI-POAs, as there was not a clear definition or second source to validate the data. Our modified NHSN definition for CLABSI-POA requires further

validation. Because we could not capture denominator data, we could not calculate rates or the total number of patients admitted with central lines. However, despite these limitations, we believe our findings add to the understanding of CLABSIs in alternative health care settings.

CONCLUSIONS

CLABSI-POAs occur commonly. In not capturing patients with CLABSI-POAs, we may be underestimating the total health care system burden of CLABSIs. Health care systems should focus on CLABSI surveillance no matter the site of care. Regulatory agencies and researchers should focus on further understanding the burden of CLABSIs to improve the safety of patients maintaining central lines in all locations.

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Table 1:

Characteristics of CLABSI present at the time of acute care hospital admission (N = 130 admissions)

Characteristics of CLABSI	n (%)
Organisms	
Methicillin-resistant <i>Staphylococcus aureus</i>	10 (7.9)
Methicillin-susceptible <i>S aureus</i>	19 (14.6)
Coagulase-negative <i>Staphylococcus</i>	19 (14.6)
<i>Enterococcus</i>	11 (8.5)
<i>Streptococcus</i>	2 (1.5)
Anaerobic Gram-positive bacteria	2 (1.5)
Gram-negative organisms	67 (51.5)
<i>Enterobacter</i> = 12, <i>Klebsiella</i> = 16, <i>Pseudomonas</i> = 13, <i>Serratia</i> = 9, <i>Achromobacter</i> = 3; <i>Acinetobacter</i> = 1, <i>Aeromonas</i> = 1, <i>Burkholderia</i> = 1, <i>Citrobacter</i> = 1, <i>Delftia</i> = 1, <i>Pantoea</i> = 3, <i>Rhizobium</i> = 1, <i>Stenotrophomonas</i> = 4, <i>Sphingomonas</i> = 1	
Fungal infection	12 (9.2)
<i>Candida</i> = 11, <i>Lomentospora</i> = 1	
Polymicrobial infection	18 (13.8)
Type of venous catheter	
Tunneled central line	60 (46.2)
Peripherally inserted central catheter	39 (30.0)
Hemodialysis catheter	20 (15.4)
Non-tunneled central line	6 (4.6)
Accessed port	7(5.4)
Multiple central lines	8 (6.2)
Location prior to admission	
Home infusion therapy	61 (46.9)
Oncology clinic	29 (22.3)
Hemodialysis	18 (13.8)
Outside hospital or hospital transfer	9 (6.9)
Skilled nursing facility	11 (8.5)
Outpatient infusion center	3 (2.3)
Incarceration	1 (0.8)

CLABSI, central line–associated bloodstream infection.