CLABSI Rates in Immunocompromised Patients: A Valuable Patient Centered Outcome?

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The accepted approach to surveillance for hospital-acquired bloodstream infection (HABSI) due to central venous catheters requires use of the National Health and Safety Network (NHSN) definition for catheter-associated bloodstream infection (CLABSI). In this commentary, we discuss our experience with the application of current NHSN surveillance definitions for CLABSI and the impact that public reporting of CLABSI rates in settings with a high prevalence of special populations has on infection prevention (IP) programs. For IP programs to serve the continuous improvement needs of their organizations, surveillance methodologies need to accurately capture the burden of preventable HABSI among immunocompromised individuals with inherent risk for infection. Current NHSN CLABSI definitions lack specificity for complex and heterogeneous patient populations and require modification. Beyond definitions, IP programs must critically assess the value of their current approach to surveillance to assure that patient-centered outcomes are the focus of prevention efforts.

Hospital-acquired bloodstream infections (HABSI) occur “on the watch” of infection prevention (IP) programs that are charged with identifying HABSI, categorizing HABSI, and providing guidance to organizations for the prevention of HABSI. Standardized surveillance definitions for catheter-associated bloodstream infections (CLABSI), put forth by the Centers for Disease Control and Prevention (CDC) through the National Health and Safety Network (NHSN), aid programs in their daily work [5].

Much is being asked of surveillance methodology and rates in 2011. Traditional surveillance continues to be a core functionality of IP programs for tracking rates and pathogens over time. Surveillance rates also serve as outcome metrics for multidisciplinary quality initiatives. Finally, CLABSI rates are now a public quality metric. Beginning this year, hospitals are compelled to report CLABSI rates to NHSN or face a reduction in their annual payment from the Centers for Medicare and Medicaid Services (CMS). Rates will be displayed on CMS’s Hospital Compare Web page, which has the stated goals of helping patients use quality information to make decisions about their health care and helping hospitals improve the quality of care they provide [6]. In this commentary, we discuss our experience with the application of current NHSN surveillance definitions for...
CLABSI as IP programs strive to provide a patient-centered data-driven approach to IP that optimizes value for the patient. A 57-year-old civil servant with a past history of diabetes mellitus and coronary artery disease is admitted to the hospital with a new diagnosis of acute myelogenous leukemia. A tunneled central catheter is inserted and the patient receives standard induction chemotherapy, the stress of which causes his chronic comorbidities to decompensate, requiring medical intensive care unit (MICU) support on hospital day 5. He appears ill and has mucositis and diarrhea. On hospital day 9, he develops neutropenic fever. His examination is nonlocalizing, and broad-spectrum antibiotics are started. Blood cultures obtained from the central line and the periphery grow Klebsiella pneumoniae.

Surveillance for HABSIs serves many purposes, but one of the most important is to inform prevention interventions [7]. The NHSN definition of CLABSI is the recognized standard for case ascertainment, although it has been noted to be clinically imprecise, overestimating the true incidence of bloodstream infections due to catheters [8]. When applied to large populations, particularly those wherein the pathophysiology of HABSI is most commonly related to central line use, this definition provides a good estimate of the burden of device-related infection. Most clinicians would agree that the patient in the clinical vignette above likely developed a bloodstream infection due to translocation of an enteric pathogen across a compromised colonic mucosa. However, by NHSN surveillance definitions, this bloodstream infection is a CLABSI and IP should classify it as such.

A multidisciplinary team is assembled to review CLABSIs in the MICU. The bloodstream infection described above is reviewed to identify opportunities for improvement. The clinical team disagrees with the classification of the bloodstream infection as a CLABSI. The infection preventionist (ICP) reviews the methodology and the NHSN CLABSI definition with them and acknowledges that surveillance definitions do not always reflect clinical reality. The medical director of the MICU replies, “I am being held accountable for these events by hospital leadership. Tell me how this event was preventable?”

The benefits of a robust surveillance process are considerable. Among like-minded individuals well-versed in the subject matter, the limitations of surveillance definitions are recognized and accepted, including the application of NHSN definitions to special care populations [9]. These limitations, however, have offsetting detrimental consequences, specifically as they apply to patients with hematological malignancies. Identifying HABSI as CLABSI due to constraints of methodology is not well accepted by clinical teams who are attempting to improve the delivery of care and are at the same time being judged on their efforts. At Cleveland Clinic, application of the NHSN definition of CLABSI across 44 leukemia and bone marrow transplant beds results in a near one-to-one correlation such that HABSI equals CLABSI. For some hospitals, clinical scenarios such as that outlined above may represent a small portion of HABSIs. For our organization, infections that are line-related by definition represent nearly 10% of the NHSN-defined CLABSI burden in the MICU and nearly 50% outside the MICU. These same limitations can be seen with other special populations such as patients with inflammatory bowel disease and short gut who are dependent on total parenteral nutrition, visceral solid organ transplant recipients, critically ill patients who have had abdominal surgery, and cardiac surgery patients with vasoplegic shock at risk for small bowel ischemia [10].

If the metric supplied by an IP program consistently identifies events that are not related to vascular catheter use, then there is a detrimental effect on the morale of the caregivers and the creation of a culture of consistent improvement. The credibility of the ICP as a content expert is also compromised. Infections that are potentially preventable, particularly if they are in the minority, can get lost among the others.

In response to this challenge, we have internally modified our surveillance definitions for patients with leukemia and bone marrow transplant recipients (Table 1). HABSI due to viridans group streptococci in patients who are neutropenic with mucositis are not considered to be CLABSIs [11]. Neither are HABSI due to enteric pathogens, Candida species, and Enterococcus species in patients who have received dose-intensive chemotherapy and are neutropenic or who are bone marrow transplant recipients and have graft-versus-host disease of the gut. These infections are still captured and reported as part of routine bloodstream surveillance so that the total burden of HABSI can be tracked and help inform the delivery of care as appropriate. Application of this modified definition has shown a significant change in the rates of CLABSI and in the pathogens deemed responsible for CLABSIs from enteric organisms to staphylococci—organisms more readily associated with device-related infection (Figure 1) [12]. In our experience, enacting this change has resulted in constructive discussions of ways to improve patient care instead of a debate about definitions.

The discussion above is to some extent about the lack of risk adjustment and accounting of case mix with the NHSN definition. Other authors have noted surveillance definitions in general to be similarly lacking in this regard [13]. This issue is not limited to patients with hematological malignancies. CLABSI rates as defined by NHSN do not account for heterogeneous populations including immunocompetent patients with more advanced critical illness. An often heard defense from physicians who are challenged about CLABSI outcomes is that their patients are sicker. The complexity of the patients under care in no way should be an excuse for failure to optimize practice. However, attempts to improve care for complicated patients need a metric that is meaningful and more rooted in clinical practice. For example, a reliable “foot of the bed test” for
the seriousness of the condition of a patient in the intensive care unit (ICU) and his or her risk of HAI is the number of vascular lines required for support and whether the patient is mechanically ventilated. However, by NHSN methodology, a patient day is a central line day if there is ≥1 central line in place. By this definition of a line day, a patient with 1 central line is considered to be the same as a mechanically ventilated patient with a central line, a temporary dialysis catheter, and an arterial line.

Adjusting risk on the basis of actual device exposure would have an impact on CLABSI rates [14]. We recently examined the prevalence and intensity of vascular access use in our ICU patients [15]. Over an 8-week period, 1,636 ICU patients across 209 adult ICU beds accounted for 5,940 patient days. There were 4,666 line days by traditional count and 5,936 line days by actual line day count. If arterial line days were added, there were 9,789 total vascular line days. If the presence of ≥1 central line adds at minimum an additive effect on the risk of CLABSI, then using actual line days as the denominator in our ICU population would result in a 30% decrease in the CLABSI rate during the observation period. The risk of infection due to arterial catheters in the ICU has been reported to be nearly equivalent to that of central venous catheters [16]. If total vascular access days are used as the denominator in our ICU population, the device-related bloodstream infection rate decreases by 50%. We plan on further investigation of the intensity of catheter use in our ICU population to see whether it correlates with other measures of disease severity and also so as to better inform strategies for decreasing HABSI.

A 68-year-old man is hospitalized after having an infected biventricular pacemaker removed. He is receiving vancomycin through a peripherally inserted central catheter in the left arm. He develops a fever, and evaluation reveals 1 blood culture positive for Pseudomonas aeruginosa, a urinalysis with 10 white blood cells, and a urine culture positive for 50,000 colonies of the same organism. He is known to have benign prostatic hypertrophy and some urinary retention with chronic symptoms of urgency.

Results of surveillance for CLABSI are increasingly perceived by many as objective measures of performance and markers of quality that accurately reflect clinical care. Pronovost et al [17] have described HAIs as “perhaps the only valid outcome measure of harm.” Furthermore, these authors go on to describe HAIs as preventable and measurable by well-validated systems and definitions. Approaching the problem of CLABSI with tenacity by examining each HABSI, using scorecards and “Days Since” dashboards, and creating multidisciplinary teams to enact improvements is powerful. To muster this effort requires a commitment of time and resources that comes at the expense of other priorities.

As mentioned above, much is being asked of surveillance rates at present, and surveillance definitions are inextricably linked to this challenge. Under the best of circumstances there will be inprecision in the application of CLABSI surveillance. This has recently been demonstrated by Lin et al [18], who showed significant variability in observed CLABSI rates when comparing ICP surveillance to a computerized gold standard. One solution to this variability is to accept the inherent limitations of current definitions and focus on significant deviations from established means as a signal for intervention. Such an approach, while reasonable, is at odds with increasingly prevalent expectations of “getting to zero.” Our experience is that an imprecise definition does not adequately support the intensive quality improvement efforts that hospitals are pursuing, which prompted the development of our modified definition for patients with hematological malignancy. The other issue with current CLABSI definitions, as noted by Lin et al [18], is that CLABSI rates are publicly reported metrics and are used as a measure of the quality of care delivered.

The benefits of greater transparency of quality parameters for patients seeking care are numerous and are an added incentive for quality improvement. However, a practical effect of transparency is that decisions about the portal of entry of HABSI defined by surveillance definitions that are not clinically precise nor adjusted for risk have unintended consequences. Rates are compared and variance needs to be explained. When an ICP decides that a HABSI is a CLABSI, that decision can affect colleagues, friends, and institutions.

Table 1. Internally Derived Exclusions to National Health and Safety Network Definition of Catheter-Associated Bloodstream Infection for Patients With Hematological Malignancies and Bone Marrow Transplant Recipients

<table>
<thead>
<tr>
<th>Hospital-acquired bloodstream infection (HABSI) in patients treated with intensive chemotherapy resulting in neutropenia and mucositis due to viridans group Streptococcus.</th>
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<tr>
<td>HABSI in patients treated with intensive chemotherapy with neutropenia or HABSI in bone marrow transplant recipients with graft-versus-host disease of the gastrointestinal tract due to:</td>
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<tr>
<td>Enteric gram-negative bacilli</td>
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<tr>
<td>Enterococcus species</td>
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<td>Candida species</td>
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Figure 1. Comparison of Catheter-associated Bloodstream Infection (CLABSI) Rates by National Health and Safety Network (NHSN) Definition and by Modified Definition for Calendar Year 2010. Qtr, quarter.
A modification in methodology and definition is necessary if CLABSI surveillance is to be an effective complement to continuous improvement in special care populations—those most at risk for HAIIs and those who can most benefit from further prevention efforts. Dedicating resources to form CLABSI reduction task forces to decrease HABSIIs that are not device related is costly to hospitals. Public reporting of CLABSI rates also compels modification to the current approach. There is a cost to caregiver morale and hospital reputation of having rates internally and externally reported that account for infections that either are not or may not be device related. If the issues we have identified and other limitations with NHSN definitions that have been identified by others are not addressed, internal and external pressure will grow and incentives for good faith efforts at surveillance by ICPs will decrease [10].

A 55-year-old man with end stage ischemic cardiomyopathy requires placement of a left ventricular assist device. His initial postoperative course smoothes out, and he is transferred to a regular nursing department. He does not have a central line in place. He abruptly deteriorates 5 days later with a septic picture and is transferred to the ICU. He has induration at the site of a peripheral intravenous line. Two blood cultures return positive for methicillin-sensitive Staphylococcus aureus (MSSA). He is treated, improves, and is maintained on first therapeutic and then suppressive antibiotic therapy for the next several weeks. He successfully undergoes orthotopic heart transplant. Deep cultures at time of transplant reveal MSSA.

Health care value has been defined as health outcomes per dollar spent [19]. The value of an infection control program could similarly be described as the effectiveness of prevention programs per dollar spent. A program could reasonably be considered valuable if it has been able to help its organization establish the appropriate structure and process for the delivery of quality care, increasing the chances of good outcomes [20]. From a patient perspective, health care value is ultimately measured in outcomes [19]—am I better or worse off from the health care experience? Efforts to reduce the rate of CLABSIIs are important and do provide value to patients, and those hospitals that have been successful should be emulated.

A patient with a HABSI, whether it is a CLABSI or not, has most likely had their health adversely affected and their hospital stay become longer and more costly. A CLABSI rate of 0 is a valid surrogate marker of quality as long as it reflects a proportional decrease in total HABSIIs, nosocomial antibiotic use, length of hospital stay, and observed mortality. Keeping a focus on these patient-centered outcomes leads to a construct of IP value: a program that has a flexible structure, is able to implement processes, and effectively measures and reports outcomes that empower continuous improvement.

The national focus on HAI is an opportunity for IP programs to make their case as patient advocates and to demonstrate that prevention efforts are focused on maximizing value to patients. Modifications to existing NHSN definitions are needed or ICPs and hospital epidemiologists will increasingly find themselves choosing between fidelity to surveillance or being a partner to clinical teams that are working to improve the delivery of care in a highly scrutinized industry. Will the next great debate be about whether or not a urinary tract infection in an ICU patient who cannot have the Foley catheter removed is symptomatic even though it meets the NHSN definition, or can we lead our institutions forward to issues that truly have an impact on patient outcomes?

Tracking and reporting total HABSI rates, either as an alternative or as a companion to CLABSI rates, should be considered as an opportunity to move prevention efforts forward and increase the value provided by IP programs to patients and hospitals. HABSI, regardless of source, is an outcome that is nearly independent of interpretation bias and is generally accepted as representative of hospital-acquired morbidity. Reporting total HABSIIs, potentially as an attack rate, puts the fraction of infections that are CLABSIIs in perspective and potentially exposes other areas of care that could be fertile prevention opportunities. Tracking and reporting total HABSIIs along with CLABSIIs also facilitates an honest conversation with caregivers about the true burden of disease and with patients about the limits of preventability. Further research examining HABSI as an outcome measure, particularly as it compares with CLABSI rates, is needed.

The patient discussed in the vignette above suffered a HABSI from a serious pathogen that had significant consequences. There was not a central line in place, the offending pathogen was not a resistant organism, and the patient was not in an ICU.
Would your current surveillance program capture this infection? Does the current surveillance construct on a national level provide incentive to hospitals that do? What if it was indicative of a problem with peripheral (noncentral) intravenous catheters, the use of which affects many more patients than that of central venous lines? IP programs need to be organized to provide optimal value to the patients whom their institutions serve, and ICPS must assure themselves that they are focused on patient-centered outcomes.

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