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## Abstract

Surveillance is an active process which requires proactively reviewing data sources indicative of an infection with the most common starting point through review of positive blood cultures. Based on the model of surveillance in the United States, if it is determined the bloodstream infection is associated with the central venous access device, mandatory data is collected. Other parts of the world do not have mandatory reporting. The surveillance data is used in a variety of ways including rating of hospitals for patient satisfaction, reimbursement/value-based purchasing percentages, comparison to other hospitals of similar bed size, central line device utilization ratio to determine if a hospital is using an inordinate ratio of central catheters, and determination of a standardized infection ratio. This chapter aims to define how surveillance is performed and the various uses of the gathered/reported information.

## Keywords

CLABSI surveillance · CLABSI reporting · CLABSI definition · CLABSI rate · Central line utilization ratio · Standardized Infection Rate

## 12.1 Surveillance Definition

### 12.1.1 CDC CLABSI Protocol

The National Healthcare Safety Network (NHSN) of the Centers for Disease Control and Prevention (CDC) publishes surveillance definitions for a broad range of healthcare-associated infections (HAI) (Horan et al. 2008). These definitions are reviewed and may be slightly revised annually and serve as the standard surveillance criteria for infections included in public reporting mandates through state regulations and federal Centers for Medicare and Medicaid Services (CMS) requirements for value-based purchasing (CDC 2017). They are also used for reporting into Press Ganey/National Database of Nursing Quality Indicators (NDNQI), which serves as the data repository for hospitals seeking Magnet™ designation. With minor variations, the Australian Commission on Safety and Quality in Health Care has implemented the same definitions throughout their country (Healthcare 2015).

Surveillance for CLABSIs is recommended in all areas of healthcare facilities that care for patients with CVADs and is required by Joint Commission

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to be conducted facility-wide rather than in a targeted manner (T.J. Commission 2012). Surveillance is an active process which requires proactively reviewing data sources indicative of an infection rather than relying on coded data or provider self-reporting of infections. The most common starting point is through review of positive blood cultures. Based on whether the organism is classified as a pathogen or a commensal (defined by CDC), the appropriate next steps are followed. Pathogens do not require symptoms in addition to the positive culture, but the patient record must be reviewed to rule out other potential sources of infection, which may cause the bacteremia to be defined as secondary to another site of infection. There are specific criteria to be followed when determining whether a suspected infection can be labeled as a secondary infection rather than a CLABSI. A pathogen requires only one positive culture to be considered an infection; organisms identified as commensals (i.e., coagulase-negative staphylococcus or diphtheroids) require two positive cultures collected at different times, in addition to clinical symptoms of infection such as fever or hypotension.

Equally important to the above infection surveillance is the collection of accurate denominators to allow for risk-adjusted CLABSI rates and ratios. Central line days are used as the standardized denominator for reporting CLABSI across units, expressed as the number of CLABSI/1000 central line days historically. Each unit has a mean rate of infection to which comparisons are made. More recently, public reporting has created a need for a standardized infection ratio (SIR) which allows for a single number to be used to reflect overall hospital CLABSI performance while allowing appropriate risk adjustment to take place to account for differing patient populations and other facility considerations. To collect these denominator days (regardless of whether using rates or SIRs), each unit provides a count at the same time every day of how many patients on the unit have one or more central lines at that specific point in time. Each patient only counts once, even if they have more than one central line. (Of note, neonatal ICU and nursery locations require stratification by birth weight, and specialty areas such as dialysis and oncology require stratification by temporary and permanent central lines). Those counts are totaled and

reported once a month. Of interest to some organizations, there is now an option to collect this data by doing a once-a-week sample to extrapolate monthly line days. Electronic data capture is permitted for denominator calculations as well, but only after successful pre-validation for 3 months. Each unit must complete its own validation, confirming that electronic counts are within  $\pm 5\%$  of the manually collected numbers. Ensuring the accuracy of denominator collection cannot be overemphasized (CDC 2017).

The protocol details may change annually. The most recent protocol is always available at [https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc\\_clabscurrent.pdf](https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf) with compliance with the new version becoming required starting January first of each year for state and federal reporting. Each spring, the CDC offers a free, detailed training on the surveillance protocol to ensure that the definitions are strictly adhered to by all participating organizations. There is a lottery to attend the event live, but it is available for all to participate via webstream. Those training materials are archived and readily accessible for anyone interested at <https://www.cdc.gov/nhsn/training/patient-safety-component/index.html>. Infection preventionists and any others involved in collection of the data must remain up-to-date with the protocols and related reporting requirements as they evolve.

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## 12.2 Understanding the Goals and Limitations of Surveillance Definitions

CLABSI is a surveillance definition only. It is not synonymous with the catheter-related bloodstream infection (CRBSI) definition and is not intended to offer guidance regarding patient care decisions for the patient who has been classified as meeting the definition. Use of standardized surveillance protocols allows for data to be compared (with appropriate risk adjustment) across facilities and within organizations for performance improvement. Because of limitations of surveillance definitions in their ability to identify the central line as the true source of infection, it may overestimate the true burden of disease. CLABSI does not have any elements which assess which device (if any) is the

true source of the infection, nor do paired cultures or time to positivity studies play a role in ruling in or ruling out an infection which has otherwise met the definition. This can create discomfort with treatment teams and vascular access experts, but the importance of adherence to the protocol is crucial, particularly with regulatory and accreditation requirements for accurate data collection.

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### 12.3 Using CDC Protocol Beyond Central Lines

Although hospitals commonly use the laboratory-confirmed bloodstream infection (LCBI) definitions only for CLABSI reporting, the actual definition is not specific to only central lines. A LCBI is reported as a CLABSI when the patient has a central line in for greater than 2 days and is in place the day of or the day before the first sign or symptom used to meet the definition. That same LCBI definition is appropriate for bloodstream infections that do not have a central line present. Some organizations identify those infections as CLABSI vs. non-CLABSI; others apply the line designation with other devices in the same manner as central lines are evaluated to make the determination of CLABSI. That same rationale can be applied to short peripheral catheters and midlines. It should be noted that the requirement for greater than 2 days of dwell time does not require a single catheter to account for that; in the case of peripherals, it may be seen that a patient has a series of devices during that time interval. If there is not a full calendar day without a device in place, the dwell time can be met using sequential devices. At the time of this writing, CDC has a proposal open for comment which considers expanding surveillance to include all hospital onset bacteremia, of which CLABSI would be a subset.

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### 12.4 Brief Primer on How to Interpret Surveillance Data

With NHSN data as the standard method of collecting and reporting hospital-acquired infections throughout the United States and mirrored in

many other countries, there is robust data available through the required database. Partnering with infection prevention teams at the organization to provide reports on a routine basis helps guide the vascular access team to areas for focused education or monitoring.

#### 12.4.1 CLABSI Rate

Historically, CLABSI incidence was analyzed by reviewing an individual unit's incidence of CLABSI expressed as a rate per 1000 central line days. Using historic data (within an institution, system-wide aggregate performance, state-based goals, or national benchmarks), the performance can be easily evaluated and compared to other similar units. The CDC publishes descriptions of the different unit types which require carefully "mapping" each unit in the hospital to identify the appropriate comparison group. Each type of unit and specialty within many types of units (i.e., critical care has many different risk types based on the primary patient population served) will have published information on the average rate of infection in that population. Reports run from within NHSN historically also specify where a hospital's performance is on the bell curve of all other similar units in the reporting period, based on percentile distribution.

#### 12.4.2 Central Line Device Utilization Ratio

Central line utilization is a required element for existence of a CLABSI, with many recent publications assessing the appropriateness of specific line choices. As part of the CLABSI rate reports available within NHSN, information is also shared on central line utilization for each individual unit. This is expressed as a ratio of central line days over patient days for the unit. Similar to what is produced for CLABSI comparisons, there is data that allows facilities to compare their central line utilization ratios to other similar units to see if there is potential for decreasing excess central line utilization. Most recently, there are now reports on standardized utilization ratios (SUR) which represent a hospi-

tal's device utilization compared to what is predicted based on the types of patients seen. This new measure allows for aggregate review of device utilization opportunities as well as a more detailed review at the unit level. There is more discussion on how to interpret the ratios in the section below regarding infection ratios.

### 12.4.3 Standardized Infection Ratio

Standardized infection ratios (SIR) allow for aggregate data to be used to produce a single number reflecting the performance of an entire hospital or a group of units. This is the figure that is used for public reporting on Hospital Compare and for evaluation of hospital performance as part of the Centers for Medicare and Medicaid Services (CMS) value-based purchasing (VBP). This ratio allows for complicated risk adjustment to take place “behind the scenes” and allows for a simple comparison against expected performance. A SIR of “1” indicates that performance is consistent with what is predicted based on the patient population included in the report. Numbers of less than one indicate that patients in the assessed population experienced fewer infections than predicted, and similarly a SIR of greater than one indicates that the assessed population observed more infections than were predicted. This is qualified with tests of statistical significance. It is possible to run SIR reports for individual units, for specified groupings of units, and for an entire organization to provide whichever overview is most useful.

## 12.5 Understanding Variations and Limitations in Technique for Diagnosing CRBSI

The need to determine the role of the central venous catheter as the underlying source of infection may have clinical relevance to inform treatment decisions by the medical team. Depending on available laboratory resources, options may include culturing of the catheter tip, reviewing differential time to positivity between blood cultures collected from the implicated device and from a peripheral stick, and quantitative assess-

ment of culture results. There is no recommendation for routinely culturing catheter tips on removal in the absence of a suspected infection.

The Infectious Diseases Society of America publishes recommendations for diagnosis and treatment of vascular catheter-related bloodstream infections. They describe preferential culturing of catheter tips and avoidance of broth culturing techniques and define interpretation of roll plate ( $>15$  CFU from a 5 cm segment) and sonication techniques ( $>10^2$  CFU) when assessing for colonization. CRBSI diagnosis can be made when culture results identify the same organism in at least the culture obtained as a peripheral stick and from a culture of the catheter tip. If the catheter is left in place, the diagnosis can be made if there are two blood samples being drawn (one from the catheter and one from a peripheral stick) that meet specific criteria for quantitative blood cultures or differential time to positivity. For multi-lumen catheters, quantitative cultures may be obtained through multiple lumens; results at least 3 times higher through one of the lumens are suggestive of CRBSI (Mermel et al. 2009).

Recommendations regarding treatment and possible removal or replacement of CVCs suspected of infection are based on several factors including pathogen, underlying health conditions, and consultation with infectious disease specialists (Center for Disease Control 2017; Chopra et al. 2015).

## 12.6 Summary

The surveillance for CLABSI and the required reporting of those results provide useful information to determine if a facility is operating within common averages. The information is used to compare one hospital CLABSI rate to another, compare central line device utilization ratios to see if a particular unit is using a higher percentage of central lines compared to similar units in other hospitals, and to determine a standardized infection ratio for each hospital to be used when comparing facilities.

While surveillance for CLABSIs does not provide information regarding how to treat the infec-

tions, it does provide information allowing facilities to determine what may be causing higher than normal CRBSIs at their facility (e.g., higher central line usage rates).

### Case Study

As part of the hospital's annual infection control risk assessment, CLABSI is listed as a priority based on performance of the organization not meeting value-based purchasing thresholds. The infection prevention team provides a detailed breakdown of the standardized infection ratio as well as central line standardized utilization ratio to target specific units which are high outliers for either or both infections or excess device utilization. Working collaboratively with vascular access and professional development, the team can use this information to create meaningful action plans and a standard method of assessment for improvement against institutional as well as accreditation and regulatory goals.

### Summary of Key Points

1. Surveillance for CLABSI is an active process which requires proactively reviewing data sources indicative of an infection.
2. CLABSI is a surveillance definition only. It is not synonymous with CRBSI and is not intended to offer guidance regarding patient care decisions. It is for the collection of data.
3. Blood is tested when there is a clinical suspicion of bloodstream infection. When a positive blood culture is present, the organism is classified as a pathogen or a commensal, and the appropriate next steps are followed.
4. There are specific criteria to be followed when determining whether a suspected

infection is labeled as a CLABSI or a secondary infection. The need to determine the role of the central venous catheter as the underlying source of infection may have clinical relevance to inform treatment decisions by the medical team.

5. Surveillance data can be used to help guide the vascular access team to areas for focused education or monitoring. The data is useful to:
  - (a) Compare one population's CLABSI incidence to another in a risk-adjusted manner.
  - (b) Compare central line device utilization ratios to see if a particular unit or population is using a higher percentage of central lines compared to similar units in other hospitals.

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