Review of Best Practices for CLABSI Prevention and the Impact of Recent Legislation on CLABSI Reporting

Benjamin Woodward\(^1\) and Reba Umberger\(^1\)

Abstract
Central line-associated bloodstream infections (CLABSI) are a very common source of healthcare-associated infection (HAI). Incidence of CLABSI has been significantly reduced through the efforts of nurses, healthcare providers, and infection preventionists. Extrinsic factors such as recently enacted legislation and mandatory reporting have not been closely examined in relation to changes in rates of HAI. The following review will examine evidence-based practices related to CLABSI and how they are reported, as well as how the Affordable Care Act, mandatory reporting, and pay-for-performance programs have affected these best practices related to CLABSI prevention. There is a disconnect in the methods and guidelines for reporting CLABSI between these programs, specifically among local monitoring agencies and the various federal oversight organizations. Future research will focus on addressing the gap in what defines a CLABSI and whether or not these programs to incentivize hospital to reduce CLABSI rates are effective.

Keywords
CLABSI, ACA, pay-for-performance, prevention, legislation, reporting

Introduction
Central line-associated bloodstream infections (CLABSI) are the third most frequent cause of healthcare-associated infection (HAI; The Joint Commission, 2012). Mortality rates from CLABSI are 12% to 25% and significantly increase cost and hospital length of stay (Centers for Disease Control and Prevention [CDC], 2011). Nurses are on the frontline of CLABSI prevention, contributing to the 58% decrease in CLABSI rates that has occurred between 2001 and 2009 (CDC, 2016). Despite their involvement in the process, they may not understand the implications that mandatory public reporting or current pay-for-performance programs may have on their hospital system. Statistics are readily available online for consumers to review how local hospitals compare with one another in terms of HAI rates and other critical factors that determine hospital quality. Favorable performance in these metrics attracts patients, influences accreditation boards, and may lead to salary bonuses. Mandatory public reporting of CLABSI and other HAI began in 2003 and has increased incrementally over time in terms of participation and what is required to be reported—37 states currently require reporting, while the rest are incentivized to do so (Herzig, Reagan, Pogorzelska-Maziarz, Srinath, & Stone, 2015; Stone et al., 2015). Hospitals are now facing extrinsic pressures to keep their CLABSI rates low; otherwise, they may experience a 1% reduction in Medicare reimbursement.

Pressure on hospital systems may enhance CLABSI safety and prevention efforts. Attempts at improving healthcare outcomes and cost are deeply interrelated, and this review of literature aims to summarize current knowledge regarding how extrinsic factors have affected rates of CLABSI.

Current State of CLABSI Prevention
Best evidence-based practice is a driver to intrinsically changing individual nurse behavior and individual hospital standards extrinsically influence nursing practice to achieve lower CLABSI rates. One of the most researched aspects of CLABSIs is testing various prevention methods. Study of best practices is important to review because the purpose of mandatory reporting, pay-for-performance, and the Affordable Care Act (ACA) are all designed at incentivizing hospitals toward implementing best practices and punishing those who fail to do so. CLABSI-prevention research has been pivotal in the gradual decline of CLABSIs and development of best practices implemented over the past decade,

\(^1\)The University of Tennessee, Knoxville, USA

Corresponding Author:
Benjamin Woodward, College of Nursing, The University of Tennessee, Knoxville, 1200 Volunteer Blvd., Knoxville, TN 37996, USA.
Email: bwoodwa4@vols.utk.edu
including studies focusing strictly on strict hand hygiene (Johnson et al., 2014), CLABSI-prevention bundles including interventions to increase hand hygiene compliance (Berenholtz et al., 2014; Guerin, Wagner, Rains, & Bessesen, 2010; Theodore et al., 2015), antimicrobial catheters (Rutkoff, 2014), and chlorhexidine baths (Dixon & Carver, 2010; Scheithauer et al., 2014). Hospital culture is an extrinsic motivator that plays a large role in the effectiveness of adopting these best practices (Fan et al., 2016). Intrinsic motivation, the degree to which individual healthcare providers drive toward and implement best practices, is difficult to cultivate but can be aided by champions of a particular healthcare improvement process who have stronger professional relationships with bedside nurses and physicians (Damschroder et al., 2009). If healthcare providers are unwilling to alter their practice, little change is likely to occur, and those attempting to improve hospital CLABSI rates should consider these intrinsic and extrinsic factors as equally important to establishing hospital protocols in line with best practice guidelines.

Although the reduction in CLABSI rates is an excellent trend, recent research indicates that rates can still be significantly reduced across the United States by applying a simple bundled approach. The bundle includes efforts to ensure best practices are being implemented, to improve safety culture and teamwork, and to provide feedback to leaders in quality improvement (Berenholtz et al., 2014; Guerin et al., 2010). There has been a vast amount of research devoted to discovering best practices related to CLABSI prevention, but this review will focus on the less-studied extrinsic factors related to CLABSI prevention.

**Regulatory Bodies and Their Roles in Mandatory Reporting**

The following three sections will cover the current process of reporting CLABSIIs. This information is important for nurses to understand because it will help them to understand why CLABSI has become such a large focus in hospitals. There are several regulatory bodies that determine whether a CLABSI is present, how they are coded for medical billing, and methods of reporting CLABSI to state and federal databases. The CDC and the National Healthcare Safety Network (NHSN) have guidelines for laboratory-confirmed bloodstream infection (LCBI), which determines whether or not a bloodstream infection is the result of a central line. Once a CLABSI has been identified, the CMS utilize the International Classification of Diseases (ICD) selected by providers to code the CLABSI for billing. The majority of states also require hospitals to report their CLABSIIs to the NHSN through providers coding with ICD and/or infection preventionists following LCBI guidelines. In states where this is not mandated, healthcare providers are incentivized to provide their ICD codes to payers such as CMS and private insurance companies. Each of these links in the chain of mandatory reporting is vital to ensuring accurate CLABSI identification at the levels of the patient, hospital, state, and nation.

**Identifying Patients With CLABSI**

According to further CDC guidelines, LCBIIs are divided into LCBI 1, LCBI 2, and LCBI 3 (LCBI 3 will not be defined or used due to its sole use in patients < 1 year of age, which is not the focus of this review). An LCBI 1 is defined as a patient with a recognized pathogen cultured from one or more blood cultures, and this cultured bacteria is not related to an infection at any other site. This confirms that the bloodstream infection is not related to another source of infection and is therefore determined to be caused by the central line. LCBI 2 requires that the patient have either fever (>38°C), chills, or hypotension, alongside positive blood lab results (cultures) that are not related to infection at another site. Finally, bacteria must be cultured from two or more blood tests drawn within a 24-hr period. LCBI 2 allows for diagnosis of a CLABSI when blood cultures reveal a microorganism that is not strictly pathogenic in nature (CDC, 2016). Recent changes occurred in 2015, with the CDC and NHSN (Patient Safety Manual, 2015) adding an extra table in their guidelines, which was “added to highlight site specific criteria that require blood cultures in order to meet a secondary BSI” (p. 1).

Culturing bacteria from blood samples taken from patients who are suspected to have a CLABSI is a pivotal piece in diagnosing the infection, as outlined in LCBIIs 1 and 2. If there are multiple central lines in place, they should be cultured at the same time, and oftentimes, the suspected catheter is removed to do so. Evidence-based practice calls for all short-term catheters such as peripherally inserted catheters (not peripherally inserted central catheters [PICC]), midline catheters, and non-tunneled central venous catheters (CVCs) to be removed, while long-term catheters such as PICCs and tunneled CVCs should be removed in the event of severe sepsis, thrombophlebitis, pulmonary embolism, and instances of bloodstream infection, which do not resolve within 72 hr following appropriate antibiotic therapy (Han, Liang, & Marschall, 2010). If removal of the line for culturing is not recommended, then the possibility of infection from any other sites must be ruled out (CDC, 2016). Culturing allows providers to know exactly what type of microorganism that they are trying to treat/eradicate, which allows for directed antibiotic therapy. In practice, it is illogical and dangerous to wait for culture results, and providers usually begin immediate treatment.

Catheter tips should not be routinely cultured unless there is a clinical indication that a CLABSI may be present (CDC, 2015c). Complexity can make this extremely difficult because patients may have several potential sources of infection. Current recommendations are to rely on clinical judgment when determining whether to remove a line and culture it; use of culturing methods that preserve the integrity of the
central line is recommended to prevent unnecessary expense and time by providers and the laboratory personnel (CDC, 2015a; Raad, Hanna, & Maki, 2007).

**Medical Billing for CLABSI**

Currently, the ICD Version 10 coding is the most used system of reporting medical diagnoses and procedures in the United States (CMS, 2015b). This classification system replaced ICD-9 starting on October 1, 2015 (World Health Organization, 2015). In this system, a specific numerical code is assigned to an individual diagnosis or medical procedure to facilitate easier reporting to surveillance system and insurance agencies. According to CMS (2015), hospitals are now required under the ACA to report their ICD findings and actions (including CLABSIs and HAIs) within this system to be eligible for full reimbursement. In short, if these codes are not reported, then Medicare or Medicaid will not pay for aspects of the bill. Hospitals with higher rates of CLABSIs will have their federal reimbursement rates cut, with the hope being that hospitals will take more measures and precautions to receive more of this money. Now that hospitals and healthcare providers are beginning to adapt and accept these measures as the norm, research is necessary to assess whether or not these goals have been met. Nursing research is beginning to fill this gap, concluding that increased communication between health departments and agencies such as CMS is occurring, but uniform definition of HAIs is still lacking between them (Stone et al., 2015). A great deal more study is needed to evaluate the success of these incentivizing or penalizing measures including perspectives on specific mandates.

**Reporting CLABSI at the National and State Levels**

As dictated by The Joint Commission on Accreditation of Healthcare Organizations (JCAHO), hereinafter referred to as The Joint Commission, CLABSIs are to be reported to the NHSN. Although not all states have legislated this mandate, there are incentives to report CLABSI in all states (The Joint Commission, 2012). For states that do not mandate reporting, there are still systems in place to transfer ICD codes to the CMS or private insurer to receive reimbursement. These systems are specific to each state that does not have mandatory reporting guidelines (Beck & Margolin, 2007). CLABSIs that are present on admission (POA), such as from contamination from a long-term central line, do not need to be reported to the NHSN. A CLABSI is considered POA if it occurs within two calendar days of admission (CDC, 2016). The hospital’s infection prevention (IP) team is the primary avenue of reporting as it collects data on infection rates throughout its healthcare facility. In general, if a CLABSI is suspected, an IP expert first examines the Electronic Medical Record (EMR) for cultures and evidence to determine whether the infection originated in a site other than a central line. IPs consult with the nurse managers, team leaders, bedside nurses, and providers to glean pertinent information related to the patient’s condition. For example, in patients who have a history of known intravenous (IV) drug use, some CLABSI cases have been linked to IV drug abuse in the hospital (Sammons, 2015). Ultimately, IP must prove that another site is responsible for the infection, or it must be considered a CLABSI and reported (CDC, 2016). The NHSN tracks HAIs in the United States.

**Problems With Current Reporting Guidelines**

The process of identifying and reporting CLABSI has been described as complicated and complex due to the ever-changing definition of what constitutes a CLABSI and ambiguity about where infections come from, and complex medical patients are at higher risk of contracting a CLABSI (Backman, Melchreit, & Rodriguez, 2010; Hazamy et al., 2013). Hospitals and infection preventionists use the LCBI system to report to the NHSN, while healthcare providers treat patients with CLABSI, who are assigned codes based on the World Health Organization’s ICD and used by the CMS and the NHSN. The NHSN is primarily responsible for surveillance of HAIs, whereas the CMS controls hospital reimbursement. These two systems should ideally reach the same findings regarding identification of CLABSI, but studies have shown that this is not always the case (Backman et al., 2010; Hazamy et al., 2013; Moehring et al., 2013). Incongruent interpretation between IP and healthcare providers can distort reported CLABSI rates and hospital reimbursement. With the advent of ICD-10 coding in October of 2015, adequacy in training of healthcare providers in a completely revamped system is currently unclear (World Health Organization, 2015). Also a problem is the fact that only two methods of CLABSI exist (LCBI and ICD). There is movement to combine these two systems (Stone et al., 2015), but healthcare providers may not have time to constantly update their understanding of what currently constitutes a CLABSI. Although healthcare providers are not directly responsible for coding each diagnosis (this is the responsibility of trained coders), they must have adequate support through labs, assessments, and cultures to justify their medical interventions. New definitions of requirements for confirming diagnoses are constantly changing, and healthcare providers must keep up with these changes to ensure accurate documentation and application of best practices.

**Real-World Examples of Problems in CLABSI Reporting**

In a retrospective chart review study performed in Connecticut from January 2009 through April 2009 in 30 adult intensive care units (ICUs) and 3 pediatric ICUs (30 acute care hospitals), 476 septic events were identified (Backman et al., 2010). Forty-eight
of these events were diagnosed as CLABSIs according to guidelines outlined by the NHSN and previously in this article. Twenty-three (48%) of these CLABSIs had been reported to the NHSN, leaving 25 (52%) CLABSIs, as defined by the reviewer who utilized LCBIs 1 and 2 criteria, unreported. “Thirteen (43%) hospitals were responsible for the 25 infections not reported” (Backman et al., 2010, p. 384). This led to a deficit between the hospital’s reported rate of 1.97 infections per 1,000 central line days and the actual rate of 3.51 per 1,000 central line days for this period as determined by the researchers.

Going deeper into the data, 76% of the unreported CLABSIs were diagnosed using LCBI 1 (as outlined in the “Introduction” section of this article), leaving 24% of the unreported CLABSIs being diagnosed with LCBI 2. In general, underreporting appeared to be the trend, but certain hospitals also fell victim to over-reporting bloodstream infections that could be traced to sources other than a central line. In discussion, the primary cause of this under- and over-reporting was believed to be confusion by providers and IP staff about surveillance definitions of CLABSIs and could also be related to complex cases where sources of infection are unclear. This confusion is compounded if central venous catheters are simply removed without culturing once other sources of infection are ruled out. Physicians are rightfully more concerned with treating what they see as a bloodstream infection rather than spending valuable time determining whether this infection fits the specific requirements for a CLABSI. It is IP’s job to investigate and determine the source of infection, but retrospective communication is likely inadequate for analysis of all the factors in play at the time of infection. Attributing positive blood cultures to CLABSI can be challenging. The researchers concluded that further education and training would be necessary to ensure that all healthcare providers achieve a uniform definition of what requirements the NHSN has for reporting of CLABSIs (Backman et al., 2010).

In the state of New York, as of 2007, hospitals are required to publically report instances of CLABSIs. To ensure that protocols were followed, a large portion of the hospitals were audited by a group of researchers to examine their medical records of positive blood cultures obtained between 2007 and 2010 (Hazamy et al., 2013). Included in this study were 306 adult ICUs and 30 pediatric ICUs. In total, 5,697 patient records were audited; 3,104 (54%) had a central line in place; and 650 (21%) of these patients with a central line were determined to have a CLABSI based on the reviewer’s interpretation. The amount of disparity between the reviewer’s findings and reports to the NHSN steadily decreased from 14% to 6% during the period of the study, which was likely attributed to feedback from the reviewers. In the final year (2010), the reviewers found 57 missed CLABSIs, with misinterpretation of what defines a CLABSI being the most likely cause of this error (57%), and missed by surveillance (provider did not include CLABSI in the differential) being the second most likely (35%). In conclusion, this study found that audits of hospitals and their patients was an effective method for reducing confusion of CLABSI definition between IP staff and the NHSN (Hazamy et al., 2013). Researchers looking at 44 hospitals in Oregon also found a disparity between the CLABSIs found by hospitals when compared with the researchers applying strict definitions, but they were able to improve accuracy through feedback given to the hospitals (Oh et al., 2012). Feedback appears to be a simple and effective way to help hospitals ensure they are properly identifying infections.

These studies showed how the definition of a CLABSI is oftentimes misinterpreted and misreported as a result. The CDC is aware of problems in surveillance, noting that decisions from IP to report to the NHSN can be overruled, and clinicians may alter their diagnostic process to avoid classifying an infection as hospital-acquired. They affirm that this is an uncommon practice, but the fact that it exists is worrisome and puts patients in danger of overuse and underuse of diagnostic tests (CDC, 2015b). Despite this, with proper surveillance and education, hospitals and the NHSN can reach a uniform approach of identifying CLABSIs, which would promote accurate reporting and knowledge of where we are in preventing these infections. Without uniform and accurate reporting guidelines, which are understood by all healthcare providers, further study of prevention methods could be inaccurate as a result of faulty reporting. This is a pivotal area, which must be closely studied to fill in any gaps that could impede the progress of current and future studies.

**Differences of Reporting: ICD-9/10 CDC/CMS Versus NHSN**

The CDC (2015a) determines criteria for defining CLABSI. The ICD captures CLABSI based on provider diagnoses and treatment. The top 10 leading ICD discharge diagnoses are often used by health services researchers and other researchers; yet, there is some evidence that discrepancies exist between classification of CLABSI by clinicians coding using ICD and by infection preventionists applying CDC guidelines. These discrepancies indicate a need for standard definitions to be applied (Backman et al., 2010; Hazamy et al., 2013; Moehring et al., 2013). IPs use strict definitions provided by the CDC. The CDC requires that each case be reviewed and categorized as a LCBI-1 or LCBI-2. Providers code their diagnoses through ICD.

This review will now shift focus toward pay-for-performance programs, which are powerful mandates allowing Medicare to adjust reimbursement based on certain criteria (CMS, 2013).

**Pay-for-Performance**

The “Hospital Value-Based Purchasing” program as outlined by Medicare adjusts the amount that the government agency pays out to hospitals based on a total performance
score (CMS, 2013). The total performance score is calculated using clinical process of care (20%), patient experience of care (30%), efficiency (20%), and the outcome (30%). The clinical process of care focuses on five critical areas of care including acute myocardial infarctions, heart failure, pneumonia, surgical care, and HAIs. Value-based purchasing for CLABSI was not implemented until 2015 (CMS, 2013). Medicare wants improvement in these areas and has established a plan to reward good care and punish unsatisfactory care. The HAI section is particularly interesting, outlining the specific performance measures of giving patients an antibiotic within 1 hr of surgery, surgical patients being given the right kind of antibiotic to help prevent infection, and subsequently stopping unnecessary antibiotics within 24 hr after surgery. The patient experience of care encompasses a wide variety of care domains, including communication with healthcare providers, pain management, and overall rating of the hospital. Medicare reimbursements are designed to efficiently incentivize hospitals to provide services at a reasonable cost. The spending is standardized for geographic location and overall patient health status. The final piece in the total performance score is the outcome, assessed by 30-day mortality rates, which can be linked to the overall quality of care that a patient receives (CMS, 2013).

Treatment for CLABSI can last anywhere from 7 days to 6 weeks depending on the cultured organism and the patient’s response to therapy (Han et al., 2010). The average cost per inpatient day in the United States is US$2,212, although this figure likely underestimates daily cost due to most patients with CLABSI being treated in a more expensive ICU setting (Kaiser Family Foundation, 2014). On average, CLABSI diagnosis increases the cost of a hospital stay by US$30,919 to US$65,245 with an average of US$45,814. In the majority of cases, the hospital is responsible for covering these additional costs (Zimlichman et al., 2013). Vancomycin is the treatment of choice when treating CLABSI, and in instances of severe sepsis, severe illness, or an immunocompromised patient, coverage for gram-negative bacterial infection should be included. These agents may include a “fourth generation cephalosporin, a carbapenem, or a β-lactam/β-lactamase inhibitor combination, with or without an aminoglycoside” (Han et al., 2010, p. 153).

Due to the novelty of these pay-for-performance programs, there is only a small pool of empirical studies using both an experimental and control group for direct comparison. It is likely that studies are currently being performed as hospitals adapt to these new policies under the ACA, but it is important to know whether or not these programs are effective at improving long-term patient outcomes. Early research has found moderately positive results from pay-for-performance, but it is the job of the researchers to continue working to close the new gap, which has opened up with the advent of these pay-for-performance programs.

Pay-for-Performance Influence on HAI
A study was conducted to evaluate the pay-for-performance program on improving quality of care (Werner, Kolstad, Stuart, & Polsky, 2011). Two hundred sixty hospitals were included in this program, with 780 hospitals used as the control group. The researchers used several methods to try to create congruency between the experimental and control groups, including current hospital costs and risk-standardized mortality rates. The top 20% of hospitals eligible for incentives received bonus funding from Medicare and Medicaid proportional to their current level of compensation. Hospitals with poor trends or consistently high rates of hospital-associated infection were forced to pay penalties as a result of unsatisfactory performance. During the first 3 years, more than half of the pay-for-performance hospitals achieved high performance scores, whereas less than a third of the control group did. After 5 years, though, both groups became nearly identical in their performance scores. The hospitals that saw the greatest improvement were those with low competition and a chance for large monetary reimbursement. From this study, it is obvious that more research needs to be done to assess the effectiveness of pay-for-performance programs, and also that these programs will need to be tailored specifically to hospitals depending on a wide variety of factors (Werner et al., 2011). Another study on pay-for-performance programs noted general improvement in hospitals as a result of their implementation, but they also called for studies evaluating pay-for-performance programs in conjunction with mandatory reporting laws (Kahn Iii et al., 2015). Another study measuring similar variables also found that hospital costs decreased and patient satisfaction increased where these programs were in place (Stanowski, Simpson, & White, 2015). In general, it appears that initial studies on pay-for-performance programs are finding positive outcomes, but aspects of mandatory reporting are widely left out of their research.

In a study focused on the impact of pay-for-performance programs in relation to hospital-operating margins, researchers found that hospitals already experiencing financial pressure (lowest quartile of operating margins) saw decreased CLABSI rates after the CMS halted reimbursement for hospital-acquired conditions (Lee, Calderwood, Vaz, Jin, & Grant, 2015). Hospitals in the highest quartile of operating margins did not see this decrease (Lee et al., 2015). This seems to indicate that the effectiveness of pay-for-performance programs is specific to each hospital’s financial situation.

Limitations
This review was limited in scope and did not review studies focused on patient-specific risk factors such as increased susceptibility to infections due to immunosuppression. The studies examined were generally longitudinal in nature, and
the effectiveness of interventions was compared with observations from before their implementation.

**Conclusion**

Although research on CLABSIs has been widespread and fairly comprehensive, new federal legislation such as the ACA has created gaps in our knowledge about how the use of incentives and penalties affects reporting and incidence of HAIs such as CLABSIs. Studies have been conducted in various states on how effective these measures are at achieving their goals, but to truly capture its ramifications on a widespread scale, each hospital needs individual analysis. States and specific hospitals include a unique environment that may respond well or poorly to generalized legislative measures and should be individually analyzed. Laws and legal guidelines are perhaps one of the most drastic instances of inciting this change to happen. Obviously, some regulations may be unhelpful or even harmful in furthering healthcare’s progress, but it is impossible to know for sure what the ramifications are without focused study and analysis.

Although it seems unlikely that we will ever live in a world without these deadly infections, there is still obvious room for improvement, which can reasonably and economically be attained. New programs such as pay-for-performance have recently been established, which focus particularly on rewarding hospitals who are successful at reducing their rates of HAIs and withholding funds from those that are unsuccessful at doing so. Research of CLABSIs includes prevention, development, detection, and reporting of CLABSIs. All of these are interrelated and necessitate further research, especially by nurses. Nurses are in key roles to save lives and reduce hospital costs by implementing best practices to decrease the incidence of CLABSI.

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**Author Biographies**

**Benjamin Woodward**, RN is currently a new graduate registered nurse in the University of Tennessee Medical Center’s nurse residency program. He works in the Trauma-Surgical intensive care unit.

**Reba Umberger**, PhD, RN, CCRN-K is an assistant professor at the University of Tennessee Knoxville College of Nursing. Dr. Umberger’s program of research is focused on immune suppression in patients with sepsis (including genetic, epigenetic, and environmental risk factors for subsequent infections) and long term outcomes in survivors of sepsis and their informal caregivers.