How to Cite:
Alshammari, F. A. M. (2022). Prevention of central line-associated bloodstream infection via quality improvement. *International Journal of Health Sciences*, *6*(S10), 1908–1913. https://doi.org/10.53730/ijhs.v6nS10.15207

Prevention of central line-associated bloodstream infection via quality improvement

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***Abstract*---**Central line-associated bloodstream infection (CLABSI) is defined as a laboratory-confirmed bloodstream infection not related to an infection at another site when a central line was in place for more than two calendar days. The most common mechanism of CLABSI is bacterial entry into the bloodstream via the part of the central line that extends outside the patient's body. Patients with most types of bacteria can develop a CLABSI, so it is essential to target each to improve care and intervention. Improvement strategies such as quality improvement initiatives have the potential to lower the prevalence of CLABSI in patients who need central venous catheters to receive proper care.

***Keywords*---**CLABSI, infection, bloodstream.

1. Introduction to CLABSI (Central Line-Associated Bloodstream Infection)

Central line-associated bloodstream infection (CLABSI) is defined as a laboratory-confirmed bloodstream infection not related to an infection at another site when a central line was in place for more than two calendar days. A bundle is a structured way of improving the processes of care and patient outcomes: a small, straightforward set of evidence-based practices — generally three to five — for improving the care of patients. The CLABSI prevention approach focuses on preventing pathogen entry at the catheter insertion site and promptly treating infection or inflammation around the line, if it occurs. Typically, dialysis, chemotherapy, and other intravenous (IV) medications are given concurrently with the use of a central line. Patients requiring longer hospital stays, a surgical operation, or who are critically ill may also need a central line for monitoring, nutrition, or blood products. One of the major reasons for CLABSI is that the skin of patients is colonized with bacteria, and the central line can provide a direct pathway for bacteria to enter the bloodstream, thereby causing an infection. The CLABSI rates are higher among hospital patients, critically ill patients, and high-risk newborns.

The most common mechanism of CLABSI is bacterial entry into the bloodstream via the part of the central line that extends outside the patient's body. This might happen if the central venous catheter hub diaphragm and the catheter cap are contaminated during the course of manipulation and might lead to bacterial entry into the bloodstream. Patients with a central line are at a high risk of mortality, morbidity, and extended stays in healthcare settings. The primary reason for the extended hospital stay is to manage infections that develop as a result of the insertion of a central line. Healthcare infections, such as central line-associated bloodstream infections, can cost up to $56,000 per infection and $13,309 per central line. It is reported that 30,927 CLABSIs occurred among patients in U.S. acute care hospitals in 2011. It was estimated that 10% of the bacteria obtained from pediatric septicemia is due to intravascular catheter-associated infection in hospitals in Cyprus. Understanding the epidemiology and presenting signs of CLABSI can help prevent and treat the condition. Patients with chemotherapy or indwelling catheters for dialysis are at a high risk for CLABSI, although their presence may not have caused the infection. A patient can develop a CLABSI in a hospital or at home within 48 hours to more than a week of central venous catheter insertion and is characterized by a low absolute neutrophil count. It is also reported that almost half the bacteria are due to the use of central venous catheters in hospitalized patients. Prevention of CLABSI in a timely manner is necessary to decrease rates of long hospitalization, side effects, and deaths. Patients with most types of bacteria can develop a CLABSI, so it is essential to target each to improve care and intervention. Improvement strategies such as quality improvement initiatives have the potential to lower the prevalence of CLABSI in patients who need central venous catheters to receive proper care. (Malek & Raad, 2020)(Pitiriga et al.2022)

2. Quality Improvement Initiatives in Healthcare Settings

Quality improvement initiatives in healthcare settings aim to provide a high-quality, safe environment for patients and their families to receive care. Healthcare systems are complex, and their design makes it difficult to quickly identify and rectify problems. Therefore, the foundational principles of these initiatives are always to continuously assess, as well as to make iterative changes directed at the goal of improving care for the individuals that the organizations serve. Many well-known frameworks and methodologies have been employed in order to facilitate these goals. The Plan-Do-Study-Act cycle is one common setup that allows for small tests or changes to be made in order to establish if the hypothesis being tested actually improves or affects outcomes in a meaningful way. After each cycle, the data is analyzed, and further adjustments are made. This iterative process is continued until the goal is reached.

Multiple system supports must be in place in order to foster a culture of quality where quality improvement and patient safety work is essential for an organization. These supports include having strong leadership to set the culture and direction at an institution, a well-functioning leadership team, and teams of individuals in diverse areas of operation that are able to work independently but also cohesively with the other parts of the organization to reach shared goals. Active participation in teamwork, coupled with a culture of trust, transparency, and open communication, is key to success in this environment. Extended

support in areas such as education and training, as well as dedicated time for healthcare workers to participate in ongoing quality improvements and brainstorming, are all invaluable to innovation and creativity, as well as to the improvements achieved. Data also forms the cornerstone of quality improvement: it is used in baselining to recognize what the problem being addressed actually looks like and how big the issue is, but it also functions as the way in which progress and outcomes are measured and sustained.

Many healthcare organizations have successfully implemented quality improvement programs to heighten their ability to deliver safe care. Initiatives such as Six Sigma, which aim to diminish the number of failures in a given course of action, have been successfully utilized to address issues ranging from patient safety to hospital efficiency and patient satisfaction. Specific work within this field includes reports of the effective reduction in pneumonia rates in ICU patients by lessening the associated ray exposure, as well as central line-associated bloodstream infections. Alongside early work in the intensive care unit setting towards ensuring effective management of central lines in the clinical environment, these infections have remained an ongoing and persistently challenging issue facing workers across the spectrum of clinical care. They are the most serious and lethal of the healthcare-acquired infection categories, with relatively high mortality rates, extended lengths of stay, and an increase in healthcare-related monetary costs. Many quality improvement initiatives have therefore focused upon and capitalized on the prevention of these infections. The success of these initiatives forms the basis of certain thematic work in an extended study undertaken over 30 months, and a team made up of people from different areas aims now to analyze in detail how this success was reached in order to recommend its continuity further.

3. Strategies for Preventing CLABSI through Quality Improvement

Central Line-Associated Bloodstream Infection (CLABSI) remains a significant source of patient morbidity and mortality and a costly problem for society, despite its status as both preventable and not reimbursable. The majority of randomized interventions to decrease CLABSI have used quality improvement endeavors, with intensivist- or nurse-driven protocols, over reduced periods of time. This descriptive review focuses on interventions designed to prevent CLABSI via a quality improvement framework, concentrating on the recent data often excluded from earlier reviews. (Novosad et al.2020)(Alwazzeh et al.2023)

A review of the literature emphasizing quality improvement interventions to decrease CLABSI between the years 2007 and 2017 was conducted. Presentation included how programs foster a culture of safety and ongoing monitoring and feedback loops and introduce both complex multifaceted programs using checklists, bundles, and other methods to ensure compliance with infection prevention protocols, as well as interventions that emphasize proper catheter insertion and maintenance. Several quality improvement interventions have been found to effectively prevent CLABSI. Staff need to understand the importance of the central line-associated bloodstream infection (CLABSI) as a problem for those putting in a central line, as well as a preventable patient safety issue for those who receive central lines. Training and information about CLABSI prevention,

particularly the importance of additional sterile technique use in high-risk patients, is important. Central line use should follow an established standard or guideline and be reviewed by the healthcare professional and organization responsible for insertion. Data should be collected to ensure that the established standard for central line insertion is followed. Updates and/or future checklists may need to be made, dependent on ongoing review of the data. Data should be collected on line insertion procedure adherence. Healthcare organizations should be informed about the relevant data. The specific interventions can be discussed with the patient's healthcare providers.

4. Implementation of Evidence-Based Practices

That evidence-based practices (EBPs) hold the potential to prevent many central line-associated bloodstream infections (CLABSI) provides little comfort to public health practitioners and healthcare quality improvement personnel who must actually implement these techniques. Implementation typically refers to translating research findings or evidence-based practices developed in a study into real-world settings. Often, such implementation requires both organizational changes and changes in the workflow of individual providers. An alternate terminology is dissemination, which often has a top-down, administrative, and public health orientation and allocation of resources by a central office.

Stakeholder engagement in the identification of these EBPs is essential for their ultimate successful adoption, particularly within a large or complex healthcare organization. Communication and trust are important for ongoing monitoring and evaluation of EBPs to ensure their effectiveness. It is essential that efforts around identification and implementation of EBPs include interdisciplinary stakeholders relevant to the intervention, as well as target patient employees and departments. The "identification, selection, and implementation of meaningful innovations" was subsequently recognized as a means of optimizing quality of care across all transplant domains. Once EBPs are agreed upon or disseminated, what factors help or hinder their integration into the systems of care? Respondents often resist changes at both the unit level and the facility level. This confirms the findings of slower percentages of SIC standing order adopters one year post-intervention. Staff changes can bring these issues to light, and there remains a need to educate staff and assess resources and identify barriers to implementation. Evaluation of interventions using observational and/or controlled study designs can help identify and promote the implementation of EBPs. Video case studies are presented in this report as examples of successful implementation of evidence-based protocols to show dramatic declines in healthcare-associated infections for targeted settings, from the outlying tertiary care teaching hospital to small rural hospitals. Thus, these studies demonstrate that substantial reductions in CLABSI in specific settings can be achieved by diligent adherence to well-researched EBP guidelines appropriate to the patient population and institution's resources. These video presentations of the background, evolution, and jury-mandated implementation of the EBP protocols are designed for Thursday and Friday sessions of the workshop.

5. Outcomes and Impact of Quality Improvement Efforts

Outcomes are primarily evaluated in relation to the overall progress of reducing CLABSI in the NICU. For infants with a central line, the monthly CLABSI rate has been as low as 0.98 per 1,000 line days. In fiscal year 2018, there were no reported cases of proven ventilator-associated pneumonia. Our NICU has been CLABSI-free for 139 consecutive months. Focus group discussions reported a high level of satisfaction from mothers regarding central line care for their infants. Internally, this quality improvement project has increased staff awareness of the synergistic effects of teamwork and the utilization of evidence-based care on improving outcomes. It has resulted in the addition of an adult and pediatric line infection reduction initiative. This study provides further evidence in neonates that CLABSI is preventable. This interpretation is supported by the observation that the strong effort to minimize CLABSI was not associated with increased colonization. The collaborative effort could not have been sustained over time without the staff continuously refining the optimal protocols and strategies to minimize CLABSI in these medically fragile patients. This team's efforts have shown that fewer CLABSI are consistently achievable when many centers are also focused on infection control. National public health action initiatives designed to accelerate CLABSI prevention parallel our improvement. The widespread publication of brochures and solicitation of editorial support reinforces the national relevance of the problem and our successful solution. (Kim et al.2021)(Hussain et al.2021)(Khieosanuk et al., 2022)

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