

Reducing Central Line–Associated Bloodstream Infections With a Multipronged Nurse-Driven Approach

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BACKGROUND Despite implementation of central catheter bundles, central line [catheter]–associated bloodstream infections (CLABSIs) remain a preventable hospital-acquired infection.

LOCAL PROBLEM A new population of patients with pulmonary artery catheters was introduced to the cardiac progressive care unit, increasing central catheter days, device use, and CLABSI rate.

METHODS A quality improvement project was conducted. Nursing staff implemented a standardized central catheter rounding process 3 days a week to critically assess all central catheter dressings, determine the necessity of each central catheter, and educate patients on the importance of keeping central catheter dressings clean, dry, and intact. Data were collected during central catheter rounds for each patient, entered in an electronic survey tool via mobile devices, and analyzed.

RESULTS From July 2019 through June 2022, a total of 2692 rounds were conducted for 707 individual patients with 3064 central catheters. Main interventions were dressing management, monitoring insertion site bleeding that extended beyond edges of the chlorhexidine gluconate pad, treating patients' allergies to products, and maintaining sustainability within the unit. Central catheter rounds decreased the CLABSI rate from 1.86 to 0.0 despite the continued increase in central catheter days.

CONCLUSIONS Central catheter dressing assessment, intervention, and education help reduce CLABSIs. Central catheter rounds are an important adjunct to the CLABSI bundle. A central catheter dressing management algorithm helps nurses decide when to change a dressing and which type of dressing to use. (*Critical Care Nurse*. 2024;44[4]:27-36)

CE 1.0 hour, CERP B

This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:

1. Identify when a central catheter dressing requires an intervention.
2. Discuss 3 interventions used to decrease the central line [catheter]–associated bloodstream infection rate.
3. Describe 2 interventions to consider for patients with skin allergies or dermatitis.

To complete evaluation for CE contact hour(s) for activity C2482, visit aacnjournals.org/ccnonline/ce-articles. No CE fee for AACN members. See CE activity page for expiration date.

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Central catheters are commonly used in the treatment of patients in acute and chronic care settings. A central catheter is an intravascular catheter that terminates at or close to the heart or in one of the great vessels and is used for infusion, blood withdrawal, or hemodynamic monitoring.¹ The use of a central catheter can result in a bloodstream infection.^{1,3} The US Centers for Disease Control and Prevention¹ defines a central line [catheter]–associated bloodstream infection (CLABSI) as a primary bloodstream infection in a patient who had

a central catheter for more than 2 consecutive calendar days following the first access of the central catheter during

Using a flashlight for better visualization, nurses assessed the insertion site for infection, ensured that edges of the dressing were intact, and evaluated how much blood was on the CHG pad and dressing.

the current inpatient admission. Additionally, a bloodstream infection is not related to an infection at another body site.^{1,4} Central line [catheter]–associated bloodstream infections are estimated to cost institutions from \$17 896 to \$129 000 per infection.^{5–8} Prevention of CLABSIs is a nursing-sensitive quality care indicator aimed at improving patient outcomes at the unit level.^{3,9}

Studies have examined interventions used before and after catheter insertion to reduce CLABSIs. The use of a central catheter insertion and maintenance bundle is an evidence-based practice that improves patient outcomes.^{10–12} Central catheter insertion bundles include appropriate hand hygiene, skin cleaning with chlorhexidine gluconate (CHG), and sterile barriers.^{2,10–12} Maintenance bundles include catheter

site care; catheter hub, cap, and tubing care; hand hygiene before manipulation of the intravenous catheter system; alcohol scrub of infusion ports before each use; changes of dressings that are wet, soiled, or not changed for 7 days; use of aseptic techniques when accessing the central catheter; daily inspection of the insertion site and dressing; application of a CHG-impregnated sponge at the insertion site; and review of the need for the central catheter and prompt removal when it is no longer clinically indicated.^{11–13}

Local Problem

A new population of patients with pulmonary artery catheters and sheath introducers was brought to the cardiac progressive care unit. Some patients with pulmonary artery catheters and heart failure required medication optimization; others were being listed or waiting for a heart transplant. Because of this new patient population, the number of central catheter days increased from 1544 in fiscal year 2017 to 2688 in fiscal year 2018, and the device utilization rate (calculated as the number of catheter days divided by patient days on the same unit) increased from 0.23 in fiscal year 2017 to 0.31 in fiscal year 2018. The CLABSI rate (calculated as the number of patients who have a central catheter in a given location for each day of the month) also increased from 0.65 in fiscal year 2017 to 1.86 in fiscal year 2018. Many of the patients who developed a CLABSI had end-stage heart failure or were waiting for a heart transplant, and an infection prolonged their hospital stay.

Purpose

Despite adoption of standard CLABSI bundles^{2,10–13} with a high compliance rate, CLABSIs continued to occur. Therefore, we conducted a quality improvement project to investigate the risk factors for these events by analyzing data collected during central catheter rounds. We designed and implemented a multipronged nurse-driven process to assess dressing placement, quality of the catheter insertion site, and communication between nurses and physicians. Rounds for all patients with a central catheter were conducted 3 times a week under the guidance of a bloodstream infection champion nurse and a clinical nurse specialist. The goals were to ensure central catheter bundle adherence and proper dressing management. The rounds were intended to promote open communication and education regarding central catheters among patients, nurses, and physicians.

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Methods

The multipronged nurse-driven quality improvement project using the plan-do-study-act method was conducted at a 24-bed university-affiliated academic hospital. The institutional review board deemed the initiative a quality improvement project and not human subjects research.

In collaboration with the interprofessional teams, we enhanced several systems to promote patient safety. These enhancements included implementing standardized rounds by nurses 3 days a week; critically assessing all central catheter dressings; determining the necessity of each patient's central catheter; and educating patients on the importance of keeping their central catheter dressings clean, dry, and intact. Patients with central catheters were identified through the electronic medical record. Upon entering a patient's room for rounds, nurses explained to the patient and/or support person that the purpose of the central catheter rounds was to assess the central catheter dressing to minimize the risk for infection. The nurses also explained the advantages of using CHG soap and how to monitor for signs of infection. Using a flashlight for better visualization, nurses assessed the insertion site for infection, ensured that edges of the dressing were intact, and evaluated how much blood was on the CHG pad and dressing. Patient data were entered into an electronic survey tool via a mobile device during central catheter rounds.

Dressing Management

A benefit of conducting repeated catheter rounds was identifying trends in dressing management. The first intervention was minimizing exposure of new sterile insertion sites with dressing changes. The existing practice was to place an initial gauze dressing after insertion of a new central catheter in case the insertion site bled; this dressing was changed in 24 hours. This gauze dressing did not have any infection-fighting properties and exposed the new central catheter to risk of infection during the change. In partnership with the interdisciplinary teams, we changed the initial dressing from gauze to a CHG-impregnated transparent dressing¹⁴⁻¹⁶ unless a site had significant bleeding. This new hospital practice reduced the number of dressing changes, saved time for nurses, increased patient comfort, and decreased the risk for infection. Another dressing management change was to reinforce dressings with loose edges when the insertion site was not exposed during the central catheter rounds.

Bleeding

The second intervention was monitoring the amount of blood on the dressing. According to the manufacturer's guidelines,¹⁷ a CHG pad can absorb 3 times its weight in blood while maintaining antimicrobial effectiveness. If a site was not obscured and blood remained in the gel pad, the dressing was left intact. If a site had visible blood outside the gel pad, the dressing was changed. This rule had an occasional outlier because some patients were receiving blood thinners that prevented the insertion site from remaining dry. For these patients, a hemostatic agent was used to control the bleeding with gauze and the site was reassessed the next day. According to the manufacturer's recommendation, the hemostatic agent could be left in place until the next scheduled dressing change and the dressing could be reassessed daily.¹⁸

Skin Allergies

The third intervention was treating patients' skin allergies to tape and CHG, which many patients reported during rounds. For these patients, we used alternative measures to reduce dermatitis, pruritus, and patient discomfort. If a patient had a CHG allergy, nurses used povidone-iodine to clean the area and placed a silver patch at the insertion site instead of using CHG. Silver has infection-fighting properties^{19,20} and a broad antimicrobial spectrum against bacteria, fungi, and viruses.²⁰

To prevent dermatitis caused by tape, nurses placed sterile thin hydrocolloid on the skin after cleaning the skin and using skin preparation solution. Hydrocolloids adhere to the skin and absorb exudate, facilitating skin healing.²¹ The hydrocolloid protects the skin from the tape and

gives the skin time to heal. The transparent tape used to secure the dressing was placed on the hydrocolloid. Patients expressed immediate relief when hydrocolloid was used because their skin was no longer irritated. Patients appreciated this effort because they felt heard and acknowledged when measures were taken to prevent dermatitis before redness, skin breakdown, and infection developed. Pictures of the skin at the initial appearance of dermatitis and at subsequent dressing changes were documented

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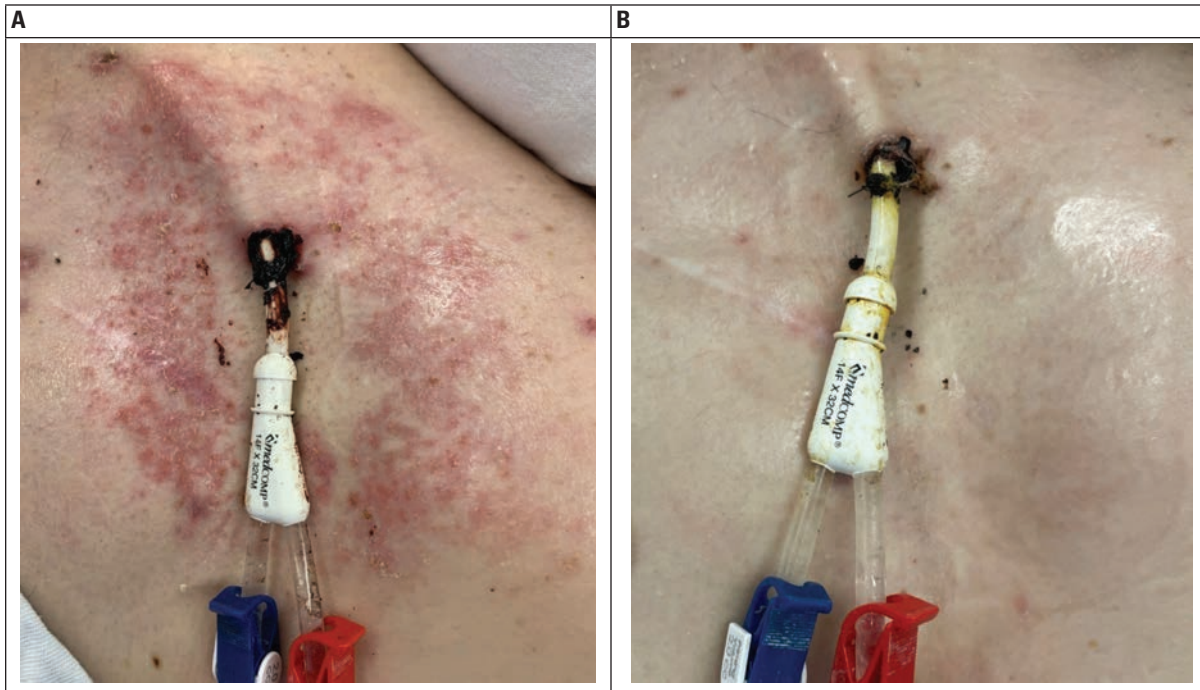


Figure 1 Appearance of the skin before and after using povidone-iodine, hydrocolloid, and silver. A, Dermatitis present before intervention. B, Dermatitis resolved after intervention.

in the electronic medical record to track improvement (Figure 1).

Sustainability

The fourth intervention focused on making these methods sustainable by embedding the education into the unit culture. We provided interdisciplinary feedback to nurses and interdisciplinary partners with weekly emails to staff members, one-on-one mentoring during dressing changes, and notes in the electronic medical record. Emails sent on Wednesdays after central catheter rounds included photographs of central catheter dressings and insertion sites (Figure 2) and were written with bullet points for quick reading. One-on-one mentoring and feedback helped build nurses' skills and confidence as they learned the various dressing techniques being used. We developed a dressing change algorithm for the nurses to follow (Figure 3).

Results

Over a 3-year period from July 1, 2019, to June 30, 2022 (fiscal year 2020 through fiscal year 2022), a total of 2692 central catheter rounds were conducted for 707 individual patients with a total of 3064 central catheters. Most patients (478) were male. Patients ranged in age

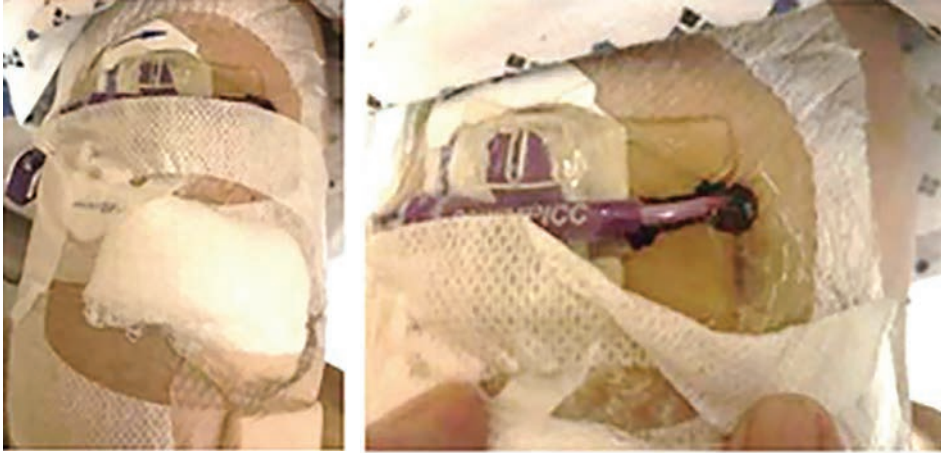
from 18 to 91 years; most patients (230) were in the age group of 61 to 70 years (see Table).

The most frequently encountered central catheters were peripherally inserted central catheters, followed by pulmonary artery catheters with exit sites primarily at the neck (internal jugular vein), tunneled hemodialysis catheters with exit sites primarily on the upper chest, and nontunneled hemodialysis catheters with exit sites at the neck. Tunneled small-bore/Hickman/triple-lumen catheters had exit sites primarily on the upper chest. Tunneled catheters can be inserted in the subclavian vein or the internal jugular vein, exiting on the patient's upper chest. Of the 3064 central catheters assessed, most dressings (2040 [66.6%]) were clean, dry, and intact; 275 dressings (9.0%) were not secure; and 123 of the 767 bloody dressings (16%) had blood extending beyond the edges of the CHG pad, requiring intervention to mitigate the risk for a CLABSI. A small number of patients (25 [3.5%]) reported allergies to CHG, tape, or both. Central catheter rounds conducted by nurses 3 times a week decreased the CLABSI rate (calculated as the number of CLABSIs divided by the number of central catheter days and multiplying the result by 1000) from 1.86 to 0.0 despite the continued increase in central catheter days.

WHAT'S WRONG WEDNESDAY!

Eyes on the prize for zero BSIs

Don't make assumptions of what a site looks like:



When to change a CHG dressing:

1. CHG saturated more than 40%
2. Blood beyond edges of the CHG pad
3. CHG pad not covering insertion site

What's wrong with this dressing?

1. Tape preventing insertion from being visible.
2. CHG pad did not cover the insertion site.
Ideally, the CHG should extend beyond the insertion site an inch.

Intervention

Dressing changed.

Another reason to always visualize your dressings:



What's wrong with this dressing?

1. 80% blood on CHG pad
2. Blood beyond edges of CHG pad, onto outer tape layer.
3. CHG pad was pitting. If the pad is like "pitting edema" it means the CHG is no longer active because it absorbed too much blood.

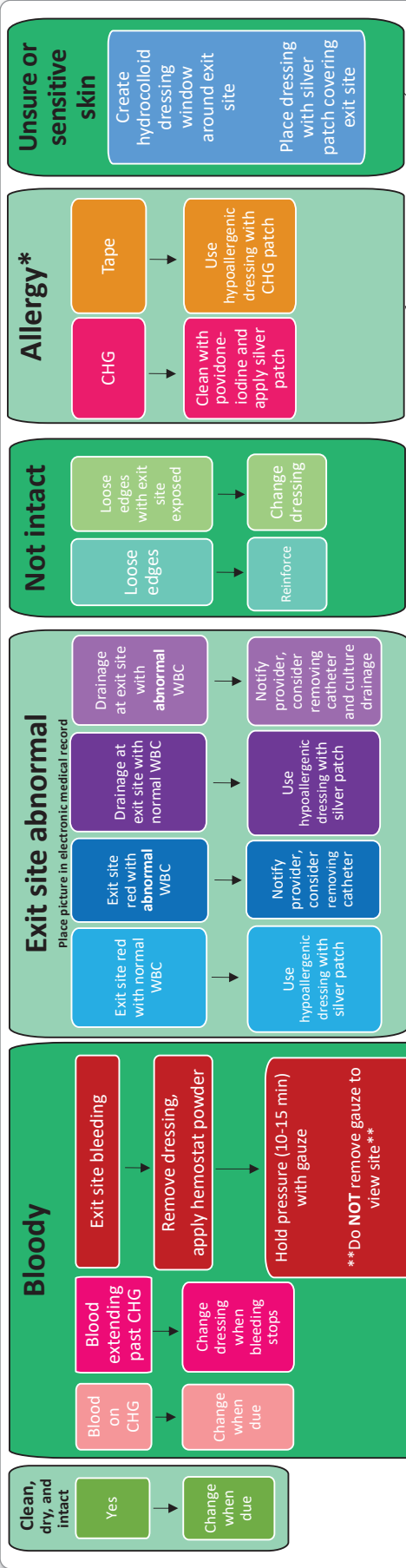
Intervention

Dressing changed. If sites continue to bleed, use powder hemostat, and place the CHG on top of it. Dressing should then get changed in 48 hours.

When in doubt, take a picture and text it to the clinical nurse specialist.

Figure 2 Weekly educational email highlighting areas of improvement.

Abbreviations: BSI, bloodstream infection; CHG, chlorhexidine gluconate.



***Perform allergy trial:** On a clean area on the back of the patient's arm, apply the product you are unsure of their allergy to. Inform patient of what skin reaction to look for and to notify RN to remove product if any irritation. Otherwise reassess site later that day and daily to determine if reaction occurred.

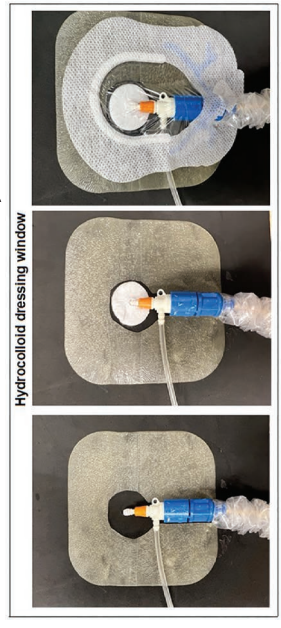


Figure 3 Algorithm for central catheter dressing management.

Abbreviations: CHG indicates chlorhexidine gluconate; RN, registered nurse; WBC, white blood cell count.

Discussion

The catheter exit site is an important consideration. Catheters exiting at the neck are harder to dress and keep intact than catheters exiting on the upper chest or arm. The weight of a neck catheter can pull the dressing down, and a patient's head hair or facial hair can compromise the integrity of the dressing if the hair is not clipped before the dressing is placed. Bartles et al²² noted more difficulty maintaining the integrity of dressings at the internal jugular vein site than at the subclavian vein site.

The type of catheter is also important. Pulmonary artery catheters, sheath introducers, and hemodialysis catheters are associated with a substantial risk for CLABSI because they are frequently accessed and used for a prolonged period.¹⁴ Despite the challenges, our cardiac progressive care unit staff was able to reduce the infection rate and sustain a lower infection rate through fiscal year 2023 (Figure 4).

Surveillance is the standard way to evaluate the effectiveness of infection control policies.²³ Many surveillance activities reported in the literature are passive, examining retrospective data and patient characteristics^{24,25} or restricted to analyzing microbiological reports of diagnostic samples.²³ Other studies have used checklists,^{2,22} interviews,²² direct observation of insertion,²⁶ or bundle documentation²⁷ and have included central catheter dressing assessment, but no studies have included critical assessment of central catheter dressings 3 times a week. Odada et al²⁶ found that continuous monitoring of observed practice may influence desired standards. In our quality improvement project, nurses assessed each central catheter dressing critically. Issues were addressed at the same time to prevent infections. Dedicated catheter rounds, CLABSI bundles, and the central catheter dressing management algorithm reduced CLABSIs in this critically ill patient population. The few CLABSIs occurred in patients with dermatitis and pruritus who tore their dressings by scratching and then touched the catheter insertion site and in patients whose dressings were not secure and fell off.

Dressing Management

The first intervention, changing the initial dressing from gauze to CHG-impregnated transparent dressing, has become the standard of care at our institution. On central catheter rounds we found a substantial decrease in the number of gauze dressings used. During the study period, only 3% of patients had gauze dressings, limiting

Table Characteristics of study patients (N=707) and their central catheters (N=3064)

Characteristic	Value
Age, y, No. (%) of patients	
16-20	4 (0.6)
21-30	29 (4.1)
31-40	53 (7.5)
41-50	87 (12.3)
51-60	153 (21.6)
61-70	230 (32.5)
71-80	127 (18.0)
81-90	23 (3.3)
91+	1 (0.1)
Sex, No. (%) of patients	
Male	478 (67.6)
Female	229 (32.4)
Type of catheter, No. (%) of catheters	
PICC	1186 (38.7)
Pulmonary artery catheter/sheath	845 (27.6)
Hemodialysis/apheresis	522 (17.0)
Small bore/Hickman/triple lumen	419 (13.7)
Pacemaker/ports/other	92 (3.0)
Type of dressing, No. (%) of catheters	
Gauze	92 (3.0)
No gauze	2972 (97.0)
Appearance of dressing, No. (%) of catheters	
Clean/dry	2040 (66.6)
Bloody dressing	767 (25.0)
Blood on CHG pad ^a	644 (84.0)
Blood beyond edges of CHG pad ^a	123 (16.0)
Unable to assess	257 (8.4)
Integrity of dressing, No. (%) of catheters	
Secure	2789 (91.0)
Not secure ^b	275 (9.0)
Exit site exposed	13 (4.7)
Loose edges	201 (73)
Gel pad not touching exit site	19 (7)
Back of dressing open	42 (15.3)
Allergy to tape or CHG, No. (%) of patients	25 (3.5)

Abbreviations: CHG, chlorhexidine gluconate; PICC, peripherally inserted central catheters.

^a Percentage is of 767 catheters with bloody dressings.

^b "Not secure" includes dressings with exit site exposed, loose edges, gel pad not touching exit site, or back of dressing open.

the number of times their catheter insertion site was exposed. During rounds, some dressings were found to need only reinforcement with extra tape if the dressing edges were loose and the catheter exit site was not exposed.

Bleeding

Nurses had been accustomed to changing central catheter dressings on which blood was visible. With education, nurses learned not to disrupt the dressing if the blood did not extend beyond the edges of the CHG pad.

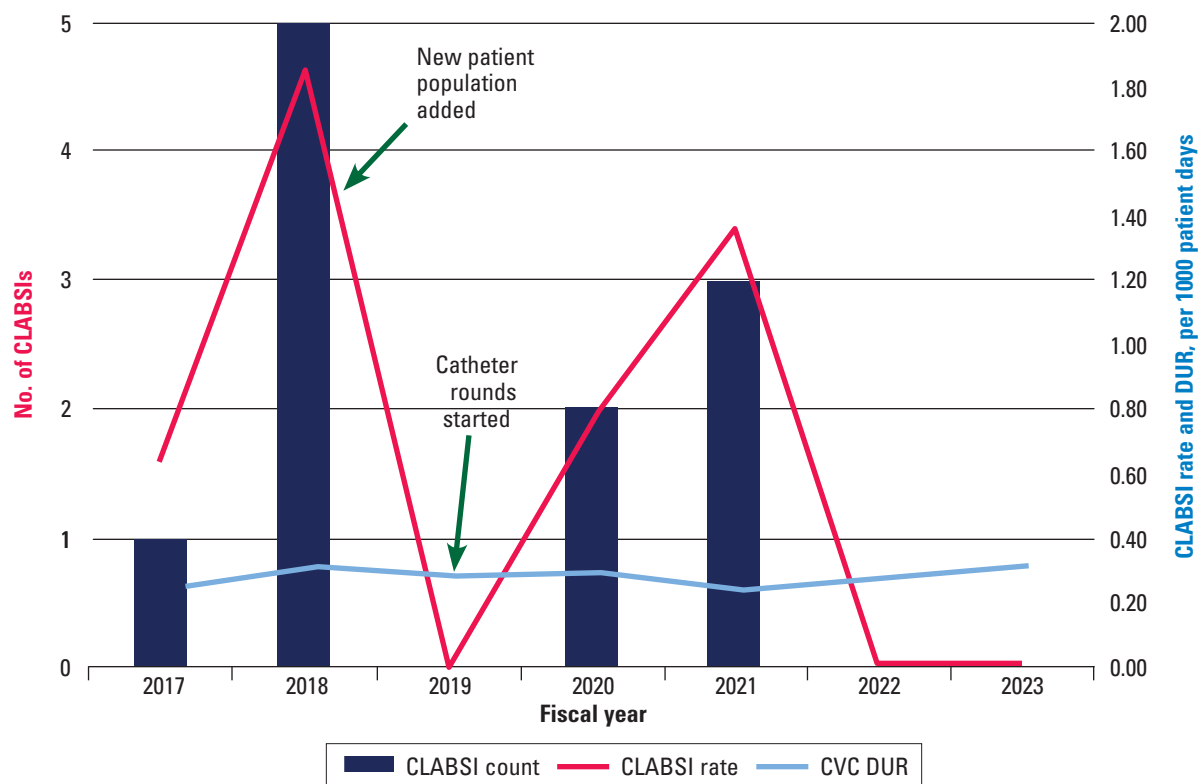


Figure 4 Central line [catheter]–associated bloodstream infection (CLABSI) counts, CLABSI rate, and device utilization rate in fiscal years 2017–2023.

Abbreviations: CLABSI, central line [catheter]-associated bloodstream infection; CVC, central venous catheter; DUR, device utilization rate; FY, fiscal year.

The number of dressings with blood on the CHG pad increased but the number of CLABSIs did not increase. For patients with continued blood ooze, a hemostatic agent was applied and left in place until the next scheduled dressing change and reassessed daily.

Skin Allergies

Allergies presented a problem because some patients in the past had CLABSIs that resulted from scratching the skin and contaminating the dressing. Some previously recommended dressings did not include CHG and were thin, so they would rip or detach. Using hydrocolloid and silver for patients with tape or CHG allergies proved successful. The use of silver has been shown to reduce CLABSIs.²⁰ In our project, silver was used only for patients with a CHG allergy.

Sustainability

Central catheter rounds have become a mainstay of our CLABSI bundle. To sustain these efforts, we encouraged

nurses to thoroughly assess central catheter dressings because their dressing assessment and management can greatly reduce the CLABSI risk. We integrated the process by providing weekly emails with examples of central catheters that had either no CHG, a poorly placed dressing, or a dressing that needed immediate attention. These emails made the entire team aware of what to look for and how to assess central catheter dressings. The education encouraged nurses' autonomy and engagement and is now part of the unit culture.

On the basis of central catheter rounds, experience, and changing dressings with nurses, we realized that the nursing staff needed an algorithm for central catheter dressing management. This algorithm provided nurses with guidance on how to choose dressings and when to change dressings (Figure 3).

Limitations

Although this project provided valuable information, it has several limitations. The study was carried out at a

single facility in a cardiac progressive care unit with a homogeneous group of patients, limiting its generalizability to other populations and clinical settings. However, the principle of our process (critical examination of each central catheter 3 times a week) should be reproducible in other clinical settings. Another limitation was that each patient's central catheter dressing was examined for the duration of their stay. Some patients were readmitted at a different time and were again included in the data collection.

Conclusion

Nurses are tasked with preventing CLABSIs. Nurse rounds were conducted by a clinical nurse or the clinical nurse specialist. Critical central catheter dressing assessment, intervention, and education are among the many tools available to reduce the CLABSI risk. Identifying patients' skin allergies and identifying appropriate dressings are essential. Standardizing nursing central catheter rounds improved patient outcomes and should be part of every institution's CLABSI bundle. **CCN**

Financial Disclosures
None reported.

See also

To learn more about central line [catheter]–associated bloodstream infections, read “Preventing Central Line–Associated Bloodstream Infection in Pediatric Oncology Care” by Duffy and Rabatin in *AACN Advanced Critical Care*, 2018;29(2):111-114. Available at www.aacnconline.org.

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Despite implementation of central catheter bundles, central line [catheter]–associated bloodstream infections (CLABSIs) remain a preventable hospital-acquired infection. The authors designed and implemented a multipronged nurse-driven process to assess dressing placement, quality of the catheter insertion site, and communication between nurses and physicians.

- In collaboration with the interprofessional teams, we enhanced several systems to promote patient safety. These enhancements included implementing standardized rounds by nurses 3 days a week, critically assessing all central catheter dressings, determining the necessity of each patient’s central catheter, and educating patients on the importance of keeping their central catheter dressings clean, dry, and intact.
- Using a flashlight for better visualization, nurses assessed the insertion site for infection, ensured that edges of the dressing were intact, and evaluated how much blood was on the chlorhexidine gluconate (CHG) pad and dressing.
- The first intervention, changing the initial dressing from gauze to CHG-impregnated transparent dressing, has become the standard of care at our institution. During rounds, some dressings were found to need only reinforcement with extra tape if the dressing edges were loose and the catheter exit site was not exposed.
- Nurses had been accustomed to changing central catheter dressings on which blood was visible. With education, nurses learned not to disrupt the dressing if the blood did not extend beyond the edges of the CHG pad. The number of dressings with blood on the CHG pad increased but the number of CLABSIs did not increase.
- Allergies presented a problem because some patients in the past had CLABSIs that resulted from scratching the skin and contaminating the dressing. Using hydrocolloid and silver for patients with tape or CHG allergies proved successful.
- Central catheter rounds have become a mainstay of our CLABSI bundle. To sustain these efforts, we encouraged nurses to thoroughly assess central catheter dressings because their dressing assessment and management can greatly reduce the CLABSI risk.
- On the basis of central catheter rounds, experience, and changing dressings with nurses, we realized that the nursing staff needed an algorithm for central catheter dressing management. This algorithm provided nurses with guidance on how to choose dressings and when to change dressings.
- Standardizing nursing central catheter rounds improved patient outcomes and should be part of every institution’s CLABSI bundle. **CCN**

Hoke LM, Mathen GC, Beckett E. Reducing central line–associated bloodstream infections with a multipronged nurse-driven approach. *Critical Care Nurse*. 2024; 44(4):27-36.