Preventing Catheter-Associated Bloodstream Infections in Hemodialysis Centers: The Facility Perspective

CNE Continuing Nursing Education

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Bloodstream infections are a potential devastating complication of hemodialysis treatment. Current evidence suggests that the burden of these infections is substantial in this setting. This review describes one facility's practical experience with preventing bloodstream infections, including participation in the Centers for Disease Control and Prevention's bloodstream infection prevention collaborative.

Goal

To provide an overview of the complication of bloodstream and catheter exit site infections in patients on hemodialysis and describe a team approach to reducing such infections.

Objectives

1. Explain how bloodstream and catheter exit site infections may occur in the patient undergoing hemodialysis.
2. Discuss how bloodstream and catheter exit site infections may be reduced or prevented in this patient population.

Bloodstream infections are a potentially devastating complication of hemodialysis treatment. These infections are associated with high rates of morbidity and mortality, and add excess costs to the care of these patients (Engemann et al., 2005). According to data from the United States Renal Data System (USRDS) (2010), rates of hospitalizations for bacteremia/septicemia increased 47% from 1993 to 2008; over the same time period, all-cause hospitalizations among patients on hemodialysis rose only 1% (USRDS, 2010). This increase in hospitalizations for bacteremia/septicemia is particularly problematic in light of the fall in the rate of bloodstream infections associated with central lines in intensive care units (ICUs) in acute care hospitals (Burton, Edwards, Horan, Jernigan, & Fridkin, 2009). This dichotomy suggests more work is needed to decrease rates of bloodstream infections among patients receiving outpatient hemodialysis.

Several risk factors have been associated with bloodstream infections among patients undergoing hemodialysis (Patel, Kallen, & Arduino, 2010). Nasal colonization with *Staphylococcus aureus*, which is more common among patients on hemodialysis than the general population, appears to put these patients at increased risk for *S. aureus* infections, including bloodstream infections. In addition, having poor hygiene, having another infection, being older, having an iron overload state, or having diabetes also appear to be important bloodstream infection risk factors. However, the most important risk factor for bloodstream infections among this population is receiving dialysis via a central venous catheter. Data from the Centers for Disease Control and Prevention's (CDC's) National Healthcare Safety Network (NHSN) surveillance system have shown that the incidence of bloodstream infections is about nine times higher in patients with central venous catheters than in those with arteriovenous (AV) fistulas and about five times higher in patients with central venous catheters than in patients with AV grafts (Klevens et al., 2008). Although the use of lower risk fistulas has increased over time, the prevalence of central venous catheters has remained relatively stable between 20% and 25% of patients on hemodialysis, suggesting that interventions to decrease infections among this group of patients are critical (Kallen, Arduino, & Patel, 2010).

A number of interventions have been shown to decrease bloodstream infections associated with central venous catheters. Many interventions

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that have contributed to decreases in bloodstream infections in ICUs have targeted catheter insertion, including the use of maximal barrier precautions (such as a gown, mask, cap, sterile gloves, and a full body drape) at insertion and the use of chlorhexidine for skin antisepsis (CDC, 2011a). These practices, although important, may have less of a role in preventing bloodstream infections in central venous catheters that might be in place for months, including catheters used for hemodialysis. In these patients, interventions that target catheter maintenance might be more important. Fortunately, there are a number of practices and interventions that might be used to decrease bloodstream infections in patients with longer-term catheters, including the use of chlorhexidine skin antisepsis during catheter site care and the use of antimicrobial ointments at catheter exit sites (CDC, 2011a). Therefore, in light of the substantial burden of bloodstream infections and the prevention success being realized in acute care settings, similar efforts are needed targeting bloodstream infection prevention in hemodialysis settings.

Bloodstream Infections At the Facility

The author's 13-station, hospital-based hemodialysis facility is located in eastern Iowa and has an average census of 60 patients on chronic hemodialysis. Staff members include registered nurses, licensed practical nurses, and dialysis technicians, all of whom participate in catheter care for patients on hemodialysis. Historically, central venous catheters have been used regularly at this facility, with about 25% of patients receiving hemodialysis through a catheter at any time. As staff began to learn about bloodstream infection prevention successes from other facilities and other settings, they began to pay closer attention to the rates of these infections in the facility. In May 2008, patients in the author's facility had averaged approximately four bloodstream infections in patients with central venous catheters per month over the preceding four months. This rate was unacceptably high, and the facility made it a priority to improve it.

To get a better sense of the context in which these bloodstream infections were occurring, staff at the author's facility began an in-house review of catheter care. After reviewing these processes and observing the techniques of staff members, a large amount of variability was discovered in how catheter care was being performed, starting with exit site care but extending to dialysis initiation and termination. All staff had been trained in the facility's method of catheter care, but they had subsequently discovered and implemented techniques and practices that worked best for them. This article describes the facility's approach to this problem and the effect of the interventions on bloodstream infections, particularly those among patients with central venous catheters.

Review of Initial Interventions

In June 2008, a retrospective review of catheter care practices was conducted, including a complete review of the facility's policies and procedures for catheter care and for catheter accessing and de-accessing. Policies were revised, including switching from povidone-iodine to sodium hypochlorite for catheter hub disinfection, and from soap and water to sodium hypochlorite for catheter exit site care. In addition, staff members were all re-educated on the recommended technique for central venous catheter care, including aseptic technique, minimum scrub and soaking times for antiseptics, and hand hygiene/gloving practices. Following these interventions, data collection continued, and for five months, no bloodstream infections occurred among catheter patients. At that point, staff believed the problem was solved; however, in November 2008, bloodstream infections began to re-occur among patients with central venous catheters.

To address this increased number of bloodstream infections, in January 2009, another education session was provided for staff members. This session included a review of the *CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections* (CDC, 2011a). In addition, use of a facemask was required for staff during catheter exit site care, as well as during catheter accessing and de-accessing. Although there was a decrease in bloodstream infections among catheter patients, bloodstream infections or catheter exit site infections continued to occur every month for the next six months.

Even though the reduction in bloodstream infections from 2008 to 2009 among patients with central venous catheters was encouraging, there was still room for improvement. It also became evident that even though the rate of bloodstream infections had declined, there had not been a decrease in the rate of catheter exit site infections (bloodstream infections 17/163 patient month in 2008 to 5/184 patient months in 2009; exit site infections 13/163 patient months in 2008 to 12/184 patient months in 2009). It became apparent that the traditional approach to preventing these infections was not working.

CDC Collaborative to Prevent Bloodstream Infections In Hemodialysis Settings

The collaborative approach to preventing healthcare–associated infections has been used successfully to prevent bloodstream infections in acute-care settings (CDC, 2005; Pronovost et al., 2006). Nearly 70% of reductions in central line-associated bloodstream infections (CLABSIs) has been recognized in ICUs when this approach has been applied, and these efforts have likely contributed to the striking 58% decrease in CLABSIs that occurred in ICUs between 2001 and 2009 (CDC, 2011b). Collaboration allows facilities to work together to develop ways to overcome barriers to implementing prevention best practices. It also dis-

arms uncertainties about preventability that can sometimes hinder prevention efforts. These uncertainties about the generalizability of prevention efforts can manifest when facilities believe their patients are different than those in other successful prevention efforts, and therefore, results of those efforts are not applicable or reproducible in their specific settings. However, when a large number of different facilities come together in a successful effort, it is much harder to argue the results that do not apply more widely.

In 2009, the CDC established a collaborative of hemodialysis facilities to target the elimination of bloodstream infections, with an emphasis on those associated with central lines. The goal of this project was to develop a group of motivated hemodialysis facilities, all performing surveillance for hemodialysis events (including bloodstream infections) using the NHSN. The participants and representatives from the CDC would work together to share information about best practices and develop practical solutions to facilitate the implementation of these best practices. The initial CDC dialysis collaborative involved about 18 facilities that have met the requirements for reporting in NHSN and implementation of the collaborative interventions.

Joining the collaborative gave the author's facility the opportunity to network with experts from the CDC and dialysis units across the country; however, more importantly, it was a catalyst that motivated the dialysis unit to improve practice and reduce catheter infections. The collaborative developed a collection of evidence-based best practices, along with tools to monitor and improve adherence to important interventions, such as hand hygiene and catheter care (these tools are available online at www.cdc.gov/dialysis/collaborative). It heightened staff awareness of the value of surveillance for outcomes (such as bloodstream infections) and process measures (such as adherence to hand hygiene).

At the outset, collaborative members worked together to develop a package of interventions designed to prevent bloodstream infections. The core interventions in this package included:

- Performing monthly surveillance for bloodstream infections, hospitalizations, and antimicrobial starts; and reporting these events to NHSN. In addition, event rates of these outcomes were reported back to frontline staff.
- Use of chlorhexidine (2% or greater) as the first choice for skin antisepsis.
- Performing monthly hand hygiene and catheter care observations, as well as feedback of adherence rates to staff.
- Improving patient education and engagement, including about catheter care.
- Performing staff education and competency testing, including about catheter care.
- Developing a facility-specific approach to catheter reduction.

In addition, the use of antimicrobial ointment or chlorhexidine-impregnated dressing at the catheter exit site was included as a final optional intervention.

Performing monthly surveillance using the NHSN was initially a very time-consuming task, but once the enrollment process for the NHSN was completed, the actual reporting of data was relatively easy. The NHSN data feedback reports were very useful tools to share with staff. These reports provided a way to compare results from the author's facility with other facilities reporting to the NHSN. They also became a source of great encouragement as the facility's rates improved.

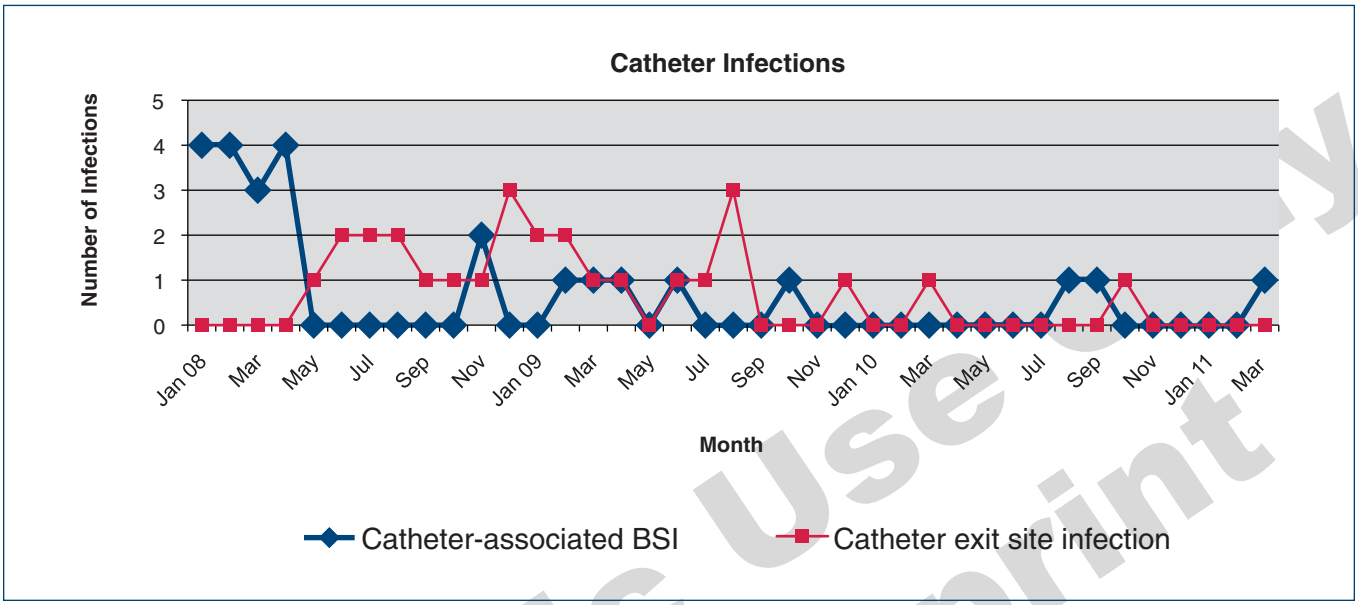
Within six months of joining the collaborative, all core interventions had been implemented. Not only were staff reporting to the NHSN on a monthly basis, but all catheter infections were being tracked daily. By tracking infections daily and providing staff members with results, it became obvious that preventing catheter infections was a high priority. Participation in the collaborative also led to an improvement in education of both staff and patients. All patients were educated about access care with a focus on reducing the overall catheter rate. Staff education was done using a team approach. Together the staff developed a detailed procedure for initiating dialysis in patients with a catheter. A copy of the procedure was laminated and put at each station so staff members could be reminded of the steps when initiating dialysis. By following the exact procedure every time, consistency became a habit, and shortcuts were reduced. To ensure adherence, staff are regularly audited to ensure adherence to the agreed upon steps.

Intervention Results

Data on bloodstream infections in patients with central venous catheters and catheter exit site infections are shown in Figure 1. Overall, there were 17 bloodstream infections and 13 exit site infections in 2008. In 2009, the number of bloodstream infections fell to five, but the number of exit site infections remained stable at 12. By January 2010, all core interventions had been adopted, and in 2010, there was a total of two bloodstream infections and two exit site infections. In the first three months of 2011, there was one bloodstream infection and no exit site infections.

The rate of bloodstream infections in patients with central venous catheters at the author's facility decreased significantly from the time prior to joining the collaborative (January 2008 to July 2009) to the time after joining the collaborative (August 2009 to March 2011) (8/100 patient months pre-collaborative vs. 2/100 patient months post-collaborative, $p = 0.003$). The same was true of catheter exit site infections (8/100 patient months pre-collaborative vs. 3/100 patient months post-collaborative, $p = 0.01$). Although it is believed that participation in the collaborative played an important part in the facility's success, it is important to note that interventions employed prior to collaborative participation also likely

Figure 1
Number of Bloodstream Infections in Patients with Catheters and Catheter Exit Site Infections, Mercy Dialysis, January 2008 to March 2011



Note: BSI = bloodstream infection.

played a role, particularly because rates of bloodstream infections had begun to fall prior to joining the collaborative.

In addition to the decrease in bloodstream and catheter exit site infections, aggressive catheter reduction also played a role in reducing the overall number of infections. In January 2008, about 25% (16/65) of patients had a catheter. In January 2009, this fell to 23% (13/50), then to 17% (11/61) in January 2010, and finally to 13% (7/56) by January 2011.

Lessons Learned and Conclusions

Bloodstream infections are a devastating but preventable complication of hemodialysis treatment. At the author's facility, staff believed they could do better in preventing these infections and worked hard to make that realization a reality. Throughout this process, many valuable lessons were learned. First, surveillance and continuous education were the keys to success. To better understand the problem, you must be able to describe it, and that is what systematic surveillance allows you to do. Although it can be time-consuming and at times challenging, surveillance provides the framework on which prevention efforts are built. In addition, changing practices does not occur overnight; it is very common for staff members to fall back into the "way it was always done." Continually reinforcing best practices and regularly assessing these practices has led to increased adherence with these practices among staff. Second, collaborating with other like-minded facilities helped with prevention efforts in the facility – the extra effort it takes is invaluable. Collaboratives provide a great opportunity to utilize outside resources and learn from others. Third, being visible to staff was also an important part of success; it demonstrated that staff were serious about a change in practice aimed at reducing catheter-associated infections. Finally, do not let up. Success may take time and may not come all at once. Be persistent and remember to monitor-educate, monitor-educate, and re-educate!

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