Using Evidence-Based Practice to Reduce Central Line Infections

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Central venous catheters (CVCs) are used commonly in a variety of inpatient and outpatient healthcare settings. Catheter-related bloodstream infections (CRBSIs) contribute to 2,400–20,000 deaths per year, with an estimated cost of $296 million to $2.30 billion (Hu, Veenstra, Lipsky, & Saint, 2004). CRBSIs can be reduced dramatically with maximal barrier precautions, chlorhexidine gluconate skin preparatory agents, and strict hand hygiene.

In December 2004, the Institute for Healthcare Improvement launched the 100,000 Lives Campaign, a national initiative with a goal of saving 100,000 lives among hospitalized patients through improvements in the safety and effectiveness of health care (Institute for Healthcare Improvement, 2006). Reducing CRBSIs was one of the six targets, all of which employ evidence-based practices to give patients the best care possible. Practitioners have found that implementing a series of linked interventions, also called a bundle, is an efficient and effective mechanism to transform healthcare practices. Although some of the practices to reduce CRBSIs have been well documented in the literature, compliance to the evidence-based practices has not been consistent. The 100,000 Lives Campaign jump-started interest in reducing lives lost because of preventable deaths, including those caused by preventable CRBSIs (Berwick, Calkins, McCannon, & Hackbarth, 2006).

The National Healthcare Safety Network has defined a central line as a catheter whose tip terminates in a great vessel, such as the aorta, pulmonary artery, superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins, and common femoral veins (Centers for Disease Control and Prevention, 2006).

CVCs benefit patients with cancer by facilitating blood draws and reducing painful peripheral blood draws, which is important for patients with cancer who have thrombocytopenia as a side effect of their treatment. However, CVCs are not risk free. Each time the system is accessed, the risk of bacterial contamination increases. The concomitant chronic illnesses and immune disturbance of patients with cancer enhance the risk of infection. Patients with cancer are at increased risk for CRBSIs (Anatoliotaki et al., 2004). Complications from CRBSIs impact healthcare costs as well as patient morbidity and mortality. Oncology professionals must be knowledgeable about the care of central lines as well as simple interventions that reduce the risk of acquiring infections. In short-term, noncuffed catheters, the skin insertion site is the major source of colonization (Ferretti et al., 2002). See Figure 1 for other sources of CVC infections.

In 2003, nine healthcare systems in the Greater Cincinnati area participated in a two-year project to reduce hospital-acquired infections, including CRBSIs. The project, which won the Joint Commission on Accreditation of Healthcare Organizations Ernest A. Codman collaborative award, was made possible through a matching federal grant awarded to investigators at the Department of Veterans Affairs Getting at Patient Safety Center located at the Cincinnati Veterans Affairs Medical Center and through the work of the Greater Cincinnati Health Council. The central line “bundle” elements that the project focused on were:

- Hand hygiene with soap and water or alcohol antiseptic hand sanitizer
- Use of chlorhexidine as a patient skin preparation prior to line insertion
- Full-body drape covering patients from head to toe

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The aggregate infection rate of the four hospitals fell from 1.7 to 0.4 infections per 1,000 line days, a statistically significant decrease.

Compliance with using evidence-based practices increased from 30% to nearly 95%.

Several factors were critical for the success of the central line project. See Figure 4 for a list of barriers and facilitators encountered when implementing evidence-based practices.

A checklist was created to monitor each central line insertion procedure and “teach” the best practices.

A rolling central line cart was assembled with only evidence-based supplies and was brought to the bedside with each central line insertion.

Nurses, residents, and attending physicians were educated about the importance of the process changes.

Staff nurses were empowered to stop the insertion procedure if inserters were not compliant with evidence-based practices.

A marketing campaign was created to motivate staff members.

Senior leadership supported the increased time devoted to the project.

A revised central line–insertion kit was developed with kit manufacturers. Unnecessary items were removed, and only evidence-based practice items were included in the kit.

Monthly feedback about infection rates and compliance to the bundle practices was provided to the staff.

Successes were celebrated.

With the implementation of all of the elements of the central line bundle, hospitals should be able to reduce their infection rates. The bundle practices show that quality of life improves, costs are reduced, and morbidity and mortality are reduced.

Maximal barrier elements worn by inserters, including sterile gloves, sterile gowns, caps, and masks

Avoidance of femoral insertion site (or change of the femoral line to another site within 24 hours of a femoral insertion).

Intensive care units that have implemented multifaceted interventions similar to this central line bundle have nearly eliminated CRBSIs (Berenholtz et al., 2004). See Figure 2 for recommended infection-prevention practices. The major factor attributed to a decrease in infection rates was the use of strict sterile insertion techniques, which included full-body draping during the procedure. See Figure 3 for a picture of the proper draping procedure. The implementation of the bundle further reduced the infection rate. In the first year of the Greater Cincinnati project (Render et al., 2006), all of the hospitals reduced their CRBSIs by at least 50%.

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Use maximal barrier precautions during insertion, including full-body drape on patients; inserters should wear sterile gowns, sterile gloves, masks, and caps.

Perform hand hygiene prior to the insertion procedure.

Prepare patients’ skin with chlorhexidine.

Avoid femoral line placement, if possible.

Do not routinely change catheters.

Consider using specialized “IV teams” for the care of central lines.

Use transparent or gauze dressings (if oozing blood) over the insertion site.

Remove the line as soon as possible after intended use.

Change the needleless system device and end cap on a routine basis according to manufacturers’ guidelines.

Consider using a chlorhexidine-silver sulfadiazine catheter if the central line is expected to be in place for two to eight days and all evidence-based practices are already in place with continued infections.

Consider using a minocycline-rifampin catheter if the central line is expected to be in place more than eight days.

Consider using a sutureless securement device.

Adhere strictly to catheter care policies when accessing the line.

Figure 1. Potential Sources of Intravascular Central Venous Catheter Infections


Figure 2. Recommendations for Central Venous Catheter Infection Prevention

Note. Based on information from Centers for Disease Control and Prevention, 2002; Marciano et al., 2003; Mermel, 2000.
should be aware of these evidence-based practices and incorporate them to provide patients with the best possible care.

**Barriers**
- “Myth of perfection”—intensive care unit physicians and staff thought that they were using all of the evidence-based practices already.
- Rates “below benchmark” created the false impression that staff were doing well enough and probably could not lower their infection rates any more.
- Leadership participation was absent or shifting.
- Project team members reported to different supervisors, thus resulting in different timelines for implementation.
- Physicians and staff were unwilling to change long-standing practices.

**Facilitators**
- Chief executive officer support ensured the availability of resources and increased the visibility of the project or initiative.
- Physician champion took an active, visible role in promoting and reinforcing evidence-based practices.
- Bedside nurses actively participated.
- Nurses and physicians received consistent feedback about the infection rates and bundle compliance rates.
- A rapid-action cycle of change was applied.
- The project was marketed in hospital newsletters and posters.
- The local hospital was compared with the aggregate performance.
- Successes were celebrated.
- Hospitals collaborated to reduce rework and increase learning from each other.
- Kits were customized to contain all necessary insertion items.
- Movable carts that hold all insertion supplies were rolled to the bedside.

**References**


**Spot on 100,000 Lives Campaign . . .**
The 100,000 Lives Campaign estimates that the initiative has saved 122,300 lives as of June 14, 2006. More than 3,100 U.S. hospitals and healthcare associations in all 50 states are participating in the program. To learn more about the 100,000 Lives Campaign or to enroll your hospital in the program, visit www.ihi.org/IHI/Programs/Campaign/Campaign.htm.