Reducing Bloodstream Infection Risk in Central and Peripheral Intravenous Lines: Initial Data on Passive Intravenous Connector Disinfection

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Abstract

Background: *Although few facilities focus on it, bloodstream infection (BSI) risk from peripheral intravenous catheters (PIVs) may exceed central line-related risk. Over a 6-year period, Methodist Hospitals substantially reduced BSIs in patients with central lines but not in patients with PIVs. A practice audit revealed deficiencies in manual disinfection of intravenous connectors, thereby increasing BSI risk. Methodist thus sought an engineered approach to hub disinfection that would compensate for variations in scrubbing technique.*

Methods: *Our institution involved bedside nurses in choosing new hub disinfection technology. They selected 2 devices to trial: a disinfection cap that passively disinfects hubs with isopropyl alcohol and a device that friction-scrubs with isopropyl alcohol. After trying both, nurses selected the cap for use in the facility's 3 intensive care units. After no BSIs occurred during a 3-month span, we implemented the cap throughout the hospital for use on central venous catheters; peripherally inserted central catheters; and peripheral lines, including tubing and Y-sites.*

Results: *Comparing the postintervention period (December 2011-August 2013) to the preintervention span (September 2009-May 2011), the BSI rate dropped 43% for PIVs, 50% for central lines, and 45% overall (PIVs + central lines). The central line and overall results are statistically significant. The PIV BSI rate drop is attributable to cap use alone because the cap was the only new intervention during the postimplementation period. The other infection reductions appear to be at least partly due to cap use.*

Conclusions: *Our institution achieved substantial BSI reductions, some statistically significant, by applying a disinfection cap to both PIVs and central lines.*

Keywords: *disinfection cap, IV connector, bloodstream infection, CRBSI, CLABSI*

Background

The risk of catheter-related bloodstream infections (CRBSIs) associated with use of a central intravenous (IV) line or peripherally inserted central catheter (PICC) is well known and well documented. Although there have been documented improvements, these infections are still estimated to affect 250,000 people annually in the United States.[1] Because bloodstream infections (BSIs) related to central lines/PICCs are so dangerous and widespread, they have been the subject of substantial public and private efforts to minimize them.[2]

Far less attention has been devoted to the BSI risk from peripheral IV catheters (PIVs), although that risk may be at least as large. The individual risk of a BSI occurring in a PIV is lower than in a central line/PICC.[3] However, some 150 million PIVs are placed in the United States annually, a number that is much greater than the number of central lines used overall.[3] PIVs have a lower infection rate (estimated at 0.5/1,000 peripheral line days), but when this is multiplied by the large number of patients receiving these lines, the total number of patients infected is seen in several studies to approach totals reported for central lines.[4]

Pujol et al[5] examined 150 BSIs in 147 patients over an 18-month span to study the relative BSI risk associated with

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PIVs versus central lines/PICCs. They actually found slightly more total BSIs related to PIVs (77 BSIs; 51.3%) than to central venous catheters (73 BSIs; 48.7%), although the results are essentially equivalent. A more extensive study of the relative BSI risk between PIVs and central catheters encompassed 72 hospitals and 14,966 patients in Germany.[6] On the day prevalence was assessed, 5.1% of patients had central lines and 23.9% had noncentral lines. The device-associated incidence rate per 1,000 catheter days was 0.8 for central lines and 0.3 for noncentral lines. In other words, the rate for central lines was about 2.7 times the rate for noncentral lines—but there were about 4.7 times more noncentral lines than central IVs.[6] Thus there were actually more BSIs in noncentral lines than in central lines in that very large sample, although statistically these 2 figures should be viewed as fundamentally equivalent numbers.

Many hospitals are engaged in substantial efforts to lower CRBSI rates. Data such as those above suggest that a hospital trying to reduce the incidence and cost of BSIs should target PIVs with preventive efforts similar to those it aims at central lines. Although central lines present the greater risk on a per-line basis, the largest numerical risk is greater with PIVs.

The failure to focus BSI prevention efforts exclusively on central lines can also distort infection reporting. When submitting mandated infection reports to the Centers for Medicare and Medicaid Services and state departments of health, hospitals must use the Centers for Disease Control and Prevention National Healthcare Safety Network's protocols for surveillance. The definitions for CLABSIs are quite broad and can overclassify infections that may not have a central line as the true source. Tip cultures or site cultures are not included in these federal definitions.

For these reasons, Methodist Hospitals (Gary, IN) has for the past 10 years closely examined CRBSI rates among both patients with central lines (central venous catheters and PICCs) and those with PIVs. Previous internal data based on a 6-year sample demonstrated that up to 21% of our facility's hospital-acquired, laboratory-confirmed bloodstream infections were in patients with peripheral lines alone. Up to 47% of infections meeting the definition of central line-associated occurred in patients with multiple lines present; the majority of those central line-associated bloodstream infections (CLABSIs) with multiple lines involved a peripheral line as well. During that 6-year period the hospital achieved substantial reductions in CLABSIs throughout the institution, as did hospitals across the country as evidence-based recommendations for risk reduction became more fully adopted. But the hospital did not see the same reduction in patients with peripheral lines only. There was not a focused campaign looking at that particular group during this period.[7]

A practice audit in 2011 revealed that manual disinfection of the hubs of IV needleless connectors was not being performed properly. The standard manual disinfection method (commonly called "scrub the hub") requires wiping the hub—using downward twisting pressure—with a disinfectant such as isopropyl alcohol (IPA) for a prescribed number of seconds and then waiting another prescribed number of seconds for the alcohol to dry before accessing the IV line. Compliance with the technique (which was mandated to be performed before all line accesses) was satisfactory at Methodist Hospitals, but virtually all bedside nurses varied from the technique in some way. Inadequate disinfection of connector hubs increases BSI risk because it enables microorganisms to gain entry to the intraluminal surfaces of the IV system and form infection-causing biofilm, which in turn promotes infections.[8] Noncompliance and variation from proper technique are widely recognized and are not just issues at Methodist Hospitals.[9]

Methodist sought an engineered approach to disinfecting connector hubs that would overcome the problem with variations in scrubbing technique, which were perceived to be a likely source of infection. This approach could be in the form of a device or devices that would address these lapses in connector disinfection practice and be applicable to both central lines and PIVs.

About the Hospital

Methodist Hospitals is a not-for-profit, community-based health care system with 2 full-service acute care facilities located 1 hour east of Chicago, Illinois. We serve a predominantly urban, economically challenged population. Based on the 2012 annual report, the hospital system has a total of 634 beds, including 504 adult beds as well as beds in 3 adult intensive care units. Services provided include behavioral health, bloodless medicine, a breast care center, cardiovascular services, a diabetes center, emergency services, home health services, a neuroscience institute, an oncology institute, orthopedic and spine care services, rehabilitation services, surgical weight loss/bariatric services, wound care services, and women's and children's services.

From 2003 through 2013, the hospital system experienced multiple turnovers in senior leadership, a workforce reduction, and patient satisfaction scores below the 10th percentile. Physician and nursing trust reached an all-time low. After new senior leadership was in place, the hospital identified key improvements and implemented a turnaround plan that reinvested in improving the patient experience, updating equipment, and staff development. Nursing turnover during this time frame remained high. New graduate staff were brought on board and were a welcome addition, but skill development remained a challenge.

Methods

Methodist Hospitals sought to involve bedside nurses in its efforts to identify and implement preventive technology for 2 reasons. First, it was believed that nurses would be more accepting of a new device if their input was central to its selection. Second, the nurses believed they were partly responsible for BSIs that may have resulted from their errors in executing the scrub-the-hub method. They wanted an opportunity to participate in formulating a less error-prone approach to connector hub disinfection.