Up for the Challenge: Eliminating Peripherally Inserted Central Catheter Infections in a Complex Patient Population

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Abstract

Background: *In response to Medicare reimbursement changes related to central line-associated blood stream infection (CLABSI) effective January 2011, a long-term acute care hospital implemented quality improvement measures to reduce these health care-associated infections. Improvements included alcohol-impregnated port protectors, chlorhexidine gluconate barrier dressings, and didactic/hands on training for care and maintenance. During 2010 the peripherally inserted central line (PICC) team at a neighboring Magnet hospital was asked to partner and develop strategies to further decrease CLABSI.*

Methods: *The PICC team evaluated the effects of an antimicrobial PICC device in an effort to further reduce the incidence of CLABSI. Upon initiation of the evaluation phase, a database was created to track infection/thrombus rate, insertion-related complications, dwell time, diagnosis, tip location, infusate, vein used, and catheter size. Data collection and reporting was managed by the PICC team.*

Results: *Across a 2-year period (July 2011-July 2013), 100 devices were inserted with a total of 1,705 line days without any reported CLABSI. The majority of patients received a 4.5F single lumen device (59%). Dwell time ranged from 1 to 57 days with an average of 17 days. To date, no CLABSIs related to this device have been reported at the long-term acute care hospital.*

Conclusions: *Based on 100 insertions yielding no infections this new product appears to improve patient safety and quality of care. Relative to these results sole use of this product has become their institutional standard for long-term intravenous needs.*

Keywords: *antimicrobial, bundle, CLABSI, long-term acute care hospital, peripherally inserted central catheter, vascular access*

Introduction

Lehigh Valley Health Network (LVHN), Bethlehem, PA, is 1 of many hospitals taking on a growing population of critically ill patients. The peripherally inserted central catheter (PICC) team at LVHN places more than 3,500 vascular access devices annually (internal data). LVHN includes more than 1,000 licensed acute inpatient beds across 3 campuses. The PICC team at LVHN-Muhlenberg campus consists of 3.0 full-time equivalent nurses who provide 365-day coverage to ensure vascular access needs of patients are met. Intravenous (IV) therapies include hydration, high-risk medications, parenteral nutrition, chemotherapy, and long-term antibiotics. In addition to providing services for both inpatient and outpatient populations, the team also provides contracted services to a long-term acute care hospital (LTACH) located adjacent to the Muhlenberg campus with 32 acute care beds. LTACHs provide medical and rehabilitative care to patients with clinically complex problems such as multiple acute or chronic conditions that require hospital-level care for relatively extended periods. The majority of the patients admitted to an LTACH are directly admitted from an intensive care unit setting. To qualify as an LTACH for Medicare payment, a facility must meet Medicare

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conditions of participation for acute care hospitals and have an average inpatient length of stay >25 days. The occupancy rates in this LTACH run a consistent 92% (internal data).

During 2010 as a response to Medicare reimbursement changes related to central line-associated bloodstream infection (CLABSI) effective January 2011, LTACH implemented quality improvement measures to reduce these health care-associated infections. Several maintenance strategies were evaluated, including neutral and negative displacement end needleless connectors, alcohol-impregnated port protectors, chlorhexidine gluconate (CHG) dressings, and continued adherence to the central line bundle. A reduction in CLABSI rates was noted the following year; however, an opportunity remained to explore additional alternatives for continued CLABSI reduction. During July 2011 LVHN's PICC team was approached by the administrators at the LTACH located adjacent to the Muhlenberg campus to evaluate an antimicrobial PICC device that is different from what was currently being used for this patient population, and its effects on CLABSI rate reduction. If shown to aid in the reduction of CLABSI rates, this would become the standard PICC device for patients requiring long-term central vascular access.

Background

PICC lines are not without risk of complications. The 2 most serious complications associated with PICCs are infection and thrombosis.[1] According to Baskin et al,[2] catheter thrombosis can set the stage for catheter-related infection. PICC-related infection has been documented at an infection rate of 2.1 per 1,000 catheter days.[3] Additionally, symptomatic thrombosis in PICC lines has a documented occurrence rate of 3.0% to 7.8%,[4] whereas asymptomatic thrombosis occurs up to 38% of the time.[5]

Approximately 80,000 CLABSIs occur annually in the United States.[6] CLABSIs are 1 of the most common health care-associated infections in the United States.[7] The costs associated with CLABSI include an estimated 28,000 deaths in intensive care settings and up to $2.3 billion annually.[7] According to the Centers for Disease Control and Prevention, the most commonly reported pathogens include coagulase-negative staphylococci, *Staphylococcus aureus*, enterococci, and *Candida*. The 4 recognized routes for catheter contamination are migration of skin organisms at the insertion site; direct contamination of the catheter or catheter hub through contact with contaminated hands, fluids, or devices; catheters that become seeded from another focus of infection; and infusate contamination.[8] Pathogenic determinates of CLABSIs are also important to note. This includes the type of material used to manufacture the product, fibrin sheath formation around the catheter, and organisms that may adhere to the catheter. Some catheter materials, such as silicone elastomer, have surface irregularities that enhance the adherence of microbes. Due to fibrin sheath formation there is an increased incidence of infection risk with the use of silicone versus polyurethane material.[8]

The Institute for Healthcare Improvement developed the concept of "bundles," a structured process to improve methods established from evidence-based practices, to assist health care providers to standardize the delivery of care for patients undergoing particular treatments with intrinsic risks with the goal of improving outcomes. Key components of the central line bundle include hand hygiene, maximum barrier precautions upon insertion, chlorhexidine (CH) skin antisepsis, optimal site selection with avoidance of the femoral vein, and daily review of line necessity with prompt removal of unnecessary lines.[9] According to the Institute for Healthcare Improvement, both of the studies conducted demonstrated that the application of maximal barrier precautions significantly reduces the risk of developing a bloodstream infection; however, the results varied. A 2.2% to 6.3% increase risk of infection without the implementation of protective barriers was noted.[9] Additionally, evidence supports the benefit of maintaining strict adherence to infection control practices at all times. This includes hand hygiene, use of standard and isolation precautions, cleaning and disinfecting the equipment and environment, and aseptic technique for the care and maintenance of centrally placed lines.[9]

During the past several years there has been new technology available to aid in decreasing the risk for CLABSI. Antimicrobial and antiseptic agents have been either applied to the surface as a coating or actually impregnated into the central venous access device. Studies have determined that overall colonization rates are significantly lower in these devices; however, they show no difference in CLABSI rates.[10] Another study reported no significant differences in colonization or bacteremia rates with an impregnated device and indicated these rates may be more dependent on noncatheter factors such as infection control standards, site selection, and bundle compliance.[11] A meta-analysis of 12 studies supported the use of CH and silver sulfadiazine (SS) externally coated catheters because these coatings were significantly more likely to prevent catheter-related infections; however, the catheters are limited by short microbial durability (3-7 days). There are also some reports of anaphylactic reactions to these devices.[12] Other catheters such as a silver-platinum-carbon or silver alone were not shown to have any benefit over the CH/SS devices.

Devices impregnated with minocycline and rifampin (M/R) are reportedly "highly effective" in CLABSI prevention. These catheters are impregnated on both internal and external surfaces and have an antimicrobial durability of 4 weeks. The issue of resistance to these antimicrobial agents was not reported in limited trials.[12] A retrospective analysis of nonimpregnated versus M/R-impregnated devices was conducted at the Henry Ford Hospital. Four thousand five hundred sixteen nonimpregnated devices were placed from January 1, 2011, through December 31, 2011. Of these, 31 documented bloodstream infections (0.69%) resulted.[13] After the initial study was concluded with the use of nonimpregnated devices, 1,515 M/R-impregnated devices were placed from April 1, 2012, through August 3, 2012. After the conclusion of this trial there were 12 documented bloodstream infections (0.79%). The authors of that study[13] concluded no significant decrease in CLABSI was found as a result of using these devices. A prospective randomized trial, conducted at the Princess Alexandra Hospital in Australia,[14] concluded the M/R-impregnated devices demonstrated lower colonization rates compared with the silver-impregnated devices.