Reducing Central Line-associated Bloodstream Infections: A Review of Literature

Catherine Roff

Ferris State University
Abstract

This paper examines the role of 70% alcohol impregnated caps in reducing the overall rate of central line-associated bloodstream infections. With abundant guidelines published to assist in proper placement, maintenance, and use of central lines, insignificant information is available on implications of using cap protectors. An extensive literature review examines specific studies that focus on cap implementation, and the impact in the acute care setting. Further research is needed to reduce variations in study design, and assist in developing clear recommendations.
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Healthcare-associated infections (HAIs) constitute various infections that patients acquire while in health-care facilities that are most frequently preventable. Although significant progress has been made in recent years, the Centers for Disease Control and Prevention [CDC] (2016) estimates that on average, one of every 25 patients has a HAI in the current hospital systems. Focusing particularly on central line-associated bloodstream infections (CLABSIs), the 2016 National Patient Safety Goals concentrate on utilizing proven guidelines to decrease the rate of infections (The Joint Commission, 2016). In an effort to offer attainable guidelines, significant research must be completed to effectively provide experts with the proper standards.

Significance

National CLABSI rates have indicated a decline by 46% from 2008-2013; however, 30,100 annual cases still occur within the United States (Centers for Disease Control and Prevention [CDC], 2016a). The overall decrease is claimed to have saved $1.8 billion and up to 27,000 lives (CDC, 2016a). Success for decreasing rates is reportedly attributed to the latest guidelines, educational initiatives, and CLABSI bundles. Recent mandates regarding reporting of CLABSIs has continued to place pressure on stakeholders to develop new ways to decrease line infections to zero.

Current published trends related to CLABSI prevention focus on the requirements of bundle initiatives. Known as CLABSI bundles, significant work has been accomplished to develop evidence-based tool-kits ranging from insertion guidelines to maintenance guidelines. Specific requirements include proper skin antiseptic, dressing changes, site assessment, replacement of caps and fluid sets, hand hygiene, and several others that make up the bundles. The Joint Commission (2013) notes that insertion bundles have played a significant role in
ensuring a consistent application of evidence-based practices when placing the catheter, yet there is less knowledge regarding the implementation of a post-insertion bundle.

Details regarding an exclusive way to disinfect catheter hubs are particularly absent in published guidelines. Noting that adequate scrubbing is dependent on the agent used, The Joint Commission’s recommended options include “…alcohol, chlorhexidine/alcohol, povidone-iodine, and iodophors before and after use…” (The Joint Commission, 2013, p. 1). In fact, The Joint Commission emphasizes that if rates continue to rise at a given facility, consideration should be placed on utilizing other methods including alcohol-impregnated port protectors, needleless connectors, and scrubbing devices in addition to standard hub disinfection. In order to identify the impact of altering an individual method of disinfection, a review of current literature focused on patients with central venous catheters, and whether the use of 70% alcohol impregnated ports, in comparison to scrubbing with 70% alcohol pads, decreases the rate of CLABSI s.

**Literature Review**

An initial inquiry was conducted utilizing CINAHL, PubMed, Medline, and Cochrane to search articles containing a combination of central lines, infection, reduction, disinfection, 70% alcohol, and impregnated caps. Inclusion criteria included quantitative research studies that were published in professional journals within the last five years. Abstracts and conference posters were not included in the review. Preliminary results yielded 50 articles, including 25 that were peer-reviewed journals. Exclusion criteria included studies that focused on implementing numerous modifications at one time in addition to 70% alcohol impregnated caps, as well as samples outside of the acute hospital setting. Four articles met specific criteria, with varying
study designs including two quasi-experimental studies, an observational pre and post, and a non-randomized prospective study.

**Passive Disinfection**

Ramirez, Lee, and Welch (2012) in a nonrandomized prospective trial emphasize the value of passive disinfection, which eliminates the chance of error and provides a structured approach to disinfecting. As mentioned, current guidelines do not specify a particular way to cleanse the port, leaving hospital personnel to establish parameters. The process of applying and removing the impregnated caps is consistent in each included study: the cap remains on the needleless connector until time of use, and then is disconnected and replaced immediately after use of port. Numerous differences are noted when comparing each study, including the type of cap, process of implementation, extent of staff compliance, and measurement of contamination rates.

**Implementation**

Selected caps and implementation plans varied throughout the included studies. Merrill, Sumner, Linford, Taylor, and Macintosh (2014) in a quasi-experimental study as well as Ramirez et al. (2012) in a non-random prospective intervention trial, both utilized the *Curos Port Protector* and implemented the intervention following focused education. Mandatory education to staff with pre and post testing were identified by Ramirez et al. (2012), to include training of cap location in medications rooms, and the process of applying caps. Miller et al. (2014) utilized a fact information sheet for staff, in addition to one-on-one training, onsite vendor training, and available online training.

Further findings by Wright et al. (2013) offered no information regarding the process of implementation with staff, but did perform a prospective, quasi-experimental design, that used a
three separate study stages for data collection including: 1) gathering data on current process of manual disinfection, 2) utilization of SwabCap protector, and 3) the removal of the intervention to return to the baseline. This gap in available information unfortunately calls into question the type of education that was conducted with the use of the particular cap.

Compliance Issues

Ramirez et al., (2012) established a basis for utilizing a weekly document to record compliance. The variation in compliance fluctuated from 25% to 100% at times through the trial. An identified barrier was the location of the cap protectors away from the patient rooms (Ramirez et al., 2012). Ramirez et al., (2012) noted that an adjustment was made to the location during the intervention phase, to include caps available on IV poles, which increased the rate from 63% to 80%.

Compliance was also a key area highlighted by Merrill et al. (2014), where compliance tracking began following execution of caps, with weekly reports issued to the unit staff and publicized to encourage proper use. The audits offered valuable insight to support the use, in that a 10% increase in compliance resulted in a 7% decrease in infection (Merrill et al., 2014). An additional adjustment that was made during the intervention phase was due to staff feedback, where no-port tubing was purchased and implemented to decrease accessible ports.

Contamination Rates

Utilizing a diverse way to assess for contamination, Wright et al. (2013) used a sampling method on day 5, 6, or 7 of catheter days, in addition to twice weekly, to obtain a positive or negative contamination rate and measurement for specific organisms. This offered insight to what type of contamination occurred, most frequently a skin colonizer of Staphylococcus, in addition to the rate of CLABSI decline. Since CLABSI criteria is established at a national level,
the researcher’s ability to examine the level of contamination brought attention to the involvement of few organisms while utilizing the caps (Wright et al., 2013). The remaining studies applied only the CDC CLABSI guidelines in order to establish the rate of contamination.

**Discussion**

Each of the four studies resulted in a decrease in CLABSI rates per 1,000 central line days following implementation of the impregnated caps. This decline may be linked to both the physical (cap covering open ports) and chemical (70% alcohol) barriers that make up the impregnated caps. The research shows variation of implementation and compliance, which calls into question whether the technique is solely response for the reduction, or a combination of behavior and compliance as well. In addition, with a lack of control group during the intervention stage in any of the studies, the multiple adjustments make it difficult to pinpoint the affect on the CLABSI rates.

Compliance issues were present in all of the articles, which increased the potential to significantly impact results. Miller et al. (2014) makes note that the feedback loop that was created due to compliance auditing, allowed for continuous adjustments to the study even after initial implementation. Sweet et al. (2012) also shed light on the impact of introducing a protector cap in addition to a negative pressure cap at the same time during some studies, which makes the impact even more difficult to determine.

**Conclusion**

CLABSIs are a significant HAI that continue to put patients at risk. Current studies reviewed show that utilizing 70% alcohol impregnated caps decrease the number of CLABSIs per 1,000 central line days. Variations in study designs, intervention methods, and result analysis leaves an unclear conclusion of the most effective tools for successful implementation. Although
The Joint Commission continues to offer little instruction regarding cap use, the decrease in rates supports the opportunity for use.
References


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