American Journal of Infection Control 41 (2013) 33-8

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Continuous passive disinfection of catheter hubs prevents contamination and bloodstream infection

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Key Words:
Central line infections
Alcohol cap
Business case analysis

Background: Catheter hub decontamination requires a thorough scrub and compliance varies. This study evaluates the effectiveness of a disinfection cap with 70% alcohol in preventing contamination/infection.
Methods: A 3-phased, multifacility, quasi-experimental study of adult patients with central lines divided into P1 (baseline), when the standard scrub was used; P2, when the cap was used on all central lines; and P3, when standard disinfection was reinstituted. House-wide central-line associated bloodstream infection (CLABSI) rates are reported with catheter-associated urinary tract infections (CAUTI) as a control measure. Adults with peripherally inserted central catheters inserted during hospitalization having 5+ consecutive line-days gave consent and were enrolled, and 1.5 mL of blood was withdrawn from each lumen not in use and quantitatively cultured.
Results: Contamination was 12.7% (32/252) during P1; 5.5% (20/364) in P2 ($P = .002$), and 12.0% (22/183; $P = 0.88$ vs P1 and $P = .01$ vs P2) in P3 ($P = .001$ vs P2). The median colony-forming units per milliliter was 4 for P1, 1 for P2 ($P = .009$), and 2 for P3 ($P = .05$ vs P2). CLABSI rates declined from 1.43 per 1,000 line-days (16/11,154) to 0.69 (13/18,972) in P2 ($P = .04$) and increased to 1.31 (7/5,354) in P3. CAUTI rates remained stable between P1 and P2 (1.42 and 1.41, respectively, $P = .90$) but declined in P3 (1.04, $P = .03$ vs P1 and P2).
Conclusion: Disinfecting caps reduce line contamination, organism density, and CLABSIs.

Central line-associated bloodstream infections (CLABSIs) are a significant cause of morbidity and mortality in hospitalized patients. The 2 predominating sources of infection are believed to be extraluminal (from the skin during and following insertion) and intraluminal (from contaminated infusates or contaminated catheter hubs).[1] Recommendations regarding the use of chlorhexidine gluconate (CHG) for skin preparation prior to insertion and in dressings/sponges placed at the insertion site or as part of the dressing have largely successfully addressed the extraluminal source.[2]

Needleless connectors were developed in part to reduce the risk of needlestick injuries to health care providers. Following their introduction, there were reports of sudden increases in line-related infections.[3-5] Salgado et al reported that infection rates increased following the introduction of a needleless device and that intense staff re-education on proper disinfection and use failed to improve the infection rate to the preneedleless device baseline.[4] Subsequently, Menyhay and Maki demonstrated in an in vitro study how a protective cap containing CHG and 70% ethanol was more successful in removing organisms from heavily inoculated catheter hubs than manual scrubbing with alcohol alone.[6]

The aim of this study was to assess the in vivo performance of a luer access valve disinfection cap impregnated with a sponge saturated in 70% alcohol affixed to catheter hubs for (1) preventing or reducing bacterial colonization of the intraluminal space and

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Conflicts of interest: None to report.

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http://dx.doi.org/10.1016/j.ajic.2012.05.030

(2) preventing bacterial CLABSIs. A business case analysis examining the costs attained and avoided by the intervention was also carried out.

METHODS

NorthShore University HealthSystem (NorthShore) is a 4-hospital, University of Chicago-affiliated health system located in the northern suburbs of the Chicago metropolitan area. The hospitals have a total of 931 beds including 4 adult intensive care units (ICU) and a neonatal ICU (at a single facility). The study includes all inpatient adult units. This study was approved by NorthShore's Institutional Review Board and was federally registered (www.ClinicalTrials.gov ID: NCT01301300).

The primary outcome measure was contamination and organism density as measured in colony-forming units (CFU) per milliliter of the intraluminal catheter space in patients with peripherally inserted central venous catheters (PICCs) inserted during their index hospitalization. Secondary outcomes included CLABSI infection rates per 1,000 line-days and CLABSI attack rates in patients with any central venous catheter.

The disinfection cap (SwabCap; Excelsior Medical, Neptune, NJ) is a plastic threaded cap that houses a small sponge saturated with 70% isopropyl alcohol. The disinfection cap is threaded on to any lumen not actively in use and remains in place until the lumen is accessed, at which time the disinfection cap is removed and discarded. After the lumen is accessed, a new disinfection cap is threaded on to the lumen, saturating it in alcohol. By remaining on the unused lumen, the device acts as a physical and chemical barrier between the lumen and the environment.

This was a multiphase, prospective, quasi-experimental, baseline-intervention-baseline study beginning with phase 1 (baseline or P1), during which intraluminal contamination and CLABSIs were assessed in the setting of standard care that included using an alcohol disinfectant wipe to scrub the hub prior to accessing the lines. This was followed by phase 2 (P2), during which the disinfection cap was used on all central venous catheters. Following the intervention, phase 3 (P3) required the removal of the intervention and a return to baseline practice. PICCs were inserted, maintained, and predominantly accessed by interventional radiology and the vascular access team nurses. This study assessed intraluminal contamination in these PICC patients alone, while infection rates (CLABSIs) are reported for all adult central catheters. To avoid potential confounding, none of the hospital start dates for phase 1 or baseline precede October 2009 because a chlorhexidine impregnated access site sponge was introduced to all 4 hospitals in August 2009. There is a 1-month implementation time between P1 (baseline) and P2 (intervention) that is excluded from the results to allow for product implementation, staff education, and compliance monitoring. Between P2 and P3 (removal of the intervention), the product was removed from the facility product storage and unit-based clean supply in 1 overnight product elimination process, and, thus, there was no need for a "de-implementation" time period to be excluded.

Of the 4 acute care facilities, hospital D was assigned immediate and continued intervention and did not enroll patients to assess intraluminal contamination. This was selected based on limited resources for travel distances needed for obtaining consent and enrolling patients. The remaining 3 facilities were phased in, with baseline assessments and intervention and return to baseline (see Table 1) over the study time. Throughout each of the 3 facilities involved in the study, adult inpatients with a PICC inserted during their index hospitalization and those remaining hospitalized for 5 or more consecutive PICC line-days gave consent and were enrolled. On days 5, 6, or 7 and twice weekly thereafter during their index hospitalization, 1.5 mL of blood (eg, intraluminal fluid) was withdrawn from each catheter lumen not actively in use and placed into an Isolator 1.5 Microbial Tube (Wampole, Cranbury, NJ) during first morning rounds by an vascular access team nurse.

The aspirate was cultured quantitatively in the following manner. After vortexing the Isolator tube for 10 seconds, 1 mL of blood was aseptically transferred from the Isolator vial and placed onto a 150-mm diameter agar plate containing Mueller Hinton Agar with 5% Sheep Blood (Remel, Lenexa, KS). The sample of blood was placed in its entirety in a line down the center of the plate. The blood was allowed to soak into the agar for 1 hour and then streaked perpendicularly. This would allow any bacteria in the sample to be cultured away from any additives or antibiotics in the sample or tube. The plates were incubated in an inverted position at 37°C in ambient air and examined for bacterial growth after 24 and 48 hours. Each colony type was identified, counted by hand, and quantified as CFU per milliliter (CFU/mL). Plate counts greater than 1,000 CFU/mL were rounded down to 1,000 CFU/mL. To identify the organism, a Gram's stain was performed. Gram-negative bacilli were plated to MacConkey agar (Remel) and identified by the MicroScan Walk-Away system (Dade Behring Inc, West Sacramento, CA). Staphylococci were identified as coagulase positive or negative with the Staphaureux test (Remel). Gram-positive bacilli and Streptococci were identified by spot tests in addition to the Gram's stain. Enterococci were identified as vancomycin resistant following Clinical and Laboratory Standards Institute standard methods.

NorthShore has performed house-wide CLABSI surveillance using National Healthcare Safety Network (NHSN) definitions since 2000.[7] Automated device-days from an electronic medical record as previously described were used to calculate CLABSI rates per 1,000 device-days since 2009 (January 1, 2010, for hospital C, acquired in 2009, with implementation of this process in December 2009).[8] Outcome measures included the presence/absence of bacterial growth in the lumen aspirate, the organism density of bacteria recovered, and all CLABSI as defined by NHSN. In an effort to assess competency of the infection preventionists (IP) performing CLABSI surveillance, each underwent a series of competency assessments for CLABSI detection via the NHSN case studies presented in the *American Journal of Infection Control*.[9] Of the 5 IPs performing CLABSI detection over 2 CLABSI-related case studies, their accurate performance was 100% (35/35 questions).

Catheter-associated urinary tract infections (CAUTI) were used as the concurrent control for this study to assess any changes because of global infection prevention practice. These rates are automated utilizing a surveillance technology algorithm combined with device information from the electronic medical record. As background for this analysis, NorthShore implemented a comprehensive program to reduce CAUTI in late 2008 with a particular emphasis on diminishing unnecessary Foley catheter utilization. This program lasted from September 2008 to October 2009 with a successful reduction in urinary tract infections and device utilization. The initiative formally concluded in October 2009, prior to the onset of this study.

A business case analysis was performed to assess the potential financial impact and cost of the intervention. Internal room charges, laboratory cost and antimicrobial cost based in 2011 dollars are used with an attributable length of stay due to CLABSI extracted from the literature.

Contamination rates were assessed 2 ways; dichotomously (eg, positive vs negative, phase 1 vs phase 2 vs phase 3) and by measuring organism density in the positive samples. The former was assessed using a Fisher exact test (SISA[10]) and the latter via Mantel-Whitey *U* test[11] (CFU results of >1,000 CFU/mL are recorded as 1,000 CFU/mL). Infection rates were compared via a rate ratio

Table 1
Implementation dates, number of enrolled/sampled patients, number of lumens drawn, positive patients/lumens, and organism density for hospitals A-C and summed overall

	Hospital A	Hospital B	Hospital C	Overall A-C
Period of enrollment				
P1	4/2010-7/2010	7/2010-1/2011	7/2010-1/2011	
P2	9/2010-3/2011	3/2011-9/2011	3/2011-9/2011	
P3	4/2011-9/2011			
Patients sampled and percent with contamination				
P1	(11/89) 12.4%	(15/118) 12.7%	(6/45) 13.3%	(32/252) 12.7%
P2	(16/246) 6.5%*	(2/56) 3.6%*	(2/62) 3.2%*	(20/364) 5.5%†
P3	(22/183) 12.0%*			(22/183) 12.0%†
Lumens sampled and percent with contamination				
P1	(15/120) 12.5%	(17/134) 12.7%	(8/69) 11.6%	(40/323) 12.4%
P2	(22/354) 6.2%‡	(3/64) 4.7%*	(3/89) 3.4%*	(28/507) 5.5%†
P3	(33/261) 12.6%†			(33/261) 12.6%†
Colony-forming units per milliliter				
P1	2	7	102	4
P2	1*	1*	100.5*	1†
P3	2‡			2‡

*P = not significant.
†$P \leq .01$.
‡$P \leq .05$.

with 95% confidence intervals and significance testing as described by Ederer and Mantel.[12]

RESULTS

Of the 799 enrollees, subjects were more likely to be female (54.0%, 56.3%, 59.0% for P1, P2, and P3, respectively) and in P3 were younger on average (67.5, 65.5, 61.8 years for P1, P2 and P3 respectively P=0.01). Results for intraluminal colonization and CLABSI by facility are presented in Table 2. Overall, fewer patients had bacterial organisms recovered from their lines in P2 following implementation of the disinfection cap (12.7% vs 5.5%, respectively, $P = .002$) compared with baseline (P1), and this reduction was consistent when measured as a percentage of the lumens sampled ($P < .001$). Organism density in the intraluminal space decreased significantly between phase 1 and 2 overall, from a median of 4 CFU/mL to 1 CFU/mL ($P = .009$). The organisms recovered are presented in Table 3. Not surprisingly, among the patients with intraluminal contamination the most commonly recovered organism was coagulase-negative *Staphylococcus* species (18/32, 12/20, $P = 1.00$), a skin colonizer and frequent cause of CLABSI. Only hospital A entered phase 3, in which the disinfection cap was removed from the facility and direct care providers were required to return to their baseline practice of scrubbing the hub with an alcohol wipe prior to access. The percent of patients with intraluminal contamination increased to 12.0% (22/183), which was significantly higher compared with P2 ($P = .01$) and unchanged from the baseline level ($P = 0.88$). Organism density increased to a median of 2 CFU/mL, not significantly different from baseline ($P = .72$) but higher compared with P2 ($P = .05$). Among the patients with intraluminal contamination in phase 3. The predominant organism recovered was again coagulase-negative *Staphylococcus* species (16/22, $P = .26$, vs P1 and $9 = .52$ vs P2).

Infection rates and attack rates are presented in Table 2. In the 3 enrolling hospitals (A-C), the rate of CLABSI was 1.45 per 1,000 line-days in P1 (14/9,677), 0.74 per 1,000 line-days in P2 (9/12,221, $P = .11$ vs P1), and 1.31 per 1,000 line-days in P3 (7/5,354, $P = .83$ vs P1 and $P = .25$ vs P2). When we include a 5-month (P1) baseline (2/1,477) and the 18 months of the study following the intervention (4/6,751) for hospital D, the decrease from 1.43 to 0.69 per 1,000 line-days between P1 and P2 results in a risk ratio and 95% confidence interval that achieves statistical significance (RR, 0.48; 95% confidence interval: 0.23-0.98; $P = .04$). The per-catheterized-patient attack rate similarly declines with the intervention, from 0.81% in P1 to 0.45% in P2 ($P = .13$), returning to 0.85% ($P = .18$ vs P2) following removal of the disinfection cap, but none of these measures reaches significance at the $P = .05$ level. CAUTIs per 1,000 patient-days served as the control group for the study. The rate was unchanged between baseline (165/115,913) and intervention (265/188,483) ($P = .90$) but was significantly lower during P3 (53/52,137) ($P = .03$ vs and P1 and $P = .03$ vs P2), a time when catheter lumen contamination increased in this study.

To examine potential economic impact of the disinfection cap intervention, we followed the approach summarized by Perencevich et al[13] as first introduced by Ward et al.[14] Total expenditures for the disinfection cap were $60,233 per year. The baseline rate of 1.4 per 1,000 line-days was used (from P1), with a proposed reduction of 52% as determined by the above risk ratio for all 4 hospitals. The number of central line catheter-days for 1 year averaged 29,151; with 1.4 CLABSI per 1,000 line-days, this results in a total of 41 anticipated CLABSIs. If the device had been used, there would be 21 fewer infections and (assuming 20% mortality) 4 fewer deaths per year. With a literature-based estimate of 2.7 days in attributable length of stay, 56.7 bed-days are made available.[15] Our average length of stay for a hospitalized patient is 4.5 days, suggesting that with the disinfection cap we could admit nearly 13 more patients per year. For a cost of $2.07 per catheterized patient per day, we avoid 21 infections and 4 deaths and make enough beds available for 13 new admissions.

DISCUSSION

The 5 primary causes of central catheter infections following insertion (device contamination, infusate contamination, hematogenous infection, skin organisms at the insertion site, and catheter hub contamination) have been well described and are largely agreed on.[2] What is less well described and likely highly variable among patients as well as health care organizations is the relative extent to which each of these causes contribute to risk of infection. Assuming device and infusate contamination are relatively rare occurrences and hematogenous seeding of the external catheter tip can be prevented through limiting unnecessary device utilization by preventing infection at other sites leading to secondary bacteremia, this leaves skin organisms (extraluminal) and contaminated catheters hubs (intraluminal) as the 2 most modifiable causal pathways to preventing infection.[1] Extraluminal sources may be more likely to contribute to earlier onset infection, while intraluminal infections may more commonly be the source in long-term

Table 2
Infection rates per 1,000 line-days, rate ratios, and CLABSI attack rates for hospitals A-D and summed overall

	Hospital A	Hospital B	Hospital C	Overall A-C	Hospital D	Overall A-D
CLABSI per central line-days						
P1	7/3,126	2/3,349	5/3,202	14/9,677	2/1,477	16/11,154
P2	6/6,089	0/3,149	3/2,983	9/12,221	4/6,751	13/18,972
P3	7/5,354			7/5,354		7/5,354
Rate ratio						
P2 vs P1	0.44 (0.16 - 1.25)*	0 (0 - 2.04)*	0.64 (0.17 - 2.44)*	0.51 (0.23 - 1.15)*	0.44 (0.09 - 2.04)*	0.48 (0.23 - 0.98)†
P3 vs P1	0.58 (0.21 - 1.59)*			0.90 (0.38 - 2.18)‡		0.91 (0.39 - 2.16)‡
Attack rate of CLABSI per catheterized patient						
P1	(7/763) 0.9%	(2/477) 0.4%	(5/482) 1.0%	(14/1,722) 0.8%	(2/255) 0.8%	(16/1,977) 0.8%
P2	(6/836) 0.7%*	(0/475) 0.0%*	(3/448) 0.7%*	(9/1,759) 0.5%*	(4/1,101) 0.4%*	(13/2,860) 0.5%*
P3	(7/820) 0.9%‡			(7/820) 0.9%‡		(7/820) 0.9%‡

*P = not significant.
†$P \leq .05$.
‡$P = 1.00$.

Table 3
Organisms causing intraluminal fluid contamination and the frequency of their recovery

Organism	Number recovered
Coagulase-negative *Staphylococcus* species	46
Micrococcus species	7
Bacillus species	5
Diptheroids	3
Enterococcus faecalis	3
Staphylococcus aureus (methicillin resistant)	3
Klebsiella pneumonia	2
Acinetobacter baumannii	1
Candida albicans	1
Corynebacterium species	1
Enterococcus faecium (vancomycin resistant)	1
Escherichia coli (ESBL)	1
Glucose nonfermentative gram-negative bacilli	1
Moraxella species	1
Oligella urethralis	1
Pseudomonas fluorescens/putida group	1
Stenotrophomonas maltophilia	1
Yeast, not *Candida albicans* or *Candida glabrata*	1

ESBL, Extended-spectrum β-lactamase.

line use.[1] Timsit et al saw a 60% reduction in catheter-related infections in a randomized controlled clinical trial with the use of a chlorhexidine impregnated sponge.[16] Based on these results, we implemented a similar protocol, with less dramatic improvement (20% reduction; authors' unpublished data).

Preventing catheter hub contamination can take many forms. Selecting a device with the minimal necessary number of lumens decreases the likelihood of unused hubs lying in the patient's environment to serve as a fomite and portal of entry. Resources highlighted by a recent APIC Elimination Guide championed intense "scrub-the-hub campaigns" to decrease infections in which staff are re-educated and/or incentivized to clean the hub thoroughly prior to accessing the line.[17] These campaigns, whereas they can be successful, are analogous to hand hygiene campaigns. After bridging any knowledge deficits through education, it becomes a matter of compliance/behavior/technique, and, arguably like hand hygiene campaigns, enthusiasm and compliance are difficult to sustain over the long term without individualized and timely feedback. Even with such feedback, improvement may be difficult to sustain as demonstrated in a hand hygiene intervention described by Bittner et al.[18] The approach of using a continuously applied alcohol impregnated sponge as a cap on the hub for a standard approach to catheter care may eliminate the problem of teaching health care providers one additional disinfection process they need to use as part of their busy patient care schedule. The introduction of needleless connectors preceded multiple reports of outbreaks, including after a transition from split septum technology to luer activated devices, especially positive-pressure activated devices.[17] Throughout this study, all facilities utilized a lower-risk negative-pressure luer access device.

In our study, catheter hub contamination was significantly less likely to occur ($P = .002$), and, when it did occur, the number of recovered organisms were significantly fewer ($P = .009$) with the use of the disinfection cap. When the device was removed in phase 3, these contamination levels and numbers of organisms returned to at or near baseline levels. The most commonly recovered organism was coagulase-negative *Staphylococcus* species throughout the study, as expected because this skin organism is a common cause of CLABSI.[19] The decline in CLABSI rates per 1,000 line-days did not reach statistical significance ($P = .11$) among the 3 enrolling facilities despite a 49% reduction. Statistically significant reduction is only attained after the fourth, intervention-only, facility is included ($P = .04$). We think it is reasonable to include the data from this hospital because it is part of our health care organization and practices there are the same as at our other 3 facilities. The only reason it was not part of the formal investigation was that we did not have sufficient resources to collect samples at that site, and so we implemented the disinfection cap as a standard practice at the onset. Measurement of CLABSI was identical at this hospital as it was for the other 3 in the formal study.

The organization's CAUTI rate was selected as the control measure for the quasi-experimental study. Similarly to the CLABSI outcome, CAUTIs are device associated; measured throughout the 4 hospitals; and adherence to fundamental infection prevention principles such as good hand hygiene, aseptic technique, and prompt removal when no longer medically necessary are apt to reduce risk of infection. There was no difference in the CAUTI rate before (P1) and after (P2) implementation of the disinfection cap. However, when the device was removed from use during P3, the CAUTI rate decreased significantly, suggesting that any change in the CLABSI rate was more likely impacted by removal of the intervention (because CAUTI and CLABSI rates went in opposite directions) rather than any changes to patient population or basic infection prevention initiatives. A visual depiction of the relationship between CLABSI attack rate, CLABSI per device-day rate, contamination, and CAUTI per 1,000 patient-days rate is in Figure 1.

We evaluated a novel alcohol impregnated disinfecting cap that, once applied to the hub, remains in place until it is accessed. Its properties are likely both chemical (alcohol) and physical (cap remains in place and protects against external contamination). Oto et al observed a similar marked reduction in contamination rates in a randomized controlled clinical trial of a protective hub cap (without any disinfectant) used in a critical care unit.[20] An earlier study by Menyhay and Maki evaluated a similarly designed device

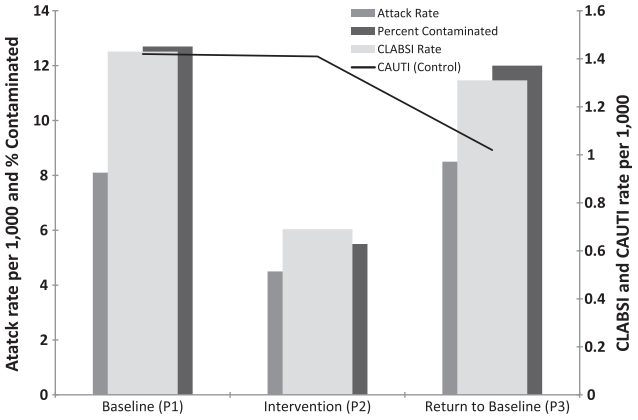

Fig 1. Central catheter attack rate per 1,000 catheterized persons, CLABSIs per 1,000 line-days, percent of enrolled with contaminated intraluminal space, and CAUTI per 1,000 patient-days for the 3 phases of the study.

with a CHG and 70% alcohol impregnated sponge within a threaded cap. Their in vitro study demonstrated that the cap design and disinfectant combination were more effective in eliminating bacterial contamination than the conventional scrub technique using an alcohol pad. That study did not determine whether the higher performance was due to disinfectants used or the cap design.[6] The disinfection cap evaluated in this study does not contain CHG, but the evaluation was in human subjects in actual hospital practice rather than a controlled laboratory environment. Two recent studies have described similar effects of an alcohol-based disinfection cap in preventing CLABSIs. Pong et al reported a reduction from 0.93 to 0.30 per 1,000 line-days over the course of 12 months in a single neonatal intensive care unit.[21] Similarly, Sweet et al reported a reduction from 2.9 to 0.4 per 1,000 line-days in an inpatient oncology unit.[22] Both studies achieve a lower overall rate than our experience following their intervention, yet neither study described using a control group, and both are restricted to single units, whereas our investigation reports comprehensive data from a 4-hospital health care system. Sweet et al include a business analysis utilizing a cost per CLABSI of $30,000, which is within the range of published estimates.[13,22] However, a recent study by Barnett et al[15] suggests that the attributable length of stay because of CLABSI (arguably the primary driver of such costs) is much less than previously reported.[15,23] If our study applied the same methodology with the estimated cost of $30,000, the 1-year annualized savings would be $390,617. In our own analysis, we described the cost per catheterized patient-day ($2.07), the infections and deaths avoided (21 and 4, respectively), and the hospital's ability to increase admissions (13) in a single year. Whether this translates to profit for an organization is debatable, but our analysis allows for this debate to be framed from societal and payer perspectives in addition to the more traditional hospital-based expenditure-profit point of view.

This study has limitations. The outcome, in the form of CLABSI, is a surveillance-based definition and, as such, likely overestimates the occurrence of clinical disease. It is, however, a standardized definition for NHSN reporting and is the measure for recent changes to the Centers for Medicare and Medicaid Services inpatient prospective payment system. There has been a recent report of inconsistent application by IP of these same NHSN-based definitions.[24] However, the individuals detecting and determining CLABSIs for this study took the first 2 CLABSI-based NHSN case studies with a 100% success rate in applying the definitions compared with 73% correct response rate nationally.[25] Compliance with using the disinfection cap required frequent reinforcement from IPs, research nurses, and vascular access team nurses. However, any lack of compliance in using the disinfection cap would bias the findings of this study toward the null hypothesis of no effect. The average length of stay for the cost analysis is markedly lower than other published estimates, but, again, these conservative estimates would bias the findings toward the null, cost-prohibitive hypothesis. The inclusion in the results of findings from the fourth, intervention only, hospital (hospital D) might be debatable. Although no patients were enrolled for the study at hospital D, CLABSI surveillance is uniform for both numerator and denominator collection across the health care system. Similarly, all infection prevention-oriented policies, procedures, and performance improvement initiatives are uniform throughout the system. The baseline period for hospital D does not include any additional interventions and is limited to 5 months to avoid overlap with the introduction of the chlorhexidine impregnated sponge that was implemented across the system in August 2009 (2 months prior P1). Recognizing that its inclusion may be controversial, we presented the results including and excluding hospital D.

This study demonstrated the effectiveness of an alcohol impregnated cap for catheter hubs in preventing intraluminal contamination and infection. With the use of such a device, contamination was significantly less frequent and, when it did occur, involved fewer organisms. Infection rates also declined, and both contamination and infection rates returned to near baseline levels after the device was removed from use. During the intervention, another device-associated infection rate in the form of CAUTI remained unchanged and actually declined significantly when the intervention was discontinued and CLABSI rates returned (increased) to their baseline. The use of this device is estimated to be financially attainable for the organization after accounting for the reduction in infections, attributable length of stay, deaths, and the cost of the device. At the conclusion of this investigation, our Infection Control Committee approved the permanent introduction of this device for use with central lines, and it is now the standard of practice for the organization.

Acknowledgment

The authors thank Eli Perencevich and Hongyan Du for their consultative contributions to this study.

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