The Art and Science of Infusion Nursing

Project HANDS

A Bundled Approach to Increase Short Peripheral Catheter Dwell Time

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ABSTRACT

Increasing short peripheral catheter (SPC) dwell time is becoming common practice. A number of variables lead to unscheduled restarts and significant complications with SPCs. Preventing complications is important to patient outcomes as dwell time increases. This quality improvement project compared the use of a manufactured securement device versus tape and transparent occlusive dressing while instituting a standardized insertion and care bundle with a 96-hour dwell time. Major findings included no statistically significant difference in restart rates in SPCs secured with a device compared with those secured with tape and transparent occlusive dressing ($P = .06$). These results differ from other published studies and may be due to the traditional nature of the hospital's infusion team and patients' average length of stay.

Key words: catheter-related bloodstream infection, dwell time, HANDS bundle, infusion teams, manufactured securement device, short peripheral catheter insertion and maintenance bundles

The purpose of this quality improvement project was to develop a bundled approach to short peripheral catheter (SPC) insertion and maintenance based on recommendations of the Centers for Disease Control and Prevention (CDC) and the Infusion Nurses Society (INS).[1,2] Increasing SPC dwell time from 72 to 96 hours with a manufactured securement device and a bundled approach to SPC care and management was investigated.

The assumption was that in hospitalized adults there is no difference in SPC dwell time and complications when an SPC is secured with the Centurion SorbaView SHIELD (Centurion, Williamston, MI) compared with the 3M Tegaderm IV Advanced securement dressing (3M, St Paul, MN), when both are part of an overall bundled approach to SPC insertion and care. The project investigated whether the current method of securement with tape and transparent occlusive dressing was comparable to a manufactured securement device in allowing catheters to dwell for 96 hours. In addition, the team examined whether maintaining a catheter in situ for 96 hours was affected by the skill and knowledge of the nurse, and whether the current 4.2-day average length of stay warranted the use of a more expensive securement device.

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The authors of this article have no conflicts of interest to disclose.

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DOI: 10.1097/NAN.0000000000000237

BACKGROUND

The project was conducted at a community teaching hospital in New England with a traditional infusion team. The infusion team inserts all inpatient vascular access devices (VADs) and assesses them daily. In addition, the primary nurse caring for patients assesses SPCs every shift. Nurses working in areas such as the emergency department are responsible for placing their own SPCs. During the period in which the project was conducted, a patient's average length of hospitalization was 4.2 days, or approximately 101 hours. The routine catheter restart protocol was every 3 calendar days, approximating 72 hours. Based on workflow in practice, routine restarts often occurred around

2.5 calendar days, or approximately 60 hours, because the infusion nurses count calendar days, not hours, as they make their rounds. The team contemplated whether increasing SPC dwell time to 96 hours would allow patients with an average length of stay to require only 1 SPC. While the facility endeavored to follow evidence-based practice guidelines, those practices had not been formalized into a bundled set of sequential actions.

Short Peripheral Catheters

SPC insertion falls under a capitated fee structure and is not directly reimbursable. Increasing the dwell time of catheters has been a recent focus to decrease costs, increase patient satisfaction, and prevent venous depletion. In addition, it has been suggested that frequent restarts or multiple attempts to restart an SPC increases overall complications.[3] SPC insertion is the most common invasive procedure used in hospitals, with estimates that range as high as 80% of all hospitalized patients requiring an SPC.[4,5] The average cost of an SPC insertion at the hospital in this study using the current method is $17—with supplies, labor, and wages and benefits factored in—and is based on 15 minutes of time. This figure does not account for the assessment time it may take when a patient has difficult vascular access. While SPCs are not without complications, the infusion team's hospital spent much of its focus on prevention of central vascular access device (CVAD) complications.

Infection Prevention

In 2011 and 2012, the hospital where this project took place incurred 8 SPC infections in each year. Four of the infections in 2012 occurred in VADs inserted by the infusion team; all others occurred in VADs inserted by the emergency department staff. In late 2011, the use of 2% chlorhexidine gluconate/70% isopropyl alcohol solution was incorporated as a site preparation solution. Education about the proper method of disinfecting catheter hubs before access was provided to all nurses. The CDC has emphasized that hospitals should routinely offer education for correct access, care, and maintenance to prevent infection and other complications once the SPC has been inserted.[1] The education focuses on the nurses who insert SPCs and all who use the SPCs for medication administration and blood draws. The educational campaigns are informally known as Scrub the Hub campaigns.[6] This proved helpful, since in 2013 the facility incurred just 2 infections in VADs inserted by emergency department staff.

Catheter-related bloodstream infections are considered preventable health care-associated infections, and treatment is no longer covered by the Centers for Medicare & Medicaid Services. Infiltration, thrombophlebitis, and extravasation that result in severe injury, limited limb use, or amputation may be considered sentinel events by The Joint Commission.[7] Complications such as sepsis, necrosis, compartment syndrome, and emboli from thrombus are complications that increase morbidity and mortality. Research suggests that SPC infection rates are very low compared with nontunneled CVAD and peripherally inserted central catheter (PICC) rates.[1(p22)] However, research has also suggested that many hospitals do not track SPC complications, including infection, and therefore, actual rates are unknown.[5,8] Increasing dwell time without proper site care and monitoring may lead to an increase in complications. This has caused controversy around the practice of removing catheters based on clinical indication.[5,8]

Routine Restart Versus Clinical Indication

A clinically indicated restart protocol entails the assessment of a catheter site and removal when a clinical complication, such as phlebitis or pain, is noted, versus restarting a functioning catheter with a site free of complications, based on a preset routine protocol.[3] The CDC states that routine change should be no more frequent than every 72 to 96 hours and deems clinically indicated restarts an unresolved issue.[1(p16)] INS states that SPC removal is not based solely on dwell time and that clinical indications also direct SPC removal.[2(pS91)] Evidence continues to suggest that a clinically indicated restart is safe.[3] Where complication rates may not be documented, researchers question how safe extended dwell times may be in clinical practice.[5,8] As traditional infusion therapy teams have been disbanded, experts have suggested that nurses with an interest in tracking complications have been lost.[9] As an infusion therapy team that tracks all complications for SPCs, the team in this investigation was aware of its rates. Increasing dwell time was viewed as unacceptable if complication rates also increased. Aware of both the evidence and the controversy, it was felt that increasing dwell time should be undertaken with caution and monitored. A 96-hour dwell-time trial was chosen in part because of CDC recommendations[1(p16)] and in part because the devices used in the trial were rated for a 96-hour dwell time. Bundling best practices was viewed by the team as one way of increasing dwell times while not incurring any increase in complications.

Bundled Best Practices

Bundling essential best practices into sequential steps is an evidence-based approach to preventing complications.[1] The central line bundle has received widespread attention in the United States, and its use has had a positive impact on decreasing central line-associated bloodstream infection rates.[1] The focus on central line bundles also has served to increase interest and attention in preventing other central VAD complications such as thrombus formation and air emboli.[10] In the United Kingdom, health care facilities have developed SPC bundles; the SPC bundle serves to focus attention on SPC infection and other preventable SPC complications, including phlebitis, infiltration/extravasation, occlusion, pain, and unintentional dislodgment.[11] SPC complication prevention should be a goal of all health care facilities, because complications influence patient outcomes, patient satisfaction, and an institution's financial viability.

The SPC recommendations for care and management from the CDC and INS begin with proper hand hygiene and donning of gloves.[1(p29-45),2(pS64-S65)] Antisepsis is achieved with a 2% chlorhexidine gluconate/70% isopropyl alcohol solution applied in a wide area for 30 seconds and allowed to dry for 30 seconds. Aseptic "no-touch" insertion is used once the site is prepared. The catheter is secured, the dressing is dated, the site is assessed at least daily, and the dressing is maintained dry and intact.[1(p29-45),2(pS64-S65)] Based on these standards of care and maintenance, Caguioa et al developed the mnemonic device HANDS for the bundle components and granted permission for its use in this project (Figure 1).[12]

Scrub the Hub Campaigns

In 2014, the infusion nurses were interested in increasing dwell time as a method to increase patient satisfaction and decrease costs. The need to include all nurses who worked with SPCs was apparent. Poor practice often results from a lack of knowledge and misconceptions related to SPC complications and standards of care.[11-13] As data on infections from previous years were reviewed, it was noted that several infections did not manifest themselves until 4 to 5 days after insertion. This led the team to believe that the source of infection may have been introduced into the catheter lumen after insertion. This stems from poor practice when catheters are accessed.[1] Prevention of infection once the SPC is inserted is accomplished with the HANDS bundle, which incorporates "Scrub the Hub," within the mnemonic device (Figure 1). Thus, it is applicable to all nurses who insert or access the SPC. At this hospital, only 1 campaign had been held in 2011. In addition to the basic bundle and Scrub the Hub campaigns, other means, such as the use of manufactured securement devices and specialized infusion teams, have been promoted as additional methods to prevent complications while increasing catheter dwell time.[1,2]

Infusion Teams

While experts recommend specialized infusion teams, most traditional infusion teams have been disbanded in favor of smaller, less costly vascular access teams whose primary focus is the placement of PICCs. Some vascular access teams may offer assistance to nurses who must place their own infusion devices when that nurse encounters a patient with difficult vascular access.[8] Evidence in favor of infusion teams points to lower rates of complications, fewer attempts at venipuncture, and presumably, due to both outcomes, greater patient satisfaction.[4,9]

The traditional nature of our infusion team should be emphasized. The team of 20 nurses covers the hospital 24 hours a day and places approximately 15 000 catheters a year, in addition to PICCs and other VADs. The team checks every peripheral and central catheter daily and is responsible for all CVAD dressing changes. The team runs an outpatient infusion suite and administers all chemotherapy to hospitalized patients. Leadership in the department functions on hospital-wide committees, such as the infection control, pharmacy and therapeutics, and value analysis committees. The infusion team teaches proper insertion and care techniques to select areas of the hospital where nurses insert their own catheters. The team is then available to assist patients with difficult vascular access. With this traditional infusion team in place, the hospital tracks all complications of both SPCs and CVADs.

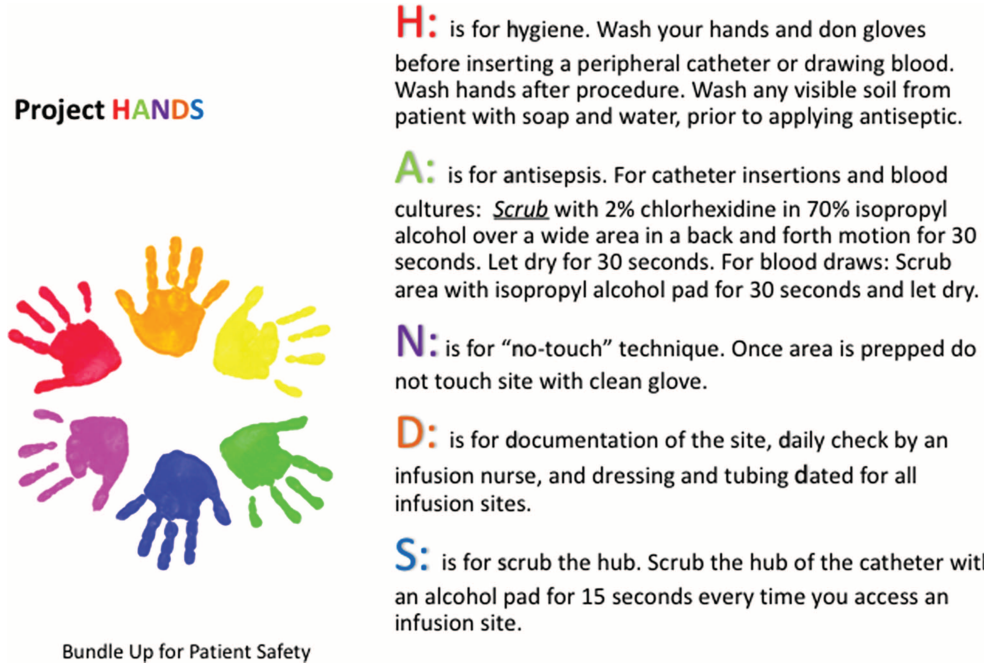

Figure 1 The Project HANDS quality improvement project developed a bundled approach to short peripheral catheter insertion and maintenance.

Securement Devices

The traditional method of securing catheters at this facility uses medical-grade tape and a transparent occlusive dressing. There is evidence that the ability to maintain an SPC in situ is dependent on how it has been secured. A traditional securement method through tape and transparent occlusive dressing often is not sufficient to maintain an SPC for 72 to 96 hours.[14-19] The addition of a securement device as recommended[1,2] has been shown to increase dwell time by aiding in the reduction of common SPC complications. When the catheter hub is firmly seated on the skin, pulling, drag, and micromotion of the catheter within the vessel are prevented. Phlebitis, infiltration, leaking, occlusion, pain, and unintentional dislodgment may all be reduced with the use of a securement device.[11,15-19] The migration of skin flora through the percutaneous site has been implicated in the cause of bloodstream infection and may be reduced with adequate stabilization. Therefore, both the CDC and INS recommend the use of a securement device.[1,2] The use of a securement device does add to the cost of SPC supplies, but others have found cost savings over time as the frequency of restarts decreases.[15-19] The team probed the benefit of a securement device in achieving a 96-hour dwell time and in preventing complications.

METHODS

The decision was made to trial 2 securement devices that are designed as device and dressing combined. A 96-hour catheter restart protocol was introduced with a bundled process for SPC insertion and care, including a Scrub the Hub campaign. An institutional review board waiver was received to trial the bundle and securement devices as a performance improvement project.

The Scrub the Hub campaign and device trial was introduced to all nurses using walking rounds on each unit and self-learning modules using the institution's computerized learning management system (Health Stream, Nashville, TN), as well as at nursing education days. SPC care and maintenance topics were presented over a series of months on Health Stream. Issues addressed during the Scrub the Hub campaign included scrubbing the SPC hub with alcohol for 15 seconds (like juicing an orange), proper securement of administration sets, and thorough mixing of medications. Education included information on biofilm formation in infection, applying clean connectors to intermittent administration sets, and discouraging the practice of "looping" used connectors into administration set injection ports for later use.[1,2,12] A logo and slogan were created to promote the project (Figure 1). Buttons, posters, and pocket cards that included the mnemonic device were distributed to nurses or posted during walking rounds.

Representatives from Centurion (Centurion Medical Products, Williamston, MI) and 3M (3M, St Paul, MN) provided education in the proper application of their products to the infusion team. Each manufacturer donated securement dressings for trial. One device was trialed at a time. Inpatients requiring a new SPC or a restart were sequentially enrolled. Areas in which nurses were responsible for placing their own SPCs for the device trial were excluded. However, they were included in the Scrub the Hub campaign. Included in the device trial were all medical-surgical floors, the critical care step-down unit, and the critical care unit. Complications for infection, occlusion, phlebitis, infiltration, leaking, pain, unintentional dislodgment, and patient removal were assessed. Infusion nurses assessed each catheter daily and as needed, which is current practice. Infiltration and phlebitis were assessed using the INS Phlebitis and Infiltration scales.[20(p108,p113)] Each product was assessed on its ability to maintain a 96-hour dwell time. Start time and removal time, along with the reason for removal, were recorded in the computerized infusion care record. Only 1 SPC secured with the dressing was used per patient. Rates of complications and dwell times were calculated using descriptive statistics for each device. In addition, the number of attempts made by the infusion nurse to insert the SPC was calculated.

Data were recorded on SPC insertion and removal time in 939 patients. Patients were assigned to 1 of the 3 SPC securement methods: Tegaderm IV Advanced, Centurion Sorbaview SHIELD, or the traditional method using tape and a transparent occlusive dressing. Catheters were removed when any complication developed, when they were no longer needed, or at 4 days from insertion. The end point was 96 hours; however, workflow and length of stay necessitated adaptions during the project. Because of the infusion team's routine, any catheter that was in place for at least 84 hours (3.5 days) without complications was considered a success. As a performance improvement project, this allowed routine practice to be followed and aided workflow because it did not necessitate that a nurse do a second round at 96 hours exactly to remove the catheter, as would occur in a randomized controlled trial. In addition, there was interest in knowing whether the securement device would reduce unscheduled restarts based on the average length of stay.

RESULTS

Patients who received the Tegaderm IV Advanced represented 39% of the patients in the study. The Sorbaview SHIELD group represented 28% of patients, and 33% of patients received the traditional tape and transparent occlusive dressing. Overall, 55% of catheters were removed before 84 hours and were free of complications. Based on the chi-square test of independence, there was no statistically significant difference in the success rate among the 3 securement dressings (48%, 54%, and 48% for Tegaderm IV Advanced, Sorbaview SHIELD, and tape and transparent occlusive dressing, respectively; $P = .6$).

TABLE 1

Performance of 3M Tegaderm IV Advanced Dressing

Tegaderm IV Advanced	Dressing Count
Number of infusion sites started	363
Stayed in until discontinued (LOS, TX) < 84 hours	206
Stayed in until discontinued (LOS, TX) ≥ 84 hours	75
Product met 96-hour specification	39
Unscheduled restarts	82

Abbreviations: LOS, length of stay; TX, treatment completion.

Of the Tegaderm IV Advanced group, 363 sites were included in the study (Table 1). Of the 363 sites, 57% (206) were removed in under 84 hours for either discharge or treatment completion. Of the 157 Tegaderm IV Advanced group that remained, 48% (75) lasted 84 hours or more without complications. Fifty-two percent (82) developed a complication before 84 hours and required an unscheduled restart. Thirty-six (36) SPCs were discontinued after 84 hours for discharge or treatment completion without complications. Thirty-nine (39) dressings in this group met the 96-hour manufacturer's specification.

Two hundred sixty-seven sites with Centurion Sorbaview SHIELD dressings were included in the study (Table 2). Of the 267 sites, 59% (157) were removed at less than 84 hours because of discharge or treatment completion. Of the 110 Sorbaview SHIELD dressings that remained, 54% (59) lasted 84 hours or more. Forty-six percent (51) developed a complication before 84 hours and required an unscheduled restart. Eight catheters in this arm of the trial developed a complication after 84 hours, requiring unscheduled restarts. Twenty-four (24) dressings in this group met the 96-hour manufacturer's specification.

Three hundred nine sites using the traditional tape and transparent occlusive dressing were included in the study (Table 3). Of the 309 sites, 50% (155) were removed at less than 84 hours for either discharge or treatment completion. Of the 154 tape and occlusive dressings that remained, 48% (74) lasted 84 hours or longer, and 52% (80) had a complication before 84 hours. While not rated for 96 hours, 41 of these dressings survived until 96 hours.

TABLE 2

Performance of Centurion Sorbaview SHIELD

Sorbaview SHIELD	Dressing Count
Number of infusion sites started	267
Stayed in until discontinued (LOS, TX) < 84 hours	157
Stayed in until discontinued (LOS, TX) ≥ 84 hours	59
Met 96-hour specification	24
Unscheduled restarts	51

Abbreviations: LOS, length of stay, TX, treatment completion.

TABLE 3

Performance of Traditional Tape and Transparent Occlusive Dressing

Tape and Transparent Occlusive Dressing	Dressing Count
Number of infusion sites started	309
Stayed in until discontinued (LOS, TX) < 84 hours	155
Stayed in until discontinued (LOS, TX) ≥ 84 hours	74
Met 96-hour specification	41
Unscheduled restarts	80

Abbreviations: LOS, length of stay; TX, treatment completion.

Between hours 50 and 85, the Sorbaview SHIELD had a higher survival than either the Tegaderm IV Advanced or the traditional method. At hour 85, it dropped below the other two. Tape with a transparent occlusive dressing and Tegaderm IV Advanced performed the same throughout. Analysis of variance was used to test the differences among the 3 dressings' average time to failure (whether before or after 84 hours). Maximum time to failure shows how long the catheter dwelled in situ before failing. There was no significant difference in average time to failure among the 3 dressings ($P = .19$).

Of the catheters used for at least 96 hours, the manufactured devices performed up to their 96-hour specification only about 30% of the time, with the tape and transparent occlusive dressing performing similarly (Table 4). Concerning complications, all 939 catheters remained free

TABLE 4

Comparison of Short Peripheral Catheter Meeting 96-hour Specification

Type of Dressing	Percentage of Catheters Developing Complications Before 96 Hours	Percentage of Catheters in Place to 96 Hours Without Complications
Tegaderm IV Advanced	68%	32%
Sorbaview SHIELD	70%	30%
Tape and occlusive dressing[a]	66%	34%

[a]Tape and occlusive dressing not rated for 96-hour specification.

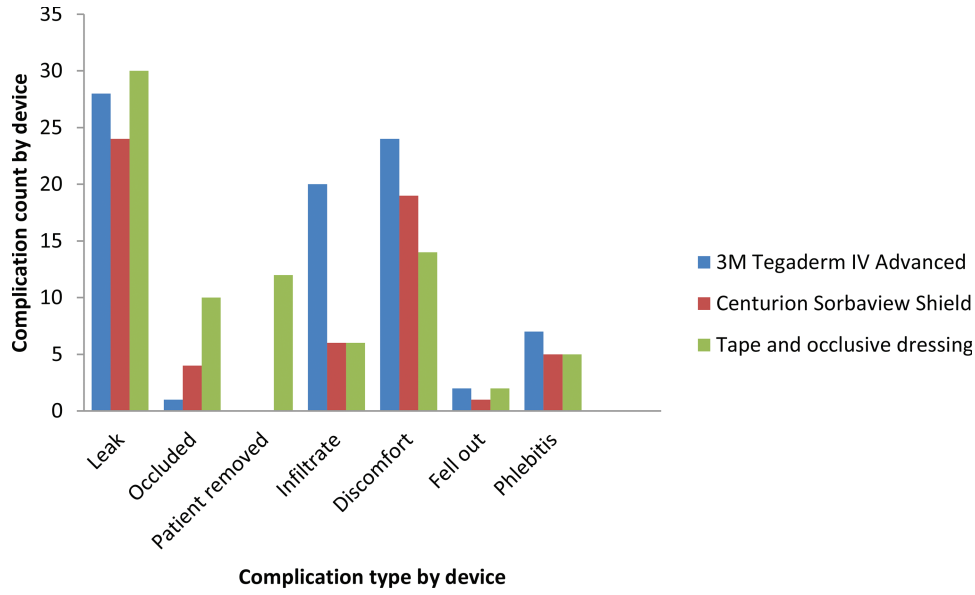

Figure 2 A comparison of complications experienced by patients according to dressing used.

of infection. Figure 2 shows the number and types of complications by device.

In each arm of the project, some catheters were in place for longer than 96 hours. In these cases, patient factors such as refusal of a restart, poor vascular access, or imminent treatment completion led to a longer dwell time. Patient comfort was also a factor; the actively dying or those anxious about needles were spared a venipuncture if the catheter was free of complications and functioning. The longest dwell time was 144 hours, and the catheter was secured in the traditional method of tape and transparent occlusive dressing.

The numbers of leaks, occlusions, and patient removals were higher using the traditional method compared with either securement dressing. This was consistent with the literature and an important factor in patient care.[11,14-19] However, significant complications, such as phlebitis, infiltration, and patient discomfort, were either on par with or less than those occurring with the securement dressings. The facility's phlebitis and infiltration rates have been consistently less than 2% and 3%, respectively, and remained so during the trial.

While the HANDS bundle was taught to the emergency department staff, there was 1 SPC infection in 2014 and another in 2015. However, this does signify a 50% decrease from the 2013 rate of infection. The research team believes it is on the right course in using education to achieve a rate of zero.

During this project, the infusion team's first-attempt success rate (FASR) was calculated to be 87%. The percentage of patients requiring more than 2 attempts to place a catheter was less than 1%. This figure is in alignment with other published studies that reflect higher FASRs with specialized infusion teams.[4,21] None of the catheters placed employed ultrasound or other visual techniques. During the project, there were 4 new team members who were inexperienced, and as such, the infusion team was pleased with the results.

LIMITATIONS

This project was not without limitations. There was an attempt to collect data on medications, comorbidities, and site selection that are often cited in the literature as a cause for either difficult vascular access or in the ability to maintain a catheter.[22,23] However, the team was unable to achieve adequate sample sizes for specific medications or comorbidities that would have provided a sound statistical analysis. The team places catheters in the forearm and hands whenever possible. There were a limited number of catheters placed in the antecubital fossa.

Although the infusion team received training and practiced using the devices, skill and comfort level with using the traditional method of securement may have been a factor in the results obtained. This project was completed at one community teaching hospital with a traditional infusion team and an average patient length of stay of 4.2 days. The results cannot be generalized to other hospitals.

DISCUSSION

A reduction in complications—most important, bloodstream infection—demonstrates the importance of using the HANDS bundle and accessing widespread education about preventing infection. While the number of infections in 2013 was only 2 from SPCs placed in the emergency room, 2014 and 2015 outcomes represent a 50% reduction in the rate of infection of SPCs placed in the emergency department. For SPCs placed by the infusion team, an SPC infection rate of zero was achieved in 2014 and 2015.

It appears that, in this hospital, traditional tape securement is as successful as the comparative dressings for up to 4 days. Length of stay is a legitimate issue when making new product decisions. Improving length of dwell time by

an average of 30% with the use of a securement device could equal substantial cost savings, especially in a facility that has a longer average length of stay. At this hospital, it does not appear that the length of stay warrants a more expensive device. After completion of the project, there was a policy change to a 96-hour dwell time, and the hospital's traditional method of securement was chosen. During this time, an increase in complications leading to unscheduled restarts has not been seen. The facility endeavors to remove SPCs that are not needed. Many patients can have their SPC removed 12 to 24 hours before discharge. While approximately 24 hours of additional dwell time have been gained, the average length of stay and the patient population do not appear to warrant the addition of a securement device. This project highlights the need to consider evidence-based practice guidelines in the context of patient and facility characteristics. Currently, this hospital has not chosen to move to a clinically indicated restart protocol. If that protocol should be instituted in the future, the tape and transparent occlusive dressing as a securement method will need reevaluation.

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