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Improving Vascular Access Dressing Integrity in the Acute Care Setting

A Quality Improvement Project

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ABSTRACT

PURPOSE: The purpose of this quality improvement project was to evaluate transparent vascular access dressings and the use of a liquid gum mastic adhesive on improving dressing integrity over peripheral intravenous (PIV) insertion sites without increasing medical adhesive-related skin injuries (MARSIs) such as tears.

PARTICIPANTS AND SETTING: A multidisciplinary team consisting of specialists in infection prevention, vascular access, nursing professional development, materials management, and WOC nurses met to review current audit data and available products to trial on 2 intermediate care units in our 2 hospitals in Indiana with a combined average daily unit census of 35 patients.

APPROACH: Four dressing protocols—including our existing dressing with education, and an updated dressing with education, and the updated and new dressing, both with education and the addition of a gum mastic adhesive agent—were sequentially implemented by nurses on the units, each over a 2-week period. The goal was for 80% of the dressings to remain with all 4 corners fully intact without reinforcement at day 7, or sooner if PIV was discontinued before day 7. Data were reported as frequencies for intact dressings and skin complications.

OUTCOMES: Education combined with the original dressing and the updated dressing did not achieve the goal of 80% fully intact dressings in the samples evaluated. The addition of the adhesive agent to the updated and new dressings with education exceeded the 80% goal. In addition, there were zero exposed PIV insertion sites and no documented MARSI in any of the 4 protocols.

IMPLICATIONS FOR PRACTICE: We continued to collect postproject data of 30,049 vascular access sites including central line catheters and observed the same effectiveness of incorporating a gum mastic adhesive on dressing integrity. This practice change has now become standard of care in our institution.

KEY WORDS: CLABSI, Dressing integrity, MARSI.

INTRODUCTION

Hospitals have a major focus on improving healthcare-associated infections (HAIs) with intense scrutiny on central line-associated bloodstream infections (CLABSIs) and other hospital-onset bacteremias. Efforts at prevention have long targeted the skin of the patient and healthcare worker processes such as hand hygiene, maximum sterile barrier precautions, antiseptic skin preparation, use of chlorhexidine-impregnated dressings, and other interventions.[1-3] Maintaining the health and integrity of the patient's skin receives considerable attention; however, less common are efforts to establish partnerships between wound/ostomy and infection prevention and/or vascular access teams to improve and promote HAI prevention processes.

Our organization reviewed available guidelines and standards as part of an assessment for reduction of hospital-onset bloodstream infections. We reviewed our current hospital policy, which emphasized the importance of maintaining dressings over vascular access devices in a clean, dry, and intact manner. We also reviewed the Infusion Therapy Standards of Practice,[2] which increase the imperative of addressing suboptimal dressings rather than just leaving them or taping them back down. The standards of practice at the time this project was conducted indicated that dressings were to be changed immediately if compromised by using the term "immediately" to specify the urgency of addressing dressings that are loose, wet, or soiled. Retrospective review of all device-associated primary bacteremias in the organization in 2016 revealed that 25% of 44 total events had documentation of a premature dressing change or tape reinforcement of the dressing. Additional data were

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derived from 3 audits of approximately 60 peripheral intravenous (PIV) insertion site dressings conducted by our infection prevention and nursing professional development staff and the dressing vendor representatives, who provided this information to nursing leadership, bedside care staff, and the infection control committee. Communication of information included direct verbal reports, email notices, unit huddles, formal committee reports, and education cycles over an 18-month period prior to the start of the project, in an effort to improve dressing practices. However, these audit and education cycles were unable to substantially improve the status of fully intact dressings, with only 55% of PIV dressings being observed as fully intact (all 4 corners adherent without reinforcement) and 15% being nonintact (insertion site exposed). Hospital policy states that clear, transparent dressings without the use of gauze must be changed every 7 days or whenever a dressing is nonintact. These findings prompted a significant effort in our hospital to improve awareness of and attention to the potential adverse consequences of nonintact dressings remaining on patients, rather than being promptly changed.

Although all evidence-based recommendations concur on the need for nonintact dressings to be changed, in a study of 1419 intensive care unit (ICU) patients, Timsit and colleagues[4] found that frequent dressing changes in response to dressing disruption are an independent risk factor for CLABSI with a more than threefold increase in infections. Findings from that study, combined with our data, provided the impetus for our organization's goal to develop a strategy to improve dressing integrity rather than focus solely on the need to change the dressing once loosened. Our WOC nurses became involved early in the efforts to identify optimal products to achieve this goal and provided guidance on any potential skin concerns introduced during these efforts.

Removal of adhesive dressings has been shown to cause stripping away of the skin's stratum corneum, the outermost layer of the epidermis.[5] It is important to keep the stratum corneum intact in order to foster its role as a barrier to mechanical pathogenic invasion.[6] Intact skin is also the body's best defense against fluid and electrolyte loss, infection, and external trauma.[7] Maintaining the integrity of a dressing over vascular devices helps with preventing CLABSI, and decreases the occurrence of medical adhesive-related skin injuries (MARSI), by helping to keep the skin intact.

While recommendations from standards are clear regarding maintaining dressings, little has been published regarding best practices to guide this care. Chan and colleagues[8] published a trial that primarily focused on improving securement of peripherally inserted central catheters using a variety of product combinations. In that study involving 122 devices, the average dressing dwell time from insertion to the first dressing changes was only 0.94 to 1.83 days. When reviewing the subset of dressing changes, "dressing lifting" was noted as the underlying cause of premature dressing changes 22% to 47 % of the time. While the trial encompassed a relatively small number of devices, overall findings suggest that dressing disruption was one of the primary reasons for nonroutine dressing changes.[8] Similarly, Richardson and colleagues[9] reviewed several high-performing options for vascular device dressings and found median dressing change times ranged from 40.5 to 68.5 hours or 1.69 to 2.84 days. When a subset of dressing changes for clammy skin, bleeding, or nonadherence were reviewed, the range was even lower ranging from 32 to 53 hours or 1.33 to 2.21 days. With significant nursing time and supply costs associated with dressing changes, and the concerns raised in several studies about frequent, unscheduled changes and associated CLABSI risk,[4] our team began to look for a solution to reduce the incidence of nonintact dressings.

The focus of this quality improvement (QI) project was to evaluate our institution's existing dressing and alternate dressings after education, and 2 new types of dressings, both with the use of a gum mastic liquid adhesive, on dressing integrity placed over PIVs. We set our goal for at least 80% of dressings to be fully intact when evaluated on day 7 after placement, or sooner if device was discontinued, which would be a substantial improvement from the 55% previously reported as being fully intact. A second objective was to document differences in the incidence of skin complications such as skin tears and MARSI associated with and without the use of gum mastic adhesive to anchor the dressings. Prior to implementation of this QI project, it was subject to review per standard scope of the infection prevention program and approved by the infection control committee, and shared governance and medical councils, and deemed to not require institutional review board approval.

APPROACH

We assembled a multidisciplinary team comprising experts from infection prevention, vascular access, nursing professional development, WOC nurses, and materials management to review current audit data, and available products for trial. Although the Six Sigma improvement model was not formally identified as the conceptual framework of the study, several important principles were adopted from this model.[9] In particular, the define, measure, analyze, improve, and control (DMAIC) concept (phases) of the Six Sigma initiative provides a measurable QI and defect reduction process structure.[10] DMAIC guides the team from question development with associated process measures and a plan to analyze defect elimination, implementation, and integration of improvements (Table 1).

We applied DMAIC concepts to our project and focused on the importance of defining how intact, nonintact, and reinforced-lifted dressings would be assessed. During the define phase, the problem we sought to address was: Only 55% of the original dressings evaluated prior to the project were still intact during repeated prestudy education and audit cycles. We also sought to determine how outcomes would be measured with the goal of achieving 80% of intact dressings, defined as all 4 corners adherent to skin without reinforcement, evaluated at day 7 after placement unless the device was removed. We also focused on controlling the impact of extraneous variables, for example by only including PIVs rather than midlines and central lines. We also collected data on the incidence of MARSI and skin complications through direct observation during rounds, review of incident reports, and WOC nurse consults.

PROTOCOLS

We sequentially introduced the 4 transparent dressing protocols, 1 at a time rather than all at the same time in the following order: original dressing (3M 9525HP Securement Dressing, St Paul, Minnesota) plus education, updated dressing (updated version of the existing IV dressing, 3M 1683 IV Advanced Dressing, St Paul, Minnesota) plus education, new dressing (Sorbaview Shield, Centurion Medical Products, Williamston, Michigan) plus gum mastic adhesive (Mastisol, Eloquest

TABLE 1.
DMAIC Framework Model

DMAIC Stage	Project Activities	Responsible Parties	Outcomes	Timeline
Define	1. Review baseline audit data on dressing integrity. 2. Identify the problem. 3. Meet with materials management and manufacturer to identify opportunities for improvement. 4. Define scope.	1. Infection control (IC), vascular access team (VAT), nursing professional development (NPD), materials management (MM), wound ostomy certified nurses (WOCs), and manufacturer's sales representative and clinical educators (MCE).	1. 55% of PIV dressings were intact. 2. Nonintact dressings or multiple or premature dressing changes increase risk of bloodstream infections. 3. 3 possible options selected: additional education to staff on existing dressing, trial of a new dressing, or trial of original and new dressings using a gum mastic adhesive. 4. Scope would be limited to 2 IMCUs (65 beds total).	1. 1 mo 2. 1 wk 3. 1 mo 4. 1 mo 2 wk of education followed by 2 wk of evaluation
Measure	1. Intact dressings defined as insertion site not being exposed. 2. Goal: 80% of dressings to be intact at 7 d or time of device removal if sooner. 3. Trial first new updated dressing (3M 1683 IV Advanced)	1. IC, NPD, VAT. 2. IC, NPD, VAT. 3. IC, NPD, VAT, WOCs, MCE.	1. 100% of team agreed on definition. 2. 57% (n = 76/134) of existing dressing intact following additional education only. 3. 9% (n = 1/11) of new 3M dressings were intact.	1. 1 wk 2. 2 wk of dressing evaluations 3. 2 wk of education followed by 2 wk of evaluations
Analyze	1. Trial of a second new dressing (Centurion Sorbaview Shield) plus gum mastic adhesive. Goal is for 80% of the dressings to be intact.	1. IC, NPD, VAT, WOCs, MCE.	1. 93% (n =26/28) of Centurion dressings were intact.	1. 2 wk of education followed by 2 wk of evaluations.
Improve	1. The cost of the second new dressings was significantly higher than updated 3M dressing. Decision was made to see if results could also be obtained using gum mastic adhesive with updated dressing.	1. IC, NPD, VAT, WOCs, MM, MCE.	1. 83% (n = 19/23) of dressings were intact.	1. 2 wk of education followed by 2 wk of evaluations
Control	1. Decision to go with updated 3M dressing plus the use of gum mastic adhesive: a. Exceeded the 80% goal. b. No increase in MARSI. c. Significant cost savings using current dressing. 2. Continued surveillance to ensure no increase in MARSI and sustained dressing integrity.	1. IC, NPD, VAT, WOCs, MM.	1. 83% (n =19/23) of dressings were intact. 2. A total of 8442 out of 8918 dressings evaluated were intact, corresponding to a rate of 95.11%.	1. 2 wk of evaluations 2. Ongoing surveillance over 6 mo

Abbreviations: DMAIC, define, measure, analyze, improve, and control; IMCU, intermediate care unit; MARSI, medical adhesive-related skin injury; PIV, peripheral intravenous.

Healthcare, Ferndale, MI) plus education, or updated dressing with adhesive plus education. Selection criteria for the new dressings was ease of application, maintenance of dressing integrity, and preference for contractual compliance, meaning that the dressing would be listed on the organization's purchasing agreement.

Each protocol was conducted over a 2-week period. The first protocol was to determine whether education alone would significantly improve dressing integrity of the existing dressing. Once this was completed, the second protocol was implemented to determine the effects of education on an updated version of the existing IV dressing. Both of these first 2 protocol periods took place during the measure stage of the DMAIC model. The second protocol was terminated early when it became clear that dressing integrity with the updated dressing was not better than the baseline with the original dressing. The third protocol involved examining the effects of the adhesive in combination with the Centurion dressing and education. This corresponded to the analyze stage of the DMAIC model. Finally, the fourth protocol combined adhesive plus education with the 3M 1683 dressing. This occurred during the improve stage of the DMAIC model. Because the 3M products were on the hospital's purchasing agreement, whereas Centurion was not, the investigators wanted to see whether a successful outcome (at least 80% integrity) could be achieved with the existing and new 3M dressings plus adhesive and education. This occurred during the control stage of the model.

SETTING

Two intermediate care units (IMCUs), 1 from each of the organization's 2 campuses, were chosen as the project units because the majority of patients on these 2 units had PIV access. The unit at the Northlake campus has 31 beds, whereas the unit at the Southlake campus has 34 beds. Prior to beginning the project, the multidisciplinary team reviewed the plan and objectives with the organization's infection control committee and shared governance council and received approval from both to proceed with the project.

EDUCATION OF NURSES

Education was provided to the nurses on the pilot units on the 12-hour day and 12-hour night shifts for 2 weeks prior to implementation of each of the 4 dressing protocols. The nurses were aware that the goal was to achieve 80% intact dressings. The content was determined in the multidisciplinary group discussions held before the pilot was initiated. There were a total of 31 of 33 RNs from the Southlake pilot unit and 21 of 23 RNs from the Northlake project unit who received instruction on the correct use of each dressing as well as the gum mastic adhesive, including the importance of allowing it to dry adequately before applying the dressing. They were advised to note that a gum mastic adhesive was used by marking an "M" on the dressing itself, in addition to making a note in the patient's electronic medical record during the pilot. The nurses were also instructed to use the gum mastic adhesive on all PIV dressings during the 2-week pilot, unless otherwise contraindicated (eg, the skin was damaged prior to dressing application). The nurses were also educated on the proper use of an adhesive remover. Education was done by the multidisciplinary team working closely with the manufacturer's clinical support staff. Reliability of the education was enhanced by ensuring that a member of the manufacturer's clinical support staff was always accompanied by a member of the multidisciplinary team to verify that the same content was included in each educational session. The nurses on these units were shown examples of reinforced/lifted, intact, and nonintact dressings, so they would know what the evaluation expectations were. Finally, nurses were also given the opportunity to apply the dressing on a model, so that techniques could be observed and corrected as needed.

Evaluation forms were placed on the project units for each of the protocols. Team members continued to round frequently multiple times each week on these units to check how nurses were managing the dressings and to pick up completed forms.

OUTCOME ANALYSIS

Dressing adherence (integrity) and skin complications were evaluated based on a review of completed evaluations during each protocol period, chart audits, and documentation by team members during multidisciplinary rounding. Information obtained from these sources was entered on a spreadsheet to allow further analysis and breakdown of the data according to dressing integrity, device type, anatomical location, and observer type. An examination of risk control reports and consults and rounding by the WOC nurses and multidisciplinary monthly vascular access rounds were used to record reports of MARSI on an ongoing basis. Descriptive statistics including frequencies and percentages were used to analyze the outcomes including intact dressings and MARSIs.

OUTCOMES

During the measure phase of the project, education alone with the original and updated 3M dressings was unable to achieve the goal of 80% fully intact dressings; only 53% of dressings were found to be intact during this phase in the small samples evaluated. The addition of the adhesive to both of the new dressings achieved and exceeded the goal and resulted in zero nonintact dressings over PIV insertion sites (Table 2). There were zero reported MARSIs such as skin tears or skin injuries in the patients receiving either new dressings plus education or the new dressings plus adhesive plus education.

After our project, we fully standardized the selected new 3M dressing with adhesive and education protocols from August 2017 through December 2017 and expanded the application of the adhesive to dressings for central venous catheters. During postimplementation of this second project, we developed a robust plan for ongoing monitoring that allowed us to evaluate the dressing protocol in a large number of patients to confidently conduct ongoing assessments after the expansion project was completed. In 2018, we evaluated the new dressing protocol dressings placed over to 30,049 vascular access sites at our 2 hospitals (excluding the nursery) and found fully intact dressings in 96.78% (29,081) cases (Table 3).

DISCUSSION

In our hospitals on 2 IMCUs, we compared 4 dressing protocols, each implemented sequentially and over a 2-week period, to improve the integrity of the dressings on PIVs. We found the dressing integrity improved with the addition of the adhesive; there where zero reported MARSI skin tears or skin injuries in any of the protocols. Recognizing the low sensitivity of relying on risk control reporting as the only data source for examining patient harm, our protocol added WOC nurses' assessments, because they routinely respond to nursing concerns and consults and also perform periodic, collaborative skin rounds on every patient in the hospital.

As a result of our project, monthly multidisciplinary vascular access rounds are now conducted, which include an overall assessment of device performance and complications. We also found no MARSIs reported during the project period. During the initial phases of the project in which we compared our existing and updated dressings without adhesive, dressing integrity was unable to be achieved to meet the 80% goal even with education. Adding the adhesive to the updated dressings achieved our objective. While there were clinicians such as

TABLE 2.
Baseline, Preimplementation and Postimplementation Percentages for the 4 Dressing Protocols

Results	Fully Intact	Insertion Site Exposed
Baseline: 3 audits conducted over 18 mo (sample sizes varied)	55%	15%
Original dressing kit: 3M 9525HP Securement Dressing plus education	57% (76/134)	15% (20/134)
Updated new dressing: 3M 1683 Securement Dressing alone plus education	9% (1/11)	27% (3/11)
New dressing: Centurion Sorbaview Shield plus Mastisol adhesive plus education	93% (26/28)	0%
Updated dressing: 3M 1683 Securement Dressing plus adhesive plus education	83% (19/23)	0%

TABLE 3.
Overall Dressing Integrity of New Standardized Protocol With 3M 1683 Securement Dressing + Mastisol Adhesive + Education Over the First 18 Months Postproject Implementation

Dressing status on Visual Assessment	4th Quarter 2017	1st Quarter 2018	2nd Quarter 2018	3rd Quarter 2018	4th Quarter 2018	1st Quarter 2019	Total October 2017 Through March 2019
Intact	6,750	8,046	4,882	2,572	4,218	2,613	29,081
Nonintact	105	66	75	50	190	93	579
Reinforced/lifted	82	59	41	25	88	94	389
Total	6,937	8,171	4,998	2,647	4,496	2,800	30,049
Fully intact without reinforcement or lifted edges, %	97.30	98.47	97.68	97.17	93.82	93.32	96.78

bedside nurses who preferred one dressing over the other or one combination over the other, both met the predetermined goal of 80%. Initially, the adhesive and adhesive remover were made available on the inpatient units as individual items while custom PIV kits were created. Throughout the study, bedside staff began independently exploring its use on devices beyond the original scope of the project, specifically central venous catheters. After the PIV kits were produced, the organization continued to provide the product individually to allow clinician judgment for expanded use. After several months, central line dressing change kits were updated to also include the adhesive, and policies were updated to include this as a standard practice within the organization for inpatients and for emergency room patients anticipated to be admitted.

Presently ongoing monitoring takes place each month, which involves direct visualization of between 1000 and 2500 vascular access device insertion sites. These assessments are conducted by bedside staff, nursing leadership, nursing professional development/clinical nurse specialists, infection prevention, and collaborative, multidisciplinary partners. Once a month, a diverse multidisciplinary team and industry support representative round on a subset of patients with vascular access devices to review opportunities for improvement. This also serves as a validation of the larger numbers reported of intact dressings, recognizing that self-reported numbers by the units may include some inflated success rates. Since hospital-wide implementation, the organization has captured over 30,000 direct dressing observations. Vascular access device type and anatomical location are both recognized as factors that play a role in maintaining an intact dressing. Unfortunately upon review of the literature after our project, we were unable to locate other studies in which adhesives were used to secure vascular access dressings, thus comparisons with our protocol could not be made.

Throughout the postproject period, WOC nurses continued their ongoing monitoring of patients in the hospital, as well as responding to skin care consults. Further observations conducted 18 months after the onset of new protocol practice adoption show there have been zero requests to consult for skin tears or other skin injuries related to vascular access dressings in the 3600 general skin and wound consults, other than noted next. Infection prevention and risk management continue to monitor risk control reports from nursing staff to identify any injuries related to vascular access devices.

During this postproject period, 1 skin tear was reported involving a vascular access device and dressing. An infiltrated IV resulted in a skin tear beneath the dressing. When the dressing was removed in accordance with use of the adhesive remover protocol, the skin tore further. We believe the products used were not the cause of the original tear, but given the skin damage from the infiltration cannot be ruled out as contributing to further damage upon removal. During vascular access device rounds, a patient in the ICU who was admitted with necrotizing fasciitis was noted to have multiple skin tears on the arm, including near the vascular access device insertion site and within dressing boundaries. This skin disruption was not captured in a risk control report system, but a consult was made to the WOC nurse who reported the case. Nonetheless, these cases represent vary rare occurrences in the setting of tens of thousands of dressing applications and removals.

Finding a product that maintained proper adhesion and produced the least amount of skin stripping was the major goal of our project. It was the combination of a gum mastic adhesive and a quality transparent vascular dressing coupled with education that allowed for the best length in dressing integrity. While achieving adherence to the site for a larger number of days, we also identified zero occurrences of MARSIs. This could be due to a twofold effect: our ability to succeed in maintenance of dressing integrity for a longer duration; and, removal of a dressing safely by the incorporation of a medical adhesive releaser. We posit that by maintaining the skin natural barrier function, without evidence of MARSI, our protocol strongly aided in the prevention of our CLABSI occurrence. With the collaboration of our multidisciplinary team, we were able to standardize consistent and appropriate application of vascular access dressings. Because MARSI is preventable, the team's continued audit, feedback, and education cycles conducted during this project were instrumental in achieving positive outcomes including preventing MARSI in our patient population. Thus, the protocol led to improved dressing integrity and provided support for evidence-based standards.

CONCLUSION

A collaborative QI project to improve vascular access dressing integrity by selecting different dressings from our previous protocols and adding gum mastic liquid adhesive successfully increased the rate of intact dressings in adult patients in an acute care, community hospital and were sustained after expanded adoption throughout the organization. Using risk control reports and WOC nurse consults, skin assessments and prevalence rounds as data sources, there were no reports of increased MARSIs related to the updated practices. The common concern received when discussing addition of gum mastic adhesive is the belief that there will be skin injury with its use, which we did not experience in our project. There were none noted in our study and we continue to monitor our protocol for ongoing effectiveness.

KEY POINTS

- Maintaining intact dressings is a core element of preventing vascular access device-associated bloodstream infections.
- Frequent dressing changes can have an adverse impact on patients' skin integrity.
- A multidisciplinary plan to enhance dressing integrity while protecting skin was successful at achieving the goal without noted harm to patients.

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