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**Reducing CLABSI Rates Through Education on Maintaining CVC Dressing Integrity:
A Quality Improvement Initiative**

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NURS 958: Clinical Nurse Leader Capstone

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July 28, 2023

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Abstract

BACKGROUND: Central line-associated bloodstream infections (CLABSIs) are a type of hospital-acquired infection (HAI). They arise as a complication from patients having a central venous catheter (CVC) placed. CVCs can provide numerous benefits for patients who require long-term venous access or hemodynamic monitoring. Acquiring a CLABSI can place patients at higher risk for complications, increased length of stay, and mortality. Reducing the risk of infection is imperative for all patients, but especially those who are more vulnerable to opportunistic infections, such as those in critical care units.

LOCAL PROBLEM: This quality improvement project took place at a 234-bed, level II trauma center hospital in the Seacoast region of New Hampshire. The aim of this quality improvement project was to improve CVC dressing integrity through re-education of the application protocol and subsequently decrease the risk for CLABSIs.

METHODS: The Plan, Do, Study, Act (PDSA) framework was utilized to design and carry out this quality improvement project. Based on auditing conducted by the infection prevention team, it was concluded that there was a lack of understanding of the dressing application protocol which may have been contributing to the decreased integrity of the CVC dressings.

INTERVENTION: The intervention was centered around re-education for the staff nurses on the unit. Both a pamphlet and an instructional video were developed highlighting key points about the benefits of the CHG dressings in preventing CLABSIs as well as demonstrating the proper steps for dressing application to optimize integrity. The educational materials were disseminated to all nurses on the unit via email.

RESULTS: Data was collected via weekly auditing sessions with the infection prevention team utilizing an updated CVC maintenance checklist that was altered to address the needs of this project. The data collection revealed that only a 54% adherence rate for the application protocol was achieved. There were no reported CLABSIs during this period. There was no statistically significant difference between dressings from pre-intervention to post-intervention for either category (“clean/dry”; $p = 0.278$, “intact”; $p = 0.442$).

CONCLUSIONS: Although the intervention did not meet the specific aim or yield statistically significant results, there are several limitations that may have contributed. Limitations included a lack of acknowledgment and engagement with the educational materials by the nurse, assessment of dressings not placed by nurses on the unit, infrequent auditing sessions, as well as differing sample sizes between pre-intervention and post-intervention. Whilst the specific aim was not met, the infection prevention team and nurses on the unit expressed their encouragement for the project and the hopes to implement in more capacities throughout the hospital.

Keywords: Central line-associated bloodstream infections (CLABSIs), CHG Tegaderm dressings, infection prevention, dressing integrity

Introduction

Problem Description

Central line-associated bloodstream infections (CLABSIs) are a global issue that continues to affect patients in healthcare settings, such as intensive care units (ICU). Central venous catheters (CVCs) or central lines provide direct access to the vena cava of the heart and therefore direct access to the systemic circulation. CVCs are often placed when a patient requires long-term venous access, long-term intravenous treatment, or administration of drugs that commonly irritate peripheral veins. In addition, CVCs can be placed when a patient requires hemodynamic access or hemodynamic monitoring in their heart (Leib et al., 2022).

Despite the benefits that CVCs can provide, CVCs/central lines can also come with severe complications such as arrhythmias, arterial puncture, nerve injury, and infections (Leib et al., 2022). Because CVCs are typically used in scenarios that require long-term access, the longer a foreign object is introduced, the greater the risk of infection, especially if proper care is not being taken at the insertion site. According to the Centers for Disease Control and Prevention, also known as the CDC (2022) and their National Healthcare Safety Network, there were a total of 30,389 CLABSIs that occurred in 2021. The CDC notes that between 2020 and 2021, in the United States, there was a 7% increase in CLABSI rates, with a 10% increase in specifically ICU settings. When a patient acquires a CLABSI, the risk for long-term hospitalization, higher medical costs, and mortality increases (Lee et al., 2018). A systematic review by Larsen et al. (2019), suggests that the current CLABSI rates are underestimated by nearly 3-4%, which indicates that these infections may be even more prevalent than currently known.

In ICU settings, many patients require central line insertions. The most recent CLABSI rate at a Southern New Hampshire hospital was 0.230 in 2022 (Medicare, 2023). This does

indicate that the ICU at this hospital is performing better than the national average when it comes to central line care (national benchmark 1.000), but the goal for all hospital-acquired infections is zero. The CDC has developed evidence-based central line bundles to decrease the likelihood of complications such as infections with central lines (Burke et al., 2021). These bundles include steps that can be taken during insertion, during care, and during the use of central lines (Appendix A). These bundles can include utilizing aseptic technique during insertion, scrubbing the access port before use, and changing the dressing every seven days or as needed to maintain integrity. Daily and weekly rounding is done by the ICU nurse manager and infection prevention (IP) team which shows that the ICU staff does follow the CDC's central line bundle. The IP team utilizes a specific CVC Daily Maintenance Checklist to complete the audits (Appendix B).

Compliance with the central line bundle steps influences the risk of CLABSI rates. The greater the adherence to all the steps, the lower the risk of the patient acquiring an infection. A study by Lee et al. (2018) assessed the adherence of a specific CLABSI bundle throughout four different units in one hospital. The researchers note that the highest CLABSI rates were found in the ICU where all components of the CLABSI protocol were not completed adequately. On the medical-surgical floor, where both insertion and handling of the central line catheters were in accordance with the protocol, they had the lowest rates (Lee et al., 2018). For patients in the ICU who are already most susceptible to other opportunistic infections, it is imperative that all staff who handle the CVCs do so in complete accordance with their evidence-based facility-set protocols.

The nurse manager and the IP team at this Seacoast hospital noted that an area for improvement with adherence to the central line bundle is the maintenance of CVC dressing integrity. This includes keeping the dressings clean and dry, intact and changed as needed or

every seven days. Baseline data will be provided from IP's central line auditing statistics. The author will continue to round with the IP team during the pre-intervention and intervention periods to continue to acquire data. Data from February 2023, showed that 81% of CVC dressings were found to be clean/dry, 76% were found to be intact and 71% were found to be dated. Data from March 2023 illustrated that 93% of CVC dressings were clean/dry, 64% were intact, and 79% were dated. Data from April 2023 showed that 72% of CVC dressings were clean/dry, 63% were found to be intact, and 81% were dated. This data indicates that the adherence to the CVC maintenance bundle is inconsistent and that there is room for improvement in increasing dressing integrity (Appendix C). The IP team records notes on the dressings with compromised integrity. The comments include "oozing, RN aware to change", "no date, some dried blood.", gauze under dressing, notified RN.", and "peeling & bloody".

The aim of this quality improvement initiative was to improve adherence to the central line bundle checklist specifically in regard to maintaining the CVC dressing integrity with the use of chlorhexidine gluconate (CHG)-impregnated dressings in the ICU. The process begins with the insertion of a central line catheter and ends with the removal of the catheter without the occurrence of a CLABSI. The goal was to have 90% complete adherence to the portions of the central line dressing change protocol (use of CHG dressing, clean/dry, intact, dated) by the beginning of July 2023. During this time period, the goal was to ensure that no CLABSIs occurred in the unit. The central line maintenance checklist was utilized to audit the CVC dressings and assess their integrity throughout the study period on a weekly basis. This provided data regarding multiple facets of dressing integrity. Data was also collected from the IP team regarding the status or occurrence of any CLABSIs. At the end of the PDSA cycle, the goal was

to have nurses report increased ease in maintaining the integrity of central line dressings post-education.

Available Knowledge

PICO Question

The following PICO question was developed to guide the literature review and subsequent quality improvement project (Appendix D). In patients with central lines in critical care units (Population), how does the use of chlorhexidine gluconate (CHG) IV securement dressing (Intervention) compared with non-CHG IV dressings (Comparison) affect CLABSI rates and the maintenance of overall dressing integrity (Outcome)?

Search Methods

A literature search was conducted across the Cumulative Index of Nursing and Allied Health Literature (CINAHL) Complete, Cochrane Central Register of Controlled Trials, Cochrane Clinical Answers, Cochrane Database of Systematic Reviews, Health Source: Nursing/Academic Edition, and MEDLINE. The Boolean terms that were used included; “central venous catheters” AND “chlorhexidine dressings” AND “infection”. The date range that was utilized was between 2014 through 2022 to allow for data to be gathered and reviewed from after chlorhexidine dressings were initially introduced. A total of 196 articles were originally returned. After applying the time constraints, restriction to the English language, and restriction to academic journals, only there were 99 studies left for screening. Studies were excluded if the population sample did not meet the age or population criteria, or if the main outcome measures of the study or interventions did not align with the stated PICO question. Studies from any country were included, but studies that were not in English were excluded due to the lack of translational resources. Duplicate articles were also removed. A PRISMA flow chart was created to document the full details (Appendix E).

After the screening, there was a total of 15 articles fully reviewed for inclusion in the literature review. Each article was thoroughly analyzed to evaluate for quality of evidence, patterns, conflicting statements, implications to practice, and overall conclusions. The articles were also evaluated using Melnyk's Levels of Evidence criteria.

Critical Appraisal of Level 1 Evidence Articles - Systematic Reviews & Meta-Analyses

A systematic literature review and meta-analysis by Puig-Asensio, et al. (2020) analyzed the effectiveness of chlorhexidine dressings as a method to help prevent catheter-related bloodstream infections (CRBSI). The authors reviewed a total of 20 studies, of which 18 were randomized controlled trials and the other two were quasi-experimental trials. The primary outcome that was evaluated by Puig-Asensio et al. (2020) was the definite CRBSI rate. In total, there were 15,590 catheters included. The studies included used either CHG discs or CHG gel transparent dressings. Overall, Puig-Asensio et al. (2020), found that CHG-impregnated dressings decreased the risk for CRBSIs by 33%. In the intervention group (those with CHG gel dressings or CHG discs), the CRBSI rate was 2.0% versus in the control groups (non-antibacterial dressings) where the rate was 3.2%. The forest plot for this study indicated that the pooled risk ratio is in favor of the CHG intervention outcomes (pRR = 0.71). It was important for the authors of this study to conduct a test for heterogeneity between the articles they included. A decreased level of heterogeneity as illustrated by a P value > 0.10 and a low I² percentage and indicates that the differences between the articles are minute and that the data can be summarized and the outcomes can be trusted to be due to the intervention in the studies (Chang et al., 2022). The heterogeneity P value for this meta-analysis was 0.70 with an I² of 0% which suggests an insignificant level of heterogeneity (Chang et al., 2022).

As related to the outcome of maintaining dressing integrity in this QI project, Puig-Asensio et al. (2020) discuss that when the dressing changes for the control group and intervention group were the same (every seven days), the CHG dressing had a greater impact than if the standard non-antimicrobial dressings were changed on a more frequent basis. It is important to note that at the current ICU, the standard central line bundle, regardless of dressing type, is every seven days or as needed. Limitations of this study include that the authors were unable to determine which catheter insertion site may benefit the most from the CHG dressings. There were also differing catheter models, insertion practices, and insertion sites throughout the included studies. The differing practices can provide room for skewed data.

A systematic review by Ullman et al. (2016) evaluated 22 randomized controlled trial articles. The authors defined the ideal central venous catheter dressing as having certain components including; barrier protection which prevents CLABSIs, adequate securement to prevent accidental dislodgement/failure, adequate comfort for the patient, ease of use, and cost-effectiveness (Ullman et al., 2016). This systematic review was not limited to exclusively CHG dressings as the intervention and also included interventions such as hydro-colloidal dressings, silver-impregnated dressings, and second-generation polyurethane dressings. The results of the studies that included chlorhexidine gluconate dressings versus other types of dressings showed that there was moderate quality evidence that the CHG dressings help to decrease CLABSIs and catheter tip colonization ($P = 0.08$). Although this was not found to be statistically significant, it does indicate a trend towards a decreased level of CLABSI rates when using CHG dressings ($pRR = 0.65$). The main limitation of this study is that the data is unclear about the effects of different dressing types on maintaining dressing security and integrity.

Another systematic review and meta-analysis by Wei et al. (2019), assessed 12 randomized controlled trials that evaluated the difference between CHG-impregnated dressings versus other types of dressing or no dressings at all on CRBSI rate and risk of catheter colonization. Wei et al. (2019) analyzed the studies using summary odds ratios and also assessed for heterogeneity. For the risk of catheter colonization, the odds ratio (OR) was 0.46 which illustrates that when CHG dressings were used, the likelihood of catheter colonization was decreased. The heterogeneity was not significant ($P = 0.18$, $I^2 = 33\%$) with the I^2 cut-off being 50%. For the CRBSI rate, the OR was 0.60 and the heterogeneity was also not significant ($P = 0.22$, $I^2 = 24\%$). The authors also concluded that in studies with sample sizes greater than 200 participants, the impact of the CHG dressings was greater (CRBSI rate in sample sizes > 200 ; OR = 0.53 vs CRBSI rate in sample sizes < 200 ; OR = 0.88) (Wei et al., 2019). The strengths of this study lie in the fact that it evaluates quantitative measurements instead of qualitative measures. This provides the field with concrete data on which further studies can be developed, recommendations can be made, and advancements can arise. The limitations include that the authors did not conduct further sub-analyses into catheter type, insertion location, frequency of dressing change, etc. Further studies should be conducted to analyze the effects of different dressings on different catheter insertion locations.

The last meta-analysis included in this literature review was conducted by Sadfar et al. (2014). The authors evaluated nine randomized controlled trials with a total of 11,214 catheters. The intervention included in this meta-analysis was the use of a chlorhexidine dressing and the control was a transparent occlusive dressing. The authors found that the rate of catheter colonization in the CHG group was 6.5% and 13.2% in the control group with a risk ratio of 0.51 ($P < 0.001$). The rate of CRBSI was 1.2% in the CHG group and 2.3% in the control group with

a risk ratio of 0.57 (P= 0.002). The meta-analysis did not find statistically significant heterogeneity amongst the studies (P=0.35, I² = 10%). Of note, the I² for catheter colonization amongst the studies was 64% indicating moderate heterogeneity. The authors also noted that within the included studies the use of CHG dressings was extended to arterial catheters used for hemodynamic monitoring. This suggests that CHG dressings could be beneficial for reducing infections stemming from arterial catheters as well. Limitations for this study surround the increased level of heterogeneity between the studies which can be related to sample demographics, differences in standard practices which can vary by facility, and differing catheters, and insertion sites.

It is important to note that within the meta-analyses and systematic reviews, not all of the included studies were conducted on strictly adult critical care patients. Due to the overwhelming majority of studies conducted on the adult population, it was decided to keep the systematic literature reviews included with the evidence.

Critical Appraisal of Level II Evidence Articles - Randomized Controlled Trials

There were six randomized controlled trials (RTC) included in this literature review. Biehl et al. (2016) conducted an RTC to determine the effectiveness of CHG dressings on CVCs in the neutropenic patient population. The authors specifically used Tegaderm™ CHG dressing versus the Tegaderm™ IV Advanced standard dressing. The sample included patients who were undergoing chemotherapy and were expected to experience chemotherapy-induced neutropenia for longer than five days with a CVC duration of longer than 10 days. There were a total of 613 patients included in the trial; 307 were in the CHG group and 306 were in the control group. The authors noted that all CVCs were inserted into either the subclavian or internal jugular veins. This analyzed both definite rates of CRBSI as well as definite-probable rates of CRBSI. The

definite overall CRBSI rates and the definite CRBSI rates within 14 days of insertion were both lower in the CHG group, but the change was not significant (2.6% vs. 3.9% $P = 0.375$). However, the study did conclude that the definite-probable overall rates of CRBSI and the definite-probable overall rates of CRBSI within 14 days of insertion were significantly lower in the CHG group (10.4% vs. 17.3% $P = 0.014$) (6.5% vs. 11.1% $P = 0.047$). The authors also evaluated the dressing integrity of the two types and noted that the CHG dressing required significantly fewer unscheduled dressing changes (269) compared to the standard dressing (362) ($P = 0.030$). The authors did a further subanalysis between the insertion sites and found that the rates of definite CRBSI infection overall and within 14 days of insertion were both significantly higher in CVCs placed in the subclavian vein compared to the internal jugular vein (definite within 14 days: 4.8% vs. 1.2% $P = 0.019$) (definite overall: 8.1% vs. 3.1% $P = 0.010$). This is an interesting finding because most other data will state that the internal jugular vein insertion site carries a higher risk of infection (Gaynes et al., 2022). The limitations of Biehl et al. (2016) include that they had an overall lower-than-expected event rate which may hinder the ability to assess the true impact of the CHG dressing.

Karpanen et al. (2016) conducted a prospective, comparative, single-center clinical study to evaluate the ability of a CHG dressing to decrease CVC and insertion site microbial colonization better than a non-antimicrobial dressing. There were 137 patients in the standard group and 136 patients in the CHG group. The majority of patients in both groups (87% and 82% respectively) had their CVCs placed in the internal jugular vein and all CVCs were placed following the same standard facility protocol. The researchers collected swab samples from the CVC insertion sites, suture sites, and the sutures themselves to analyze for microbial growth. The results illustrate that the CHG group had a significant reduction of microbial growth at all three

sample sites in comparison to that of the non-antimicrobial sites ($P < 0.001$). Contrary to Biehl et al. (2016) that suggested greater rates of infection at the subclavian site compared to the internal jugular site. Karpanen et al. (2016) found significantly higher numbers of microbes at the internal jugular insertion site for both the control and CHG groups. The study also notes that there are significantly higher rates of microbial colonization at the internal jugular site when the patient also has a tracheostomy present. The importance of this study, although it did not evaluate CLABSI rates, is to show that the CHG dressing has the ability to decrease the microbial growth and colonization at CVC sites which in turn can decrease the risk of developing a CLABSI.

Dolci et al. (2017) conducted a quantitative randomized controlled trial with a descriptive approach to assess the frequency of unscheduled dressing changes that occur in patients with CHG dressings. The ICU in which this study was carried out, had yet to implement the routine use of the CHG dressings so an educational session was provided on proper placement and maintenance of the dressings. The researchers conducted daily auditing of these dressings, making note of their integrity and noting how often unscheduled dressing changes occurred throughout the patient's stay. Dolci et al. (2017) included a total of 52 patients, assessing a total of 64 catheters. The CVCs were placed in the internal jugular (47%), subclavian (47%), and femoral (6%) veins. The CHG dressings were initially placed 24 hours post-insertion of the catheters. The authors found that the mean frequency of dressing changes was 3.04 days (SD = 1.917). Sixty-six percent of dressings needed to be changed within the first three days of placement and only 10% of initial dressings were in place with structural integrity after 7 days. The authors noted that the most common location for unscheduled dressing changes was the CVCs at the subclavian vein. 87% of dressing changes were unscheduled due to: wet/soiled

dressings, loose dressings (borders pulling away or air bubbles in CHG), and accidental removal of the dressings. The main limitations that the authors expressed were that the study was conducted in an ICU in Sao Paulo and therefore there could be effects from the climate of the environment as well as the skin characteristics of the Brazilian population (e.g. excess oils). The study also had a small sample size (159 total dressings). Although this study does not necessarily boast the benefits of the CHG dressings for maintaining dressing integrity, it does illustrate the importance of the dressings and changing them as needed to prevent infections.

Pivkina et al. (2018) conducted an RCT that assessed the effect of using impregnated CHG dressings plus a barrier film on infection rates, catheter colonization rates, dressing, and skin integrity. The control group received the standard transparent dressings while the intervention group received CHG dressings along with a skin-protective acrylic terpolymer barrier film. The protocol was for dressings to be changed every seven days or as needed in the case of complete dressing dislodgement or moisture present underneath the dressings. The researchers wanted to see how well the dressing stayed intact, how long it remained intact, and the effect of the dressing on skin integrity. The secondary outcomes that were evaluated were CVC colonization rates and CLABSI rates. Overall, the control group had longer dwell times (7.0 vs. 2.5 $P < 0.001$) and fewer complete dressing disruptions that resulted in dressing changes (2 vs. 17 $P < 0.001$). There was no report of skin irritations or moisture underneath the dressing within the CHG group. For secondary outcomes, there was no statistically significant difference between the rates of CVC colonization and CLABSI between the two groups ($P = 0.785$ and $P = 0.424$). The main limitations of this study include that the intervention group included two different interventions, both the CHG dressing and the barrier film. This makes it hard to distinguish which part of the intervention caused the greatest impact on the outcomes. A future

study that separates those two interventions and compares them would be beneficial for making future recommendations. This study also had a small sample size (60 total dressings) which makes it difficult to conclude the significant effects of CHG on CLABSI rates.

There were two RCTs that showed there was no statistical significance between using CHG dressings and infection prevention. Margatho et al. (2019) compared the use of CHG dressings to standard transparent polyurethane dressings for preventing CRBSIs and found no significant difference in microbial colonization between the two ($P = 0.51$). The study noted that the sample size was small, but based on the results, a larger randomized controlled trial would be plausible to conduct in order to gain further insight. Pedrolo et al. (2014) compared CHG dressings to the use of gauze and tape dressings on both CLABSI rates as well as maintaining dressing integrity. The researchers found no significant difference between the intervention and control groups for preventing CLABSIs ($P = 0.5170$) and for maintaining dressing integrity ($P = 0.2739$). Pedrolo et al. (2014) concluded that both modalities were effective for preventing infections and maintaining dressing integrity.

Critical Appraisal of Level III Evidence Articles - Quasi-Experimental Studies

Eggimann et al. (2019) conducted a real-world data study over the course of 11 years to assess the impact of CHG dressings on central line bundles in a 35-bed ICU in Switzerland. There were five different periods; Period A was pre-study, Period E was post-study and the CHG dressings were introduced over the course of Periods B through D. The CLABSI rate in Period A was 1.48/1,000 catheter days and in Period E the rate was 0.23/1,000 catheter days and this was a significant reduction ($P < 0.0001$). Throughout the introduction periods, Eggimann et al. (2019) introduced CHG sponge dressings and then eventually switched to CHG gel dressings. When this switch was made they saw a further decrease in CLABSI incidence rate (0.69/1,000 to

0.23/1,000; $P = 0.019$). During the post-study period (Jan. 2015 through Dec. 2018), the CLABSI rate remained at 0.32/1,000 catheter days indicating that the decrease in incidence rate was sustainable. The limitations of this study are that it was monocentric and without randomization and that the compliance of the other central line bundle steps was never assessed alongside the CHG dressing compliance. This study is suitable for recommending that CHG dressings are effective in reducing CLABSI rates.

Critical Appraisal of Level IV Evidence Articles - Retrospective Studies

There were two retrospective studies that were included in this review. Scheithauer et al. (2014) implemented the use of CHG dressings at two ICUs over the course of 19 months and compared the CLABSI rates to historical controls from before the introduction of CHG dressings. A total of 7,282 CVC days with the CHG dressing and 4,938 CVC days with the standard dressing were evaluated. In the CHG group, there were a total of 11 CLABSIs at a rate of 1.51/1,000 CVC days. In the control group, there was a total of 29 CLABSIs at a rate of 5.87/1,000 CVC days. The difference in CLABSI rate was statistically significant ($P < 0.001$). The researchers further analyzed the cause of the CLABSIs and noted that the CHG dressing was more effective at reducing CLABSIs by reducing gram-positive bacterial growth (Scheithauer et al., 2014). This study did conclude that the durability of the CHG dressings was greater than that of the standard dressing with an average dressing duration of seven days thus reducing the risk of infection exposure. The main limitation of this study was that there was no randomization within the design as it was a surveillance study.

Evidence Synthesis

By taking steps to reduce CLABSI rates in the ICU, patients' overall length of stay, treatment cost, complications, mortality risk, and risk for post-intensive care syndrome can all be

subsequently decreased. In conclusion, the overarching theme is that the use of chlorhexidine gluconate dressings is effective in decreasing rates of CLABSI/CRBSI in ICU/critical care areas when applied to central venous catheters compared to standard polyurethane/alternative dressings. There was some data that also showed that the CHG dressings were able to maintain dressing integrity for longer periods of time compared to alternative dressings (Scheithauer et al., 2014, Pivkina et al., 2018, Biehl et al., 2016, Puig-Asensio et al., 2020). Thokala et al. (2016) & Heimann et al. (2018) assessed the economic impact and benefits of CHG dressing and illustrated the positive end-economic savings that investing in CHG dressings can provide. Even though the data from Ullman et al. (2016) was not statistically significant, the current ICU already keeps the CHG dressings in stock so therefore it would not be an additional cost to the hospital to invest in these dressings and it could only provide benefits for the patient outcomes and the hospital. It is important to note that considering the nature of the intervention and that a main part of the studies is to observe/visualize the dressings for adverse effects and signs of infection, it is impossible to make these studies true blind studies. Even though not all studies concluded statistical significance in favor of the CHG dressing, the overwhelming trend was that the 3M™ Tegaderm CHG dressings do reduce CLABSI rates and improve dressing integrity when applied properly.

Rationale

The Plan-Do-Study-Act (PDSA) cycle framework was used in the implementation of this quality improvement project, collection of the data and analysis of the intervention's efficacy. Using the PDSA framework allows for changes to be made to the intervention and a new cycle to be run until the desired level of improvement is achieved.

Plan

A literature review was conducted on the effectiveness of CHG dressings as it relates to improving dressing integrity and reducing CLABSI rates. An educational portion of the intervention was planned which included the benefits of CHG-impregnated dressings, a review of the CVC bundle steps, and the proper application steps for utilizing the CHG dressings on CVCs.

Do

The aforementioned educational session was conducted utilizing a demonstration video that was disseminated to all nurses who work in the ICU of this Seacoast hospital. This video was sent via email to ensure that all nurses have access to the video along with a review of the bundle protocol. There was a post-intervention survey distributed to the nurses of the unit as well to assess the efficacy of the intervention and possible areas of improvement in the future.

Study & Act

Weekly audits were completed with the IP team to assess the effectiveness of the education and adherence to the CVC maintenance protocol. This data, coupled with the post-intervention survey results, was analyzed to determine the efficacy of the intervention and determine areas for continued improvement. In the Act phase, the data was used to determine the next steps such as periodic re-education, etc to improve CLABSI rates for future PDSA cycles.

Global Aim

The global aim of this QI project was to decrease the risk of CLABSI in the ICU and to help ensure a 0.000% occurrence rate of CLABSIs in 2023.

Specific Aim

The specific aim of the QI project was to increase CVC dressing integrity in the ICU. The aim was to have 90% complete adherence to the portions of the central line dressing change protocol (use of CHG dressing, clean/dry, intact, dated) by the beginning of July 2023. During this time period, the goal was to ensure that no CLABSIs occurred in the unit.

Methods

Context

The hospital utilized in this quality improvement study is an acute care hospital located in Southern New Hampshire that serves the Seacoast region. The intensive care unit (ICU) is a 20-bed unit that treats a wide range of patients that require close monitoring and critical care. This ICU offers several specialty services that provide a higher level of care for patients, such as remote monitoring, hypothermia therapy, continuous renal replacement therapy (CRRT), and intra-aortic balloon pumps (IABP). This unit is typically at maximum capacity with an average of 17 to 20 patients. The patient's diagnoses can vary including trauma-related, respiratory, neurological, cardiovascular, or severe complications related to post-operative care. The average length of stay between April and September of 2022 was 4.4 days. The volume of patients during this same time period was an average of 113 patients per month. It is important to note that extra-luminal CLABSIs typically occur within the first seven days of CVC insertion (CDC, 2022).

Many of these patients require long-term venous access which leads to them receiving central venous catheters (CVCs) located in either the internal jugular (IJ), subclavian (SC), or femoral veins. The use of these devices leads to a risk of the development of central line-associated bloodstream infection (CLABSI). The hospital currently follows a specific

CLABSI bundle protocol to care for these devices and reduce the risk of infection (Appendix A). The IP team rounds on a daily and weekly basis to assess the state of all CVCs in the ICU to gather auditing data as well as collect all CLABSI-related data (Appendix B). The most recent data shows that the ICU had a CLABSI rate of 0.230 (Medicare.gov, 2023). Per the IP team, the hospital had one CLABSI in 2023 (PICC), two CLABSI in 2022 (both dialysis-related; one femoral and one IJ); two CLABSI in 2021, two in 2020, and five in 2019. This quality improvement project is aimed at reducing the overall CLABSI rate as well as improving the dressing integrity of CVCs through the implementation of CHG CVC dressings and the education on proper application.

Cost-Benefits Analysis

CLABSIs are costly to hospitals in terms of time from staff, resources such as laboratory and imaging services, extended lengths of stays, etc. It is important to address this issue to not only reduce the cost to hospitals but also to improve patient outcomes and reduce length of stays. According to the Agency for Healthcare Research and Quality which evaluated seven studies that reported CLABSI costs, the average cost of a CLABSI is \$48,108 (\$27,232 to \$68,983) (AHRQ, 2017). AHRQ also reported that within five studies there was an excess mortality rate of 0.15 (95% CI). Another study by Benenson et al. (2020) conducted a matched case-control study over 18 months to assess the difference in financial costs between patients who acquire hospital-acquired infection (HAI) versus control patients. Benenson et al. (2020) found that there was a nearly 270% increase in patient care in those who contracted a CLABSI (\$6,400 vs. \$2,376; $p < 0.0001$). The increased cost to the hospital is influenced by the increased acquisition of resources and increased length of stay. Benenson et al. (2020) concluded that on average

CLABSI patients were admitted to the hospital for 18 days longer than their control counterparts ($p < 0.0001$).

Heimann et al. (2018) conducted a cost and resource utilization analysis to establish the economic effect of using CHG dressings in comparison to non-CHG dressings. There were 356 total patients analyzed with 178 in each group (CHG vs. non-CHG). The researchers used a micro-cost approach to determine the catheter-related bloodstream infection (CRBSI)-related direct treatment cost factors. The study found that CHG dressings significantly reduced the rate of both probable/definite CRBSIs ($P = 0.011$), but that the overall rate of CRBSI did not equate to increased length of stay or higher overall costs ($P = 0.640$). Heimann et al. (2018) concluded that even though the CHG dressings cost more to obtain in comparison to the standard dressings, it did not directly correlate to higher treatment costs and therefore it would outweigh the costs of CRBSIs by decreasing their overall rate and reducing the need for antibiotics. The cost analysis also illustrated overall net savings in direct treatment costs for patients in the CHG group. The main limitation is that there are certain patient comorbidities or conditions that can influence the individual overall cost for each patient.

Thokala et al. (2016) assessed the economic impact of the Tegaderm™ CHG dressings for critically ill patients. The researchers designed an analytical cost-consequence model with data from previously published sources to compare the cost-effectiveness of CHG dressings versus standard dressings. The researchers completed a threshold analysis to determine at what point the CRBSI rate would have to be in order for the CHG dressings to not be cost-effective, they determined that the baseline CRBSI rate would have to be $<0.1/1,000$ CVC days. Thokala et al. (2016) found that per 1,000 patients, the use of CHG dressings could net an overall savings of £77,427 (\$96,373.39) with the CHG dressing having a 98.5% probability of being cost-saving.

The data determined by this study may be influenced by the specific CRBSI rates of the units and hospitals in which it was conducted, there are also other individual factors for each patient to be accounted for that influences the overall cost.

The chlorhexidine gluconate-impregnated dressing that was utilized for this intervention is made by 3M Manufacturing. The current hospital of this study already regularly orders these specific dressings and keeps them in stock throughout the ICU clean supply rooms. Therefore, there was no extra cost to the hospital or an increase in the budget in order to acquire the dressings. The costs for executing the educational portion of this were centralized to the personal time of the project leader, printer paper, ink costs, and transportation to and from the hospital.

There was no risk of excess waste of these dressings as they are not regularly stocked in the patient rooms. When a CVC dressing is required to be changed, the nurses must obtain a dressing from the clean supply room and bring it into the patient's room for change.

Interventions

To improve the CVC dressing integrity and decrease the CLABSI rate and risk, nurses were educated on the implementation of 3M™ Tegaderm™ Chlorhexidine-Gluconate IV securement dressings. To improve dressing integrity, nurses were educated on the steps of proper dressing adherence and the utilization of all provided tape strips (Appendix F). A demonstration video was created and distributed via email to all nurses on the unit by the manager and unit educator along with a link to the dressing instructions and a reminder of the CVC policy in the hospital. A number of pamphlets with visual aids were created and displayed throughout the ICU as reminders for the nurses. The weekly auditing rounds also served as opportunities for education reinforcement with individual nurses.

Nurses were encouraged to utilize the CHG dressings instead of the standard peripheral IV dressings (polyurethane transparent dressings) when performing CVC dressing changes as needed or every seven days. Nurses were re-educated on the importance of utilizing antimicrobial dressings as it relates to reducing microbial colonization and growth and the risk reduction of the patient acquiring a CLABSI. Education via demonstration video and during weekly auditing rounds was reinforced on the importance of changing dressings with compromised integrity (e.g. peeling adhesive, exposed insertion site, blood pooling).

The weekly audit form utilized by the IP team was altered to include an extra column in which the team is able to report on whether or not the antimicrobial dressing was used and if it was applied properly (Appendix B). This is in addition to the other reporting measures such as dressing labeled and dated, dressing clean and dry, dressing intact, catheter stabilization, and if the extension tubing is covered with orange (CHG) caps.

At the end of the intervention period, another email regarding the quality improvement project was sent out to all of the nurses. This email contained a link to a Qualtrics survey that asks a series of short questions including: do you feel that this re-education was beneficial to your nursing practice and to your patients? Was the education helpful in understanding the benefits of CHG-impregnated dressings? Do you feel that this improved dressing integrity? Do you have any other suggestions for further improving dressing integrity?

Study of the Interventions

This quality improvement project was assessed as the IP team continued weekly audits of the central lines throughout the ICU from the beginning of June through early July. The weekly audits gathered data regarding the CVC dressings including the type of dressing used, integrity, and date. The level of adherence was assessed through analysis of the weekly auditing forms to

determine the rate at which the CHG dressings are being used. The rate at which the dressings were applied properly and in accordance with the instructions was also recorded. The dressing integrity was separated into two categories; “integrity intact” or “integrity compromised”. The IP team also continued to gather CLABSI rate data and report it as well for utilization in this study.

All the data collected was able to determine whether the use of CHG dressings was beneficial in reducing the CLABSI rate and improving dressing integrity. By surveying the nursing staff during the post-intervention period, the author was able to determine the ease of implementation from a nursing perspective as well as gather information for future PDSA cycles and areas for improvement.

Measures

The central line maintenance checklist created by the IP team at this hospital is facility-specific. The author received permission from the IP team to alter and utilize this tool for the purposes of this project (Appendix B). This is not a standardized tool that has been used in other studies, however, researchers have used similar tools to audit and evaluate their interventions regarding the impact of CHG dressings on CLABSI rates and other factors. This is a quick tool that allows for an easy and thorough evaluation of CVCs during audit rounds in the ICU. Rather than using an alternative tool from another study, choosing this checklist is best because the IP team is comfortable with using it. The IP team that conducts the audits includes one to three individuals. The addition of the last column regarding the use and proper application of the CHG dressing was reviewed with the IP team in detail to ensure understanding. The small size of the IP team ensured a high rate of interuser reliability for this project.

As previously stated, the primary outcomes for this project include the adherence rate of CHG application, the correctness of the application, and dressing integrity, all of which are based

on the auditing forms. Secondary outcomes include CLABSI rates, which will be obtained from the IP team. Although the audits were conducted on a weekly basis, the IP team rounds daily to check on the status of all patients with CVCs. The IP team works closely with the nursing director on the ICU unit to ensure that all patients are evaluated. This author was present for the weekly auditing rounds throughout the entire intervention phase to help collect data and re-educate as needed on the unit.

The post-intervention survey provided qualitative data that informed the ease of the intervention from the nurse's standpoint as well as patterns and themes that may guide subsequent PDSA cycles. This data was important because this project and any QI projects that are aimed at improving patient care and outcomes require buy-in from the nursing population to successfully implement change. Buy-in is key to the success of any new change.

Analysis

Weekly auditing continued throughout the pre-intervention, intervention, and post-intervention periods. Data was collected for six weeks beginning May 29, 2023 and ending June 30, 2023. During this time, CHG dressing use and dressing integrity was evaluated to assess the overall level of adherence to the intervention on the unit. This data was compared to data from February, March, and April of 2023 to assess for a difference in dressing integrity. CLABSI rates from the pre-intervention and intervention periods were also compared to determine the relationship between CHG dressings in the prevention of CLABSIs. Descriptive statistical analysis was conducted for all pre-/post-intervention outcome measures to aid in better visualizing the efficacy of CHG dressings.

Ethical Considerations

There were no ethical considerations noted prior to beginning this project. The implementation of CHG CVC dressings is evidence-based and therefore poses no additional risk to patients or health outcomes by ensuring proper use and placement of these dressings. There are no conflicts of interest to be reported for the author of this study. The project proposal was submitted to the University of New Hampshire Department of Nursing Quality Review Committee to attest that the standards of the QI project warrant an exemption from the full Institutional Review Board (IRB) review.

Results

The aim of this QI project was to improve the dressing integrity of CVCs for patients in the ICU and subsequently reduce the risk of CLABSIs. The intervention was centered around re-education on best practices for CVC dressing application. The data was collected via weekly auditing sessions with the infection prevention team over the course of four weeks.

Initial Steps of the Intervention

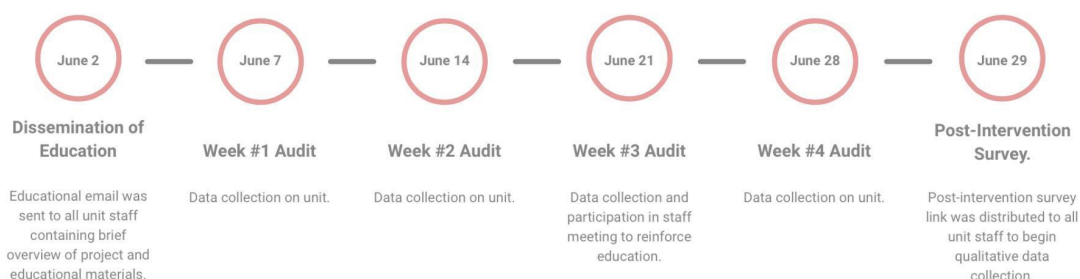
The intervention began with conversations with key stakeholders in the unit. This included leadership (nurse manager, nurse educator), staff nurses, and the infection prevention team. Once the goal of improving dressing integrity to reduce CLABSI risk was identified, in-person meetings were held with the stakeholders to discuss different potential interventions. Following a literature review of the most current evidence-based practices, a plan for the intervention was proposed and approved by the different stakeholders. The nurse manager and educator verbalized agreement to assist in the dissemination of the education via email to the staff. The infection prevention team members agreed to assist in conducting the weekly auditing rounds as well as help reinforce education when on the unit.

Creating the educational materials was the next step. This included the creation of pamphlets as well as an instructional demonstration video that illustrated the proper application steps for the CHG dressing. Initially, the pamphlets were intended to be hung throughout the unit, but they were distributed as an attachment through an educational email for the staff. The drafts of all educational materials were evaluated and approved by the IP team, Nurse Manager, Nurse Educator as well as the capstone professor overseeing this project. Please see Appendix G for a copy of this educational pamphlet.

The Nurse Educator provided a list of all staff emails to ensure that the education would reach the greatest number of staff possible. The dissemination of the educational materials took place on June 2, 2023, via email to all 78 staff nurses in the unit. The email contained a brief overview of the QI project and its goals as well as a link to the dressing demonstration video, the educational pamphlet, the current CDC CVC bundle guidelines, and the 3M application instructions for the CHG-impregnated dressing.

Data collection occurred for the following four weeks (June 7th, June 14th, June 21st, and June 28th). All data collection occurred in person in conjunction with the infection prevention team to ensure that measures were being collected as accurately as possible. The first two weeks of data revealed inconsistent adherence to the intervention. Due to this, reinforcement of the intervention occurred at the monthly staff meeting on June 21, 2023. There were 10 staff members in attendance at this Zoom meeting including the Nurse Manager. The preliminary data from the first two weeks of auditing data was shared at this meeting. The nurse manager and infection prevention team verbalized that they would continue to reinforce the education on the unit as well as print out more QR codes that contained the link to the demonstration video to hang in high-traffic areas throughout the unit.

Following the quantitative data collection, the post-intervention survey was distributed to the same list of 78 staff nurses in order to collect qualitative data surrounding the effectiveness of the intervention. This survey was distributed via email from the nurse educator after the final auditing session on June 29, 2023. Staff was asked to submit the post-intervention survey by July 3, 2023.



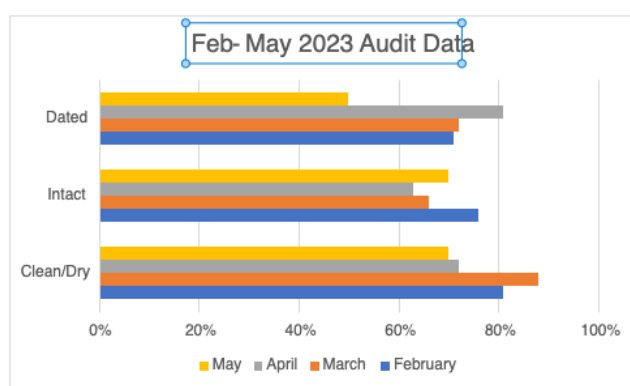
Process Measures and Outcomes

Quantitative data collection occurred via four weekly auditing sessions with the infection prevention team. The data was collected in person utilizing the central line maintenance checklist (Appendix B). All the quantitative data was transferred into Microsoft Excel and SPSS for statistical analysis. An independent t-test and Mann-Whitney U test were conducted for statistical analysis of the variables.

The number of CVCs available for auditing varied weekly based on the number of patients who required CV access. During the first week, there were only five CVCs available for auditing. Of the five CVCs, three were inserted using a BioPatch method which negates the need for CHG dressings. Of the two CHG dressings, one was applied correctly (50%). Week two had eight CVCs to observe. One dressing was obscured from view due to a cervical spine collar. Two of the seven dressings had properly applied CHG dressings (29%). In week three, there were six

CVCs for auditing and three were applied correctly (50%). During week four, there were 11 CVCs available to audit and eight of the dressings were applied properly (73%). It is difficult to conclude if there was a steady increase in adherence to the application protocol due to the varying numbers of CVCs. However, the increase in adherence between week three and week four may have been attributed to the reinforcement of education during the staff meeting on June 21, 2023. There was a total of 26 CVCs available for data analysis (three BioPatch, one covered with a C-spine collar). The average proper application of the CHG dressing throughout the intervention period was 54%.

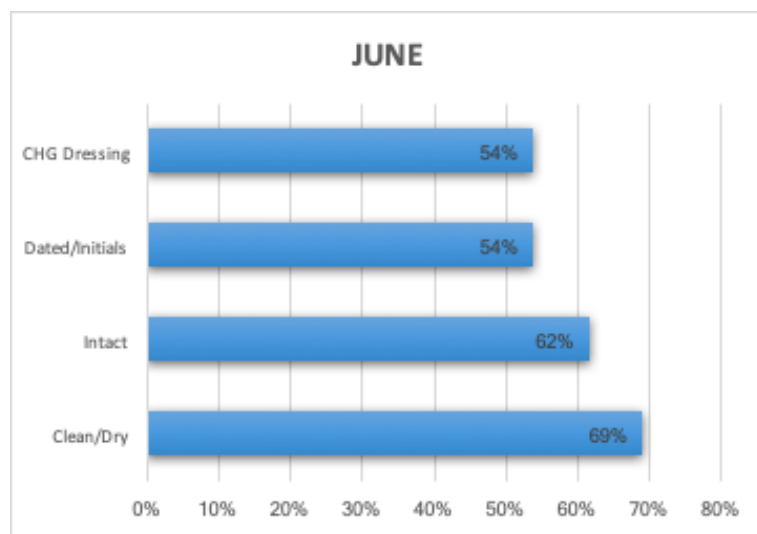
Pre-intervention data showed that between February and May 2023, 80% of dressings were “clean/dry”, and 70% were “intact” (Graph 1). Overall, for the month of June, 69% of CVC dressings were “clean/dry”, 65% of dressings were “intact” (Graph 2). This does illustrate that there was a decrease in dressing cleanliness and integrity during the post-intervention period, but it is important to note that the sample sizes were different between the pre-intervention and post-intervention period (n=60 and n=26, respectively). Table 1 illustrates the frequency and percentage of the pre-intervention and post-intervention cleanliness and integrity data.



Graph 1. Pre-intervention data results.

<u>CVC Chart Audit Data</u>	<u>Total Sample (N=86)</u> <u>Preintervention Sample (N=60)</u> <u>Postintervention Sample (N=26)</u>
Dressing Clean/Dry	
Pre-intervention - Yes	48 (80%)
Post-intervention - Yes	18 (69%)
Pre-intervention - No	12 (20%)
Post-intervention - No	8 (35%)
Dressing Intact	
Pre-intervention – Yes	42(70%)
Post-intervention – Yes	17 (65%)
Pre-intervention – No	18(30%)
Post-intervention - No	9(35%)

Table 1. Descriptive Statistics for Key Study Variables.



Graph 2. Post-intervention data results.

Of the dressings that were applied correctly (54%), 86% remained “intact” and 86% were “clean/dry”. The global aim of maintaining a 0.000% occurrence rate of CLABSIs during the intervention period was achieved.

Pre-intervention and post-intervention data were compared using SPSS software to conduct a Chi-Square test to determine the presence of a statistical significance of the intervention on the data. Pearson’s Chi-Square test for independence was selected because the data collected is non-parametric categorical data and cannot be paired like in a traditional t-test. The Chi-Square test revealed that there was not a statistically significant difference between pre-intervention and post-intervention dressing cleanliness and integrity. The Chi-Square test for dressings clean/dry between pre-intervention and post-intervention resulted in a p-value of 0.278. The Chi-Square test for dressings intact between pre-intervention and post-intervention resulted in a p-value of 0.442. These p-values are both greater than the cutoff of 0.05 indicating that there was no statistically significant difference between pre-intervention and post-intervention dressing cleanliness and integrity.

Descriptive statistical analysis was run on the post-intervention survey results. The survey was distributed via email from the ICU nursing educator to the staff nurses on the unit. Feedback was received after the dissemination of the initial education materials via the project leader that many nurses did not open the email because they did not recognize the sender. The nursing educator was chosen to disseminate the post-intervention survey versus the project leader in the hopes of reaching more nurses. At the end of the data collection period, there were a total of seven survey responses. This yielded a 9% response rate from the staff nurses on the unit. Table 2 illustrates the demographic data of the nurses that completed the post-intervention survey. Table 3 demonstrates the descriptive statistical analysis of the key variables from the survey. The survey asked respondents to answer the questions using a Likert scale of “strongly disagree” (1) to “strongly agree” (5). All results yielded a mean answer of “agree” (4) on the scale. Data collection showed a mean of 4.29 when it came to the question of if the QI initiative improved dressing integrity on the unit which indicates that respondents did feel that the QI project was beneficial. The final two questions on the survey were free-type answers in which respondents were asked to give feedback on whether or not they felt that the intervention was easily transitioned into practice and if they had any other suggestions for further improving dressing integrity. For ease of transition, ~71% of respondents said “yes” that there was an ease of implementation from education to practice. The other ~29% did not free type a response for this question. For further suggestions on dressing integrity improvement, this yielded answers such as “frequent follow-up with staff members to ensure they are using proper technique”, “audits”, and “reviewing other dressing options; reaching out to vendors for continued enhancements to the product”.

Demographic Data	Total Sample (N=7) n (%)
Age	
Under 18	0 (0)
18-24	2 (28.5%)
25-34	2 (28.5%)
35-44	2 (28.5%)
45-54	0 (0)
55-64	1 (14.5%)
65+	0 (0)
Years Working as an RN	
1-6 months	2 (28.5%)
7-11 months	0 (0)
1-3 years	2 (28.5%)
4-5 years	1 (14.5%)
>5 years	2 (28.5%)
Experience in Critical Care Settings	
1-6 months	3 (43%)
7-11 months	0 (0)
1-3 years	1 (14%)
4-5 years	1 (14%)
>5 years	2 (29%)

Table 2. Demographic Data for Post-Intervention Survey Results.

Variable	Mean	Standard Deviation	Range
Effectiveness of re-education.	4	1.07	1-5
Re-education improved understanding of CHG dressings.	4.43	1.05	1-5
QI initiative improved dressing integrity.	4.29	0.70	1-5

Table 3. Descriptive Statistics for Post-Intervention Survey Variables.

Contextual Elements

The adherence to the intervention was highly influenced by the engagement of the staff as well as the dissemination of the materials. Electronic dissemination of education materials was

chosen over an in-service presentation to increase the reach of the education to all nursing staff on the unit. However, this option proved to be difficult as the staff was wary of opening electronic communication from an address they were unfamiliar with. In turn, this led to decreased engagement with the educational materials themselves. The dressing application video that was sent to all staff nurses only received a total of 10 views during the intervention period. Having the buy-in from the infection prevention team as well as the Nurse Manager and Nurse Educator was crucial for continued reinforcement on a day-to-day basis. The low engagement with the educational materials, as well as the low adherence to the dressing application protocol, indicated a need for further reinforcement of the education. Participating in the monthly staff meeting provided an opportunity to emphasize the importance of the QI project as well as promote and encourage the educational materials that had been previously provided.

Low adherence to the intervention may also be related to the prioritization of patient needs and the level of staffing available on the unit. If the unit is understaffed and nurses have a greater number of responsibilities for their patients or their patient's acuity level is higher, then changing their CVC dressing may become one of the lesser priorities.

Observed Associations

Throughout the intervention period there was increased adherence to the dressing protocol to 73% in week four of data collection in comparison to 25% adherence in week two. The specific aim stated in the initial proposal was to reach a 90% adherence rate. With the overall average proper CHG dressing application at 54%, this QI project did not achieve this specific aim. During the final auditing session, it was noted that two of the dressings that were properly applied were on day five out of seven which indicates that when applied properly, the

CVC dressing maintains integrity for a longer period reducing the need for unnecessary dressing changes such as in Pivkina et al. (2018).

Unintended Consequences

Although this QI project was conducted within the ICU of this hospital, there are some patients in other units that require central lines (PICCs, dialysis) or patients who may have been downgraded from the ICU to other units with their CVCs. In this instance, the IP team rounded on these patients as well and noticed that those with properly applied dressings coming from the ICU maintained dressing integrity for longer periods of time. This project opened possibilities for providing this education in other departments, such as those caring for dialysis patients, and those who are dressing CVCs in the operating room.

Details About Missing Data

Data collection occurred on a weekly basis in alignment with the IP team's weekly rounding schedule for Foley catheters and central lines. There were no missed auditing sessions throughout the intervention period. It is important to note that because the patient census is constantly changing along with the patient's individual needs, the weekly auditing sessions only provide a singular snapshot into CVC maintenance on the unit. It may be pertinent to increase the frequency of auditing rounds to better determine the effects of future projects on CVC dressings and integrity. Given the limited time frame of the project, it may be beneficial to reinforce the education through in-services and future staff meetings and continue to collect data utilizing the updated CVC maintenance checklist to see if there is a possible continued benefit with this intervention.

Discussion

This project was developed following the Plan-Do-Study-Act framework. Analysis of the unit using a 5 P's approach as well as discussion with the staff revealed difficulties maintaining CVC dressing integrity in their acute care patients. The *Plan* portion began with research that illustrated that utilizing the 3M CHG-impregnated dressings according to the manufacturer's instructions was able to increase dressing integrity and decrease CLABSI risk. Research also revealed that utilizing the CHG dressings was critical in preventing microbial colonization and decreasing the risk of CLABSIs. Furthermore, educational materials were developed to disseminate the information and the importance of increasing dressing integrity in this vulnerable population.

The *Do* step involved disseminating the educational materials via email to the entire unit staff and performing weekly auditing sessions with the infection prevention team. Reinforcement of the education and project occurred at a staff meeting held during week three of the intervention period. This QI project was developed with the specific aim of increasing CVC dressing integrity within the ICU. The intervention that was implemented was centered around re-education on the CVC dressing application protocol. The goal was to have a 90% adherence rate to the proper dressing application protocol by the end of the intervention period. The global aim of this project was to decrease the risk for CLABSIs in the ICU and maintain a 0.000% CLABSI occurrence rate for 2023.

Post-intervention data analysis revealed that the specific aim was not met as there was only a 54% adherence rate to the CVC dressing application protocol at the end of the data collection period. The statistical analysis also revealed that there was no statistically significant

difference between the pre-intervention and post-intervention cleanliness and integrity variables. The global aim was met as there were zero reported CLABSIs during the intervention period.

The strengths of this project include the in-depth education materials that were developed and disseminated. There were multiple media formats to relay the education (video, diagrams, word explanations, step-by-step instructions). Using different media formats caters to a wide range of learning methods which can vary from person to person. Another strength is the strong support from the infection prevention team and leadership on the unit. Working closely with the infection prevention team allowed for high interrater reliability for the pre and post-intervention period. It also allowed for daily reinforcement of the project and education on days when auditing was not occurring. The support from the unit leadership led to encouragement and reinforcement of education amongst the staff as well. The Nurse Educator and Nurse Manager relayed their approval for all the educational materials and their desire to place the materials throughout the unit for increased access.

Interpretation

Observed Association Between Intervention and Outcome

The intervention was designed with the aim of improving dressing integrity on the unit and consequently decreasing CLABSI risk. Observations and discussions with the nurses on the unit as well as leadership and the infection prevention team showed that there was difficulty in maintaining CVC dressing integrity. It was found that the CVC CHG dressings were not being applied in accordance with manufacturer's instructions and best practice. The intervention was centered around re-education to improve knowledge on the unit of the correct steps and improve the practice of the nurses. The specific aim of this quality improvement project was to achieve a 90% correct application rate of the CVC CHG dressings by the end of the data collection period.

This data revealed that only a 54% adherence rate to the dressing application protocol was achieved. There was no statistical significance between pre-intervention and post-intervention cleanliness and integrity of the dressing. However, on numerous occasions, it was noted that dressings that were applied properly were able to withstand longer periods of time in between dressing changes. The lack of statistical significance also may be related to the low adherence rate to the protocol and the low sample size of dressings that were analyzed.

Comparison of Results

The literature search conducted during the development stage of this QI project revealed that CHG dressings were overall better at preventing CLABSIs in comparison to other dressing techniques (standard transparent polyurethane dressing). Many studies were overall inconclusive on the effects of CHG dressings on dressing integrity, however, studies did show that dressings were able to last longer before requiring a dressing change. Biehl et al. (2016) found that CHG dressings required significantly fewer dressing changes in comparison to the standard Tegaderm dressing ($p = 0.03$) as well as CHG dressings reduced risk for CLABSIs. This data corresponds to the data that when the dressings were applied in accordance with the protocol, they would be able to sustain longer time periods without requiring dressing changes. Although the integrity data from this project was not statistically significant, there were no reported CLABSIs either which indicates that the global aim of this project was achieved.

Initiative Impact

This project provided an opportunity to further the education of the unit nurses on how small adjustments in how they apply the dressings can improve their patient care. This project fostered the relationship between the infection prevention team and the ICU nurses. Working closely with leadership and the infection prevention team, this project has inspired future

opportunities for implementing a dressing protocol in other units of the hospital such as the operating room so that initial dressings are placed with increased integrity from the beginning. This project called attention to the day-to-day practices and techniques that nurses were utilizing in their care. It reminded them of the importance of how they place their dressings and the benefits it can have for not only the patient but for their patient care responsibilities.

Overall, the main process that this intervention impacted, was the type of dressing that nurses retrieved from the supply room and the steps in which they applied it. The unit itself did not face any large changes or impacts. The frequency of auditing performed by the infection prevention team was not increased so the dressing auditing was incorporated into their weekly CVC and catheter audits as it was. This project served as a reminder that one's practice can always be improved, and it may not require a large change to do so.

Influence of Context

When developing the QI project, it was anticipated that there would be a 90% adherence rate to the dressing application protocol. Data collection revealed only a 54% adherence rate to the protocol. There was no statistically significant difference between the pre-intervention and post-intervention data for the clean/dry category ($p = 0.278$) or for the integrity category ($p=0.442$). There are many possible factors that could have influenced the difference between the expected and actual outcomes of this project. First, the participation and engagement of the staff nurses was a large factor in the effective implementation of this project. Feedback was received that many nurses did not open the initial education email from the project leader because they were unaware of the sending address. This caused a lack of education dissemination which may have impacted the overall participation of nurses. Further affecting nurse participation is the number of competing responsibilities that the nurses have for their patients. Nurses must

prioritize patient care activities and the unit is a fast-paced and complex environment where situations and patient statuses are constantly changing.

The encouragement and involvement of the infection prevention team and the nursing leadership on the unit was a true strength of the project. They were able to continue education and promote the project to nursing staff on a day-to-day basis when the project leader was unable to be on the unit.

Cost-Benefit Analysis

There was no added cost to implement this quality improvement project as the hospital already carried the necessary 3M CHG dressings that the unit was being educated on. All the education materials were disseminated electronically and therefore there was no cost to print materials or purchase supplies. According to AHRQ (2017) which evaluated seven studies that reported CLABSI costs, the average cost to diagnose and treat a CLABSI is \$48,108 (\$27,232-\$68,983). This demonstrates the benefit of taking steps to reduce CLABSI risk in vulnerable patient populations such as that of critical care units. In this instance, because there is no additional cost, the benefits that may come from implementing this protocol and doing further education outweigh any costs that may be incurred. Furthermore, a study by Benenson et al. (2020) reported that there was a nearly 270% increase in patient care for those who contracted CLABSIs. This centered around increased length of stay and increased utilization of resources. It is in both the patient's and hospital's best interest to take precautions whenever possible to minimize the risk of contracting hospital-acquired infections such as that of a CLABSI. Additionally, by using the CHG dressings and following the application protocol, it is possible that dressing integrity may be improved, as suggested by Biehl et al. (2016) and certain findings

in this initiative. With improved dressing integrity, comes decreased need for frequent dressing changes which in turn reduces the number of resources a patient utilizes (dressings, staff time).

Limitations

There were several limitations of note throughout this project. First, after discussion with the infection prevention team about protocols, it was discovered that it is not required for providers to use the CHG dressings during the insertion process. Some providers may opt to use the BioPatch instead and those are then dressed with the standard polyurethane dressings versus the CHG dressings. In addition to this, if patients have CVCs placed in the OR (cardiac surgeries, etc.) or outside of the ICU, the providers or nurses who are placing the initial dressing were not included to receive the education during this QI project. Therefore, if CVC dressings were being audited that had not yet been changed since arriving in the ICU, this may skew the data collected.

Another limitation that is important to note was that there were CVCs incorporated in data collection that were for different purposes. Patients may have had CVCs in place that included a Swan-Ganz catheter, which is a pulmonary artery catheter, which places increased weight and gravitational pull on the insertion site. Other patients that were included had CVC access for hemodialysis treatment. The connection tubing for this CVC access is larger than the typical catheter size which also increases weight and gravitational pull on the insertion site and dressing. For patients who are postoperative heart surgery day one, they typically have multiple catheters from one CVC insertion and as the patient recovers different catheters may be removed one at a time which can alter the integrity of the dressing.

A major limitation of this study that was noted after the initial dissemination of the education materials was determining how many nurses utilized the education that they received.

After conversations with nurses on the unit, it was determined that some of the recipients of the educational email did not open the message because they were unaware of the sender's address. This impacts the extent to which the education was received and understood and therefore impacts the translation from education to practice.

Additionally, the number of CVCs that were assessed each week varied. In week one, there were only five CVCs to assess whereas in week four there were 11 CVCs to evaluate. In conclusion, there was a greater sample size for the pre-intervention data collection period (n=60) in comparison to the post-intervention sample size (n=26). The differing sample sizes and overall small sample sizes on both the pre-intervention and post-intervention sides can impact the ability to accurately determine statistical significance.

Conclusions

Usefulness of the Work

This quality improvement project helped to provide insight and assess the microsystem for weaknesses and areas that could be improved upon to help increase the safety of the vulnerable patient population that they care for. The aim of this project was to improve CVC dressing integrity and subsequently decrease the risk for CLABSIs in this patient population. This project helped increase the collaboration among nurses in different roles on the unit. It empowered leadership to help educate and encourage quality improvement in this microsystem. The education helped to shed light on a portion of the everyday practice that may become overlooked in the prioritization of patient care activities and bring the importance of quality in each care task to the forefront.

Sustainability

The longevity and sustainability of this quality improvement project were taken into consideration when it was developed. This project required no outside resource acquisition and very few additional staff resources. The hospital had already been purchasing and stocking the 3M CHG Tegaderm dressings within the clean supply rooms of the unit. The educational materials were prepared in different formats so that they may be altered and utilized as needed in the future by the unit educator and infection prevention team. This project could provide the foundation for other quality improvement projects centered around education. For this quality improvement project to continue to provide benefits, education needs to be reiterated amongst the nurses on the unit. There was little acknowledgment that the staff nurses received and engaged with the educational materials that were distributed which indicates that the education needs to be reinforced in a different way. The unit educator, unit leader, IP team, and project leader discussed different options for reinforcing the education during the staff meeting on June 21, 2023. There needs to be consistent auditing via the IP team in order to ensure that the protocol is being followed properly and address gaps in education as needed. If adhered to properly, this dressing protocol could have the potential for improving patient care, patient safety and decreasing the risk of CLABSI acquisition.

Potential for Spread to Other Contexts

Although the ICU is the main area in which CVCs are utilized, CVCs can be found throughout the rest of the hospital. It is imperative that all nurses who work with patients who have CVCs are knowledgeable on how to properly dress and maintain these lines. The infection prevention team has already discussed the possibility of disseminating the education to other units such as the operating room, dialysis units, and to the residents in the hospital who are

trained in placing CVCs. Proper application of the CVC dressing from the very first application is crucial in setting the standard of care and maintaining integrity throughout the lifespan of the CVC.

Implications for Practice and Further Study

In conclusion, this quality improvement project's first PDSA cycle revealed areas to be improved upon for any subsequent cycles. Although there were areas for improvement, this project also achieved its global aim by ensuring a 0.000% CLABSI rate for the intervention period. The staff should be surveyed for which form of education works best for them and which form are they most likely to participate in (on-unit in-services, classes that occur off shift, solely remote education, etc). There was a lack of engagement in the dissemination of the educational materials which may have contributed to the lack of adherence to the dressing protocol. By improving the engagement with the education and perhaps utilizing a teach-back method, future studies may be better able to elicit a higher level of understanding and adherence to the protocol and thus a better understanding of the effects of the intervention on CVC dressing integrity. It is also imperative to survey the staff on any other barriers that they feel may impede their ability to maintain CVC dressing integrity and address those concerns in subsequent PDSA cycles.

Further research should be done into any new devices being developed by medical equipment manufacturers that address the issue of CVC dressing integrity. During the development of this project, the 3M PICC/CVC Securement device was assessed for its implementation for the purpose of this project. However, after evaluation, it was determined that this securement device was too small to meet the needs of our varying CVC devices.

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Appendix A

Description of Updated Central Line Access Device Bundle Kit (CDC).

Follow proper insertion practices
1. Perform hand hygiene before insertion
2. Adhere to aseptic technique
3. Use maximal sterile barrier precautions <ol style="list-style-type: none"> a) Mask b) Cap c) Gown d) Sterile gloves e) Sterile full body drape
4. Choose the best insertion site to minimize infections and noninfectious complications <ol style="list-style-type: none"> a) Base on individual patient characteristics b) Avoid femoral site in obese adult patients
5. Prepare the insertion site with >0.5% chlorhexidine with alcohol
6. Place a sterile gauze dressing or a sterile, transparent, semipermeable dressing over the insertion site.
Handle and maintain central lines appropriately
1. Comply with hand hygiene requirements
2. Bathe intensive care unit patients over 2 months of age with a chlorhexidine preparation daily
3. Scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol)
4. Use only sterile devices to access catheters
5. Immediately replace dressings that are wet, soiled, or dislodged
6. Perform routine dressing changes using aseptic technique with clean or sterile gloves <ol style="list-style-type: none"> a) Change gauze dressings at least every 2 days b) Change semipermeable dressings at least every 7 days c) For patients ≥ 18 years of age, use chlorhexidine impregnated dressing with a Food and Drug Administration cleared label that specifies a clinical indication for reducing CLABSI for short-term non-tunneled catheters, unless the facility is demonstrating success at preventing CLABSI with baseline prevention practices
7. Change administration sets <ol style="list-style-type: none"> a) For continuous infusions: no more frequently than every 4 days, but at least every 7 days b) For blood or blood products or fat emulsions: every 24 hours c) For propofol: every 6 to 24 hours or when vial is changed
Promptly remove unnecessary central lines
1. Perform daily audits to assess whether each central line is still needed.

Appendix B

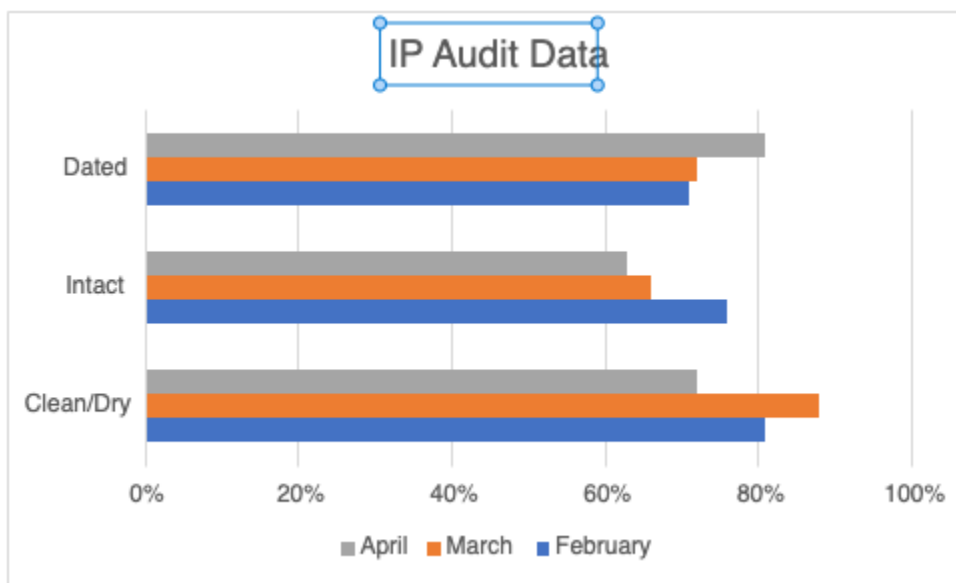
IP Central Line Maintenance Checklist

Date: _____

Room #	Injection Site Covered by Caps	Dressing (labeled with date/initials)	Dressing (Clean/Dry)	Dressing (Intact)	Catheter Stabilized (statlock/suture)	3M CHG Antimicrobial Dressing Used and Applied Properly?

Appendix C

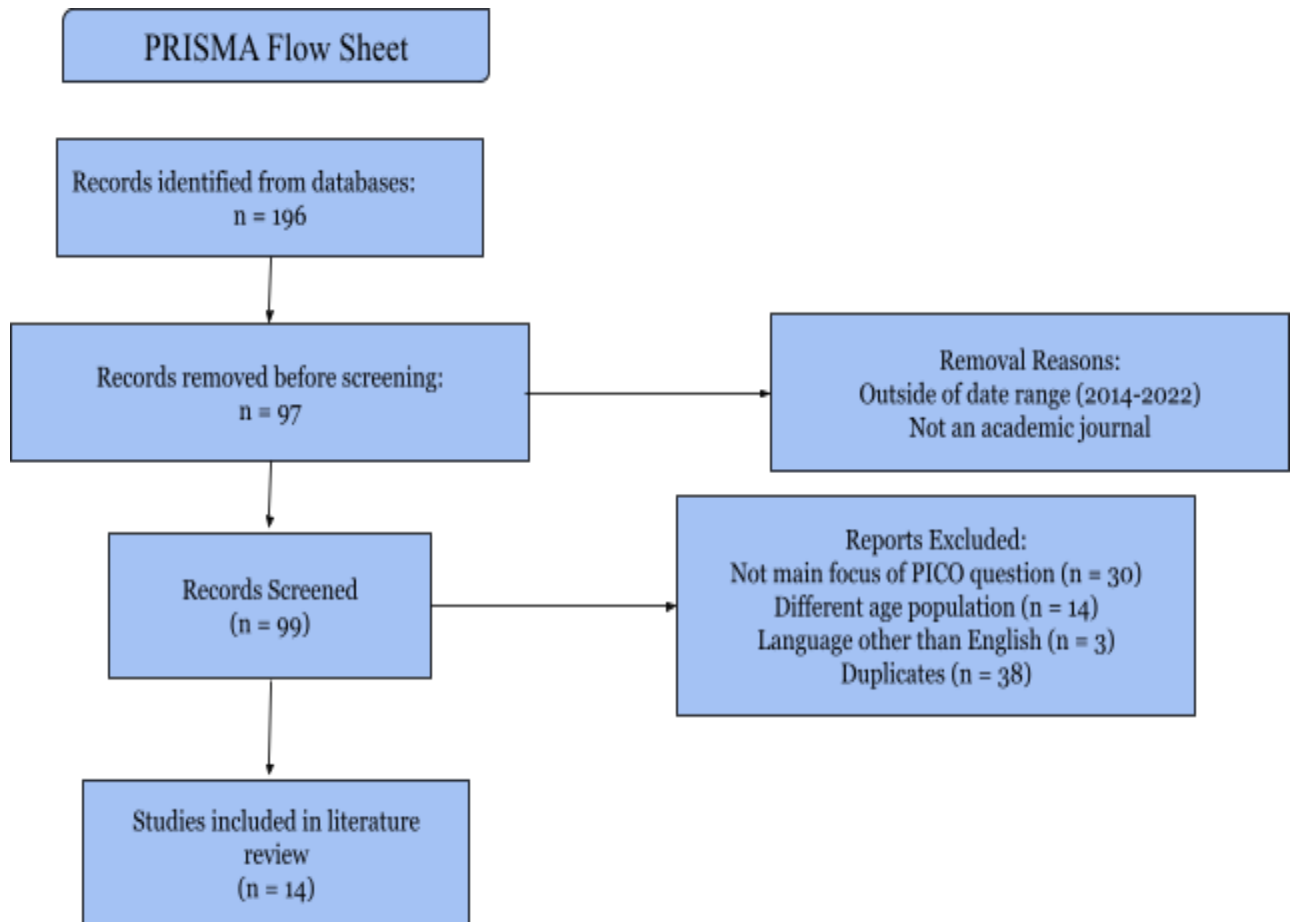
IP Audit Data from February, March & April 2023



Appendix D**PICO (Population - Intervention - Comparison - Outcome) flow sheet.**

P	Population - Adult ICU or critical care patients with central lines placed
I	Intervention - CHG Chlorhexidine Gluconate I.V. Securement dressing
C	Comparison - non-CHG IV dressings
O	Outcome - CLABSI rate/dressing integrity
T	Timeframe - collections of data by July 1st, 2023.

Appendix E
PRISMA Flow Sheet



Appendix F

Proper Application Procedure of CHG-Impregnated Dressing (3M)

Application



1. Allow all antiseptics and skin protectants to dry completely.



2. Peel the liner from the dressing. Turn over so the adhesive faces the skin. Ensure that the CHG gel pad covers the catheter insertion site (and suture sites when possible).



3. Be careful not to stretch the dressing at placement. Apply firm pressure to the entire dressing starting over the gel pad to enhance adhesion.



4. Apply pressure to securement border with one hand, while removing paper frame with opposite hand.



5. Remove notched tape strip from paper frame. Orient the notch towards the dressing and apply the tape strip under the extension tubing and over the dressing border. Remove adhesive-free tabs.



6. Document the dressing change information on the label strip. Apply label strip on top of dressing, over catheter lumen(s). Remove adhesive-free tabs.

Monitoring the Gel Pad



The dressing should be changed if the gel pad remains displaced when pressed with a finger. Change Tegaderm™ CHG Dressings every seven days, when the dressing becomes loose or soiled, if the gel pad is saturated, or in cases where there is swelling, visible drainage, or lost visibility.

Removal



1. Using a low and slow removal technique, start removing the dressing from where the catheter or tubing exits the dressing toward the catheter insertion site. Avoid skin trauma by peeling the dressing back, rather than pulling it up from the skin.

When the CHG gel pad is exposed, grasp a corner of the gel pad and the transparent film dressing between thumb and finger.



2. Apply sterile alcohol swabs or wipes, or sterile solutions (i.e., sterile water or normal saline) between gel pad and skin to facilitate removal of the gel pad dressing.



3. If needed, a medical adhesive solvent can be used to help remove the dressing border. Continue the low and slow removal method until the dressing is completely removed.

3M

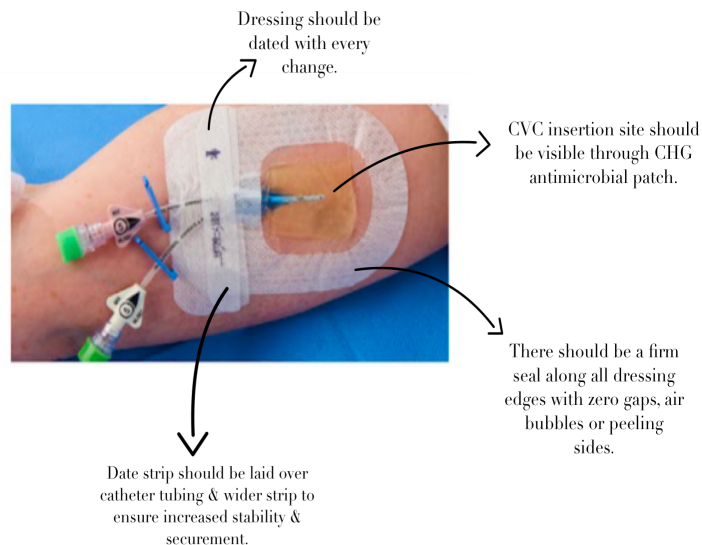
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Appendix G
Copy of Educational Pamphlet Distributed to Unit

CVC Dressings: Maintaining Integrity



Key Focus Points

- Utilize aseptic technique
- Use CHG-impregnated dressings to reduce microbial growth around CVC
- Place the wider strip **underneath** the catheters
- Place the smaller strip with the date marker **ON TOP of the broader strip** for increased securement.

Process

1. Remove the previous dressing.
2. Hand hygiene & donning sterile gloves.
3. Clean the area with antiseptic and allow to dry **completely**.
4. **Peel the liner from the dressing.** Ensure that the CHG gel pad covers the entire insertion site. Have the catheter tubing extend through the notches of the main dressing.
5. **Secure the main dressing with adequate pressure to ensure adhesion.** Remove the paper frame.
6. **Remove the notched tape strip.** Orient towards the dressing, under the extension tubing, and over the dressing border.
7. **Remove the label strip.** Orient over the extension tubing so that it adheres to the notched strip underneath.

QR Code to Demonstration Video:

