An Educational Program on Intravascular Catheter Maintenance to Reduce and Prevent Intravascular Catheter-related Infections

by

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Abstract

Central line-associated bloodstream infections are one of the leading causes of health care associated infections. To decrease and prevent morbidity, mortality, and costs of care, it is the objective of every health care facility to achieve and maintain a zero central line-associated bloodstream infection rate. The purpose of this project is to develop an evidence-based educational program on intravascular catheter maintenance for the prevention of intravascular catheter-related infections in medical-surgical units. This information will be delivered in an educational program format. This project will use pre- and posttest study design to evaluate the effectiveness of 1-hour educational program on nurses' knowledge and practice of intravascular catheter maintenance and central line associated bloodstream infections in the medical-surgical units. A retrospective review of the hospital database will be used to collect the rates of central line-associated bloodstream infections six months before and after the implementation of education. This education program is designed based on the guidelines to reduce central line-associated bloodstream infections published by the Centers for Disease Control and Prevention and the Institute for Healthcare Improvement. Comparison of the infection rates before and after the program will help evaluate the effectiveness of the educational program.

Keywords: central line-associated bloodstream infections, prevention, nursing, education, guidelines

Table of Contents

Appendices

List of Tables

Chapter One

Introduction

Bloodstream infections are life threatening, common and can be preventable (Boyd, Aggarwal, Davey, Logan, & Nathwani, 2011). Central line-associated bloodstream infections (CLABSIs) are one of the leading causes of health care associated infections (HAI) (Hewlett & Rupp, 2012). CLABSIs are associated with increased lengths of hospital stay and costs as high as 29,000 dollars per episode. The estimated annual cost of CLABSIs to the health care system in the Unites States is 2.3 billion (Guerin, Wagner, Rains, & Bessesen, 2010). In the United States, nearly 3 million central venous catheters (CVCs), also known as central lines, are used each year (Joint Commission, 2013). Modern health care relay on CVCs for the administration of antibiotics, total parenteral nutrition, blood products, and many other supportive medications to patients in acute hospital settings (Adlard, 2008). However, the use of CVCs is associated with a risk of bloodstream infection caused by microorganisms colonizing the external surface of the device or the fluid pathway when the device is inserted or in the course of its use (Joint Commission, 2013).

Over the past decade, national and regional initiatives have been undertaken to reduce the rate of CLABSI, and evidence-based infection prevention practices, including central venous catheter (CVC) insertion and maintenance bundles and guidelines have been published (Faruqi et al., 2012). Implementation of these practices have shown extremely successful in the setting of intensive care units (ICUs), with many institutions that have adopted these practices achieving impressive reductions in CLABSI rates in their ICUs (Faruqi et al, 2012). The Centers for Disease Control and Prevention (CDC)

reported an estimated 25,000 fewer incidence rates of CLABSIs reported in ICUs in 2009 compared with that in 2001, indicating 58% reduction (Faruqi et al., 2012).

Reducing CLABSIs is not just a goal but also a reality. As a result of the interventions applied to patient care by health care organizations over the last ten years, such as sustaining best practice and properly apply devices shown to aid in the reduction of catheter complications, almost all bloodstream infections are now considered preventable (Royer, 2010). Despite the significant reduction, prevention of infection from central lines such as CLABSI remains on the agenda of many governing bodies of the healthcare system and has produced CLABSI initiatives and campaigns.

The Joint Commission's accreditation and certification of healthcare organizations is recognized nationwide as a symbol of quality and reflects an organization's commitment to current standards of healthcare. The Joint Commission's 2012 Hospital National Patient Safety Goals include the prevention of infection of the blood from central lines. The purpose of the National Patient Safety Goals is to improve patient safety and provides current recommendations to solve the problem. Another organization that is committed to cultivating innovative concepts for improving patient care is the Institute for Healthcare Improvement (IHI). The 100,000 Lives Campaign is a nationwide initiative of the IHI to radically reduce morbidity and mortality in American health care. One of the six key strategies that have shown to prevent avoidable deaths in the campaign is preventing central line infections.

The economic burden of CLABSI is tremendous, with each case of CLABSI carrying estimated excess healthcare costs of 18,000 dollars. As of October 2008, the Centers for Medicare and Medicaid Services (CMS) no longer reimburse hospitals for

expenses associated with any catheter-related bloodstream infection (Faruqi et al., 2012). Therefore, a CLABSI not only negatively affects patient outcomes, but the care of a bloodstream infection also increases hospital costs by thousands of dollars (Royer, 2010).

Significance of the Problem

The prevalent use of central venous access devices with adult patients in a Medical-Surgical unit has been steadily increasing in numbers. A survey done by Climo et al. (2003) found that peripherally inserted central venous catheters (PICC) and subclavian catheters were more commonly used in non-ICU patients. It also demonstrated that two-thirds of identified CVCs were not in ICU patients and suggests that more efforts should be directed to patients with CVCs who are outside the ICU. The rate of CLABSI is a concern. According to the CDC, the reported rate of 5.3 catheter-related bloodstream infections per 1,000 catheter days represent about 80,000 patients annually who suffer from a central venous catheter infection (Hadaway, 2006). Moureau (2009) emphasized that more than 250,000-500,000 intravascular-related bloodstream infections occur in the United States each year with resulting mortality rates of 12%–25%.

The soaring healthcare cost associated with placement of CVCs and the risk of CLABSI was seen in a March 2009 CDC report. The report estimated the cost of one CLABSI in U.S dollars in 2007 to be $29, 156, which totals $2.68 billion in excess costs annually (Exline et al., 2010). Some researchers estimate mortality in patients with CLABSI to be as high as 35% (Hadaway, 2006). To date, few studies have investigated the impact of CLABSI prevention strategies in non-ICU medical/surgical units. Because less scrutiny has been focused on non-ICU settings, it is possible that adherence to central line bundles may be less rigorous and that CVCs may remain in place for longer periods

on this setting (Faruqi et al., 2012). CLABSIs are serious but often preventable infections when evidence-based guidelines are followed for the insertion and maintenance of central lines (Joint Commission, 2013).

Problem Statement

To prevent morbidity, mortality, and excess costs of care, it is the objective of every health care facility to achieve and maintain a zero CLABSI rate (Royer, 2010). The optimal intervention method for reducing or eliminating the incidence of CLABSI has not been definitively identified, however many health care organizations like the CDC has recommended the utilization of an educational program for healthcare personnel who are involved in inserting and maintaining central lines an important tool aimed at the prevention of catheter-related bloodstream infections (Santana, Furtado, Wey, & Medeiros, 2008).

Studies involving adult ICU and their use of catheter care educational programs decline hospital cost by 2.8 million dollars (East & Jacoby, 2005). Since there is an increased prevalence of CLABSIs in a non- ICU setting, implementing an evidenced-based educational program, coupled with ongoing surveillance in a medical surgical floor to promote best central line practices post-insertion can significantly improve the reduction and prevention of central line complications.

Purpose Statement

The purpose of this project is to develop an evidence-based educational program on intravascular catheter maintenance for the prevention of intravascular catheter-related infections in medical-surgical units. This information will be delivered in an educational program format. The intended audience for this educational program comprise of staff

nurses in a medical-surgical units that have direct patient contact and who are held responsible to care for intravascular catheters post-insertion.

Chapter Two

Literature Review

Articles were searched in electronic database of CINAHL, Ovid and PubMed. Keywords used for the search were CLABSI, central line bloodstream infection, central line care, education program, guidelines and nursing. The articles reviewed were not limited to nursing practice guidelines but to government guidelines as well. The articles that were reviewed were first identified to define CLABSI as defined in this project. The referenced articles were also cited for the outcome or impact and interventions towards the different strategies to prevent CLABSI. The other articles were classified under educational programs geared towards nursing. The final reviews of the articles were for the recommended practice guidelines for the care of the site and dissemination of information pertaining to evidence-based practice.

This chapter will begin by reviewing factors that put patients at risk for infections and the pathogenesis of central line associated bloodstream infections (CLABSI). The second part of the chapter will provide background on CLABSI, including clinical practice guidelines, initiatives and strategies on CLABSI prevention, and barriers to best practice. This chapter will also have a literature review on different evidence based practice strategies and techniques for preventing CLABSIs, including teaching concepts for nurses. Successful CLABSI prevention efforts require clear understanding of both the factors that influence infection risk and the sequence of events from catheter insertion to the onset of CLABSI (Joint Commission, 2013).

Types of CVCs

Several types of CVCs are available, and they come in various sizes, catheter materials and either a single or multiple lumen amounts. There are several different terms used to identify the types of catheters. One way to identify a catheter is by the intended life span (short term or temporary versus long term or permanent) or the site of insertion (internal jugular, subclavian, femoral) and its pathway from the skin to the blood vessel (tunneled versus non-tunneled) (Joint Commission, 2013). According to the CDC, all pertinent aspects of a specific type of catheter should be described to accurately define the type of catheter.

The type of catheter chosen depends on the specific needs, preferences of the patient and the health care provider, including the duration and frequency of CVC use. CVCs can be divided into four main groups that have been in use since the 1980s. They are non-tunneled catheters, tunneled catheters, implanted ports and peripherally inserted central catheters (PICC) (Farjo, 2003).

CLABSI is a commonly used term to describe bloodstream infections associated with the use of vascular access devices. The term CLABSI is also used as a surveillance definition. The CDC's National Healthcare Safety Network (NHSN) utilizes the term CLABSI for their surveillance system (Rebmann & Murphy, 2010). The CDC states that a primary bloodstream infection (BSI) is laboratory-confirmed bloodstream infections (LCBI) that are not secondary to an infection at another body site. Further, a central line-associated BSI (CLABSI) is a LCBI that develops in a patient who had a central line at the time of, or within 48 hours before, the onset of the infection (CDC, 2013).

Risk Factors for CLABSI

Risk factors can be intrinsic (nonmodifiable characteristics), extrinsic (modifiable factors associated with CVC insertion or maintenance), or the environment in which maintenance have the greatest impact on the overall risk of CLABSI (Joint Commission, 2013). One of the intrinsic risk factors is a patient's age where children, particularly neonates, and burn or trauma critical care patients for adults. Underlying disease such as hematological and immunological deficiencies, cardiovascular and gastrointestinal diseases have been associated with an increased risk for CLABSI. Also, the male gender has been identified as a factor associated with increased risk of CLABSI (Joint Commission, 2013).

Extrinsic and potentially modifiable risk factors associated with increased risk of CLABSI are prolonged hospital stay before CVC insertion, multiple CVCs, CVC duration, parenteral nutrition administration, femoral or internal jugular access site versus subclavian in adult patients, heavy microbial colonization at insertion site, multiple lumen CVCs, lack of maximal sterile barriers and CVC insertion in an ICU or emergency department (Joint Commission, 2013).

Pathogenesis of CLABSI

The pathogenesis of CLABSI involves interactions between the offending organism, the intravascular catheter, and the patient. Microbes most often gain access to short-term, nontunneled intravascular catheters via the patient's skin and migrate transcutaneously over the external surface of the catheter. These organisms may stem from endogenous skin colonization or may result from extrinsic skin or catheter

contamination. Microorganisms then colonize the luminal surface of the catheter to result in a CLABSI (Hewlett & Rupp, 2012).

CLABSIs can also be caused by hematogenous seeding of the catheter from a distant site or by infusion of a contaminated substance. After encountering the intravascular catheter, the organisms subsequently adhere to the catheter, multiply, and produce biofilm. Biofilms are complex communities of microorganisms encased in a matrix consisting of polysaccharides, proteins, and nucleic acid derived from both the host and microbe. Microorganisms existing in a mature biofilm-associated infection behave very differently to microorganisms growing in the planktonic state, and are generally less susceptible to antimicrobials and host immune response (Hewlett & Rupp, 2012).

Clinical Practice Guidelines

The CDC released guidelines in 2011 for the prevention of intravascular catheter-related infections. As in previous guidelines issued by CDC and HICPAC, each recommendation is categorized on the basis of existing scientific data, theoretical rationale, applicability, and economic impact. The systems for categorizing recommendations in these guidelines are as follows. Category IA is defined as strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies. Category IB is defined as strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale; or an accepted practice (e.g., aseptic technique) supported by limited evidence. Category IC is required by state or federal regulations, rules, or standards. Category II is where it is suggested for implementation and supported

by suggestive clinical or epidemiologic studies or a theoretical rationale. Last is the unresolved issue that represents an unresolved issue for which evidence is insufficient or no consensus regarding efficacy exists. (CDC, 2011). The guidelines are highlighted in a checklist format and categorized into three sections.

The first section describes the guidelines for the clinicians. The guideline begins with the prompt removal of unnecessary central lines by performing daily audits to assess whether each central line is still needed (Category IA). The next part in the clinician section is to follow proper insertion practices. Due to the emphasis of this project for maintenance care and infection prevention post insertion, these guidelines will not be discussed in detail. The final part in the clinician section discusses the handling and maintenance of central lines appropriately. First is to comply with hand hygiene requirements (Category IB). Next is to scrub the access port or hub immediately prior to each use with an appropriate antiseptic (e.g., chlorhexidine, povidone iodine, an iodopor, or 70% alcohol) (Category IA). Only sterile devices can access catheters (Category IA-B). Dressings must be replaced when wet, soiled, or dislodged (Category IB). Lastly, dressing changes should be performed under aseptic technique using clean or sterile gloves (Category IC) (CDC, 2011).

The second section discusses guidelines for the facility. The facility should empower staff to stop non-emergent insertion if proper procedures are not followed (Category IA). The facility should provide the supplies needed for central line care or manipulation in a "bundle" or kit to ensure items are readily available for use (Category IB). The clinicians in the facility must have access to a checklist that consists of topics discussed in the first section (Category IB). The checklist is a way for clinicians to

monitor that all insertion practices are followed at their specific sites. To ensure efficient access to hand hygiene, monitoring and providing prompt feedback for adherence to hand hygiene are some of the recommendations that fall under the facility's responsibility (Category IA). It is also recommended that facility provides recurring education sessions on central line insertion, handling and maintenance in order to keep up with current information and maintain staff compliance (Category IA) (CDC, 2011).

The third section discusses supplemental strategies for consideration. The three strategies highlighted on the checklist include 2% chlorhexidine bathing (Category II). Daily cleansing of ICU patients with a 2% chlorhexidine impregnated washcloth may be a simple, effective strategy to decrease the rate of primary BSIs. The second is Antimicrobial/antiseptic-impregnated catheters (Category IA). Certain catheters and cuffs that are coated or impregnated with antimicrobial or antiseptic agents can decrease the risk for CRBSI and potentially decrease hospital costs associated with treating CRBSIs, despite the additional acquisition cost of an antimicrobial/antiseptic impregnated catheter. The third is chlorhexidine-impregnated sponge dressings (Category IB). The largest multicenter randomized controlled trial published to date comparing chlorhexidine impregnated sponge dressings versus standard dressings in ICU patients, rates of CRBSIs were reduced even when background rates of infection were low (CDC, 2011).

The Joint Commission released the Hospital National Patient Safety Goals effective January 2013. The purpose of the National Patient Safety Goals is to improve patient safety and the goals focus on problems in health care safety and how to solve them. One of the goals pertains to preventing infection, specifically, to implement

evidence-based practices to prevent central line-associated bloodstream infections. One element with an A scoring category suggest to conduct periodic risk assessments for central-line associated bloodstream infections, monitor compliance with evidence-based practices, and evaluate the effectiveness of prevention efforts (Joint Commission, 2009). This element goes a step beyond the implementation of best practice and evaluates the outcome of best practice and helps identify gaps associated with CLABSI infection rates.

Effects of Staff Education

There have been several published articles since 2008 that have explored the effects of nursing staff education on reducing infection rates. The overall theme of the articles suggests that tailored continuous educational programs led to sustained reduction of CLABSI rates.

An interventional study was conducted to evaluate the effects of an education program in two medical-surgical intensive care units over 11 months (Santana et al., 2008). The education program was sequenced in the following fashion: pre-intervention testing, intervention period of implementation of 1-hour lecture, distribution of fact sheets, and post intervention testing. During the study period, each patient had a CVC in place for at least 48 hours, resulting 1,679 vs 1,473 catheter-days for pre-intervention and post-intervention periods, respectively. For both pre- and post-intervention tests, the lowest percentages for correct answers were related to the choice of CVC insertion site and the correct procedures for the use of alcohol-based hand gel. After implementation of the educational program, the percentage of correct answers related to the use of isolation and contact precaution (p =0.03), CVC manipulation procedures (p =0.04), and the use of alcohol-based hand gel (p =0.01) improved significantly. The incidence of

CLABSI during the post-intervention period was reduced to 5.4 infections per 1,000 catheter-days, compared with 9.5 infections per 1,000 catheter-days pre-intervention (Santana et al., 2008).

A prospective observational study measured the effects of different educational delivery systems: single lecture versus tailored continuous education (Lobo et al., 2010). During the pre-intervention period, healthcare workers knowledge of CVC care were evaluated with a questionnaire and observations of CVC care. The intervention period involved different interventions for the single lecture group and the tailored intervention group. In the tailored intervention group, the program was tailored to directed problems found during the observation phase. The interventions included feedback to staff of problems noted, lectures in small groups with simple messages, lecture on hand hygiene, posters in the unit conveying stimulating messages and step by step descriptions of hand hygiene, monthly lectures for all new medical residents and monthly updates of CVC-BSI rates posted in unit. CVC-BSI rates declined in both groups. In the tailored intervention group, this decrease was progressive and sustained, from 12 CVC-BSIs/1000 CVC-days at baseline to 0 after nine months. In the single lecture group, the rate initially dropped from 16.2 to zero CVC-BSIs/1000 CVC-days, but then increased to 13.7 CVC-BSOs/1000 CVC-days. The authors concluded that personal customized, continuous intervention seems to develop a “culture of prevention” and is more effective than single intervention, leading to a sustained reduction of infection rates (Lobo et al., 2010).

An observational pre- and post- intervention study was conducted to evaluate the effect of an evidence-based educational intervention on the incidence of CLABSI in ICUs with acceptable baseline and to assess the knowledge of standards of CLABSI prevention

among healthcare workers (Parra, Menarguez, Granda, Tomey, Padilla & Bouza, 2010). A 15 minute lecture on 10 main points of the CDC guidelines for the prevention of intravascular catheter-related infections was preceded (a few minutes before) and followed (6 months after) by identical multiple-choice questionnaires about the lecture. The lecture and questionnaire was given to all ICU workers (physicians, residents, nurses, and students) on all shifts. Post educational intervention data showed that 24 CLABSI occurred in 11,582 central venous catheter (CVC)-days, compared with 45 episodes in 10,661 CVC-days before intervention (p=0.03). This study shows that a simple, relatively inexpensive, evidence-based and updated educational measure resulted in a 30.0% reduction in the CLABSI incidence density in adult ICUs with already acceptable rates of CLABSI. Some studies on the difficulties in implementing clinical practice guidelines show that the first barrier generally identified by healthcare workers is a lack of awareness of or familiarity with the guidelines. Updated educational programs are therefore the first step toward achieving adherence to guidelines (Parra et al., 2010).

A quasi-experimental study by East and Jacoby (2005) focused on the effect of a nursing staff education program on compliance with central line care policy in the cardiac intensive care unit. A self-study module was distributed to all nurses working in the unit. Pre and post-test results were used to analyze the effectiveness of the education module. The self-study module published by BJC Healthcare included a small poster summarizing prevention of catheter-related bloodstream infections and outlining routine catheter care with pictures. Compliance was scored as “yes” or “no” based on 10 observable data points by the researchers and two independent observers proficient with hospital central line care policy. The results showed a marked improvement in compliance with policy (p

= 0.0357). The authors concluded that the implementation of an educational program had a positive impact on staff compliance with central line care policy but cautioned that the small number of policy components measured limits study result (East & Jacoby, 2005).

Although many studies have shown a decrease in CLABSI in ICUs with implementation of the bundle, few describe prevention of CLABSIs in non-ICU settings. A study (Chou et al., 2011) showed the impact of educating non-ICU nurses on CLABSI rates and about the bundle and blood culturing techniques. During the pre-education period, the non-ICU CLABSI rate was 6.9/1,000 CL days, which was higher than those reported from the ICUs. The infection rate after the first education program was 1.5/1,000 CL days. After the second education classes, it dropped to 0.7/1,000 central line days (p=0.16). The overall rate of infections after the entire education program was 1.1 infections/1,000 CL days, (p<0.000001). Chou et al. (2011) concluded that educating non-ICU nurses about the CLABSI bundle significantly reduced the CLABSI rate. Repeat education programs reinforced the concepts and resulted in a further drop in CLABSIs. Educated nurses improved practices and acted as patient advocates.

The educational methods chosen should take into consideration the preferred method of learning, principles of adult education, resources available, cultural norms, and languages spoken by health care personnel. Education can be delivered in many ways such as traditional lecture formats, computerized e-learning, self-study modules, combined didactic with hands-on training and simulation-based training (Joint Commission, 2013).

Care Bundle and Barriers to Care

Although adherence to evidence-based practices reduces inconsistencies in practice and can significantly improve patient safety and quality of care, heath care organizations often find it difficult to implement best practices. In the United States, adherence to evidence-based practices varies considerably, estimated generally to be anywhere from 20% to 100%. Identifying and removing barriers to adherence to these practices is essential to a successful implementation strategy (Joint Commission, 2013).

There has been wide implementation of CVC insertion care bundle. One central line bundle was introduced by the Institute for Healthcare Improvement (IHI) in 2010. The bundle consisted of evidence-based interventions for patients with intravascular central catheters that, when implemented together, result in better outcomes than when implemented individually (Royer, 2010). The key components of the central line bundle include hand hygiene, maximal barrier precaution upon insertion, chlohexidine (CHG) skin antisepsis, optimal catheter site selection, with avoidance of the femoral vein for central venous access in adult patients, and daily review of line necessity with prompt removal of unnecessary lines (Royer, 2010). Despite the strict compliance to a bundle, CLABSI rates in acute settings remained high (Guerin et al., 2010).

Guerin et al. (2010) looked at reduction in central line–associated bloodstream infections by implementation of a care bundle after the insertion of the CVC. The author states that the relative risk for a CLABSI occurring during the post intervention period compared to the pre-intervention period was 0.19 ($p = 0.004$). This result demonstrates that implementation of a central venous catheter post-insertion care bundle was

associated with a significant reduction in CLABSI in a setting where compliance with the central line insertion bundle was already high.

Morrison (2012) explored the barriers preserved from a medical-surgical nursing care stand point about central line care. The perceptions, experiences and challenges to central line care identified four areas of impact regarding efforts to mentor and educate nurses and undertake system changes to reduce infection. The four areas are the relationship to the nurses' understanding of CLABSI, education on CLABSI, supplies, and charting/documentation. The study finding can help further the direction of nursing staff education and the barriers perceived at the level of bed-side care.

Theoretical Framework

The theoretical perspective that provided a framework for the educational program on intravascular catheter maintenance to reduce and prevent intravascular catheter related infections was the Promoting Action on Research Implementation in Health Services (PARIHS) framework (Rycroft-Malone, 2004). The framework represents successful implementation of evidence into practice as a function of the relationship between three components. The PARIHS framework has provision of a basic "to-do" list, flexibility in application, and inclusion of successful implementation as the desired outcome (Stetler, Damschroder, Helfrich & Hagedorn, 2011). The PARIHS framework suggests that successful research utilization is the result of dynamic interplay and interdependence between 3 core elements: *evidence*, *context*, and *expert facilitation*. Each element is composed of sub-elements, which exist on a continuum ranging from weak to strong. The framework suggests that when the sub-element's criteria are

categorized as ‘strong’, the desired outcome is more likely to occur (Squires, Reay, Moralejo, LeFort, Hutchinson, & Estabrooks, 2012).

It is proposed that *evidence* in EBP should be considered to be “knowledge derived from a variety of sources that has been subjected to testing and had found to be credible” (Rycroft-Malone, 2004, p. 298). More specifically, the PARIHS framework identifies these sub-elements as research, clinical experience and patient experience (Rycroft-Malone, 2004). With respect to research, high-quality systemic reviews and randomized controlled trials (RCTs) are considered the best evidence on the effectiveness of nursing interventions. Strong clinical experience occurs when there is an increase level of consensus among nurses. Weak clinical experience occurs when expert opinion is divided. Patient preferences are considered strong when partnership between nurses and patients exists, and weak when there is lack of involvement or consideration of what the patient desires (Squires at al., 2012).

The term *contex*t in the PARIHS framework is used to refer to the environment or setting in which people receive healthcare services, or in the context of getting research evidence into practice, the environment or setting in which the proposed change is to be implemented. In the framework, the contextual factors that promote the successful implementation of evidence into practice fall under three sub-elements of culture, leadership, and evaluation (Rycroft-Malone, 2004). Organizational culture refers to defining prevailing beliefs and values, consistency in values, and receptivity to change. Culture has important implications for nurses with respect to EBP implementation. Nurses draw upon their unit’s culture to understand how to behave. This suggests they will redesign their attitudes, behaviors, and work to meet the shared beliefs and value

held by others on the unit. Leadership refers to the nature of human relationships with effective leadership being proposed to give rise to clear roles, effective teamwork, and effective organizational structures, as well as staff involvement in decision making and approach to learning. Evaluation, also referred to as measurement in the PARIHS framework, describes individuals and systems level feedback mechanisms, sources, and methods for measurement. Evaluations can take many forms from the use of hard data such as cost-effectiveness, length of hospital stay, or number of falls, to the use of soft data such as patients' experiences (Squires at al., 2012).

In the PARIHS framework, *expert facilitation* refers to the process of enabling (making easier) the implementation of evidence into practice. Thus, the facilitation is achieved by an individual carrying out a specific role (facilitator), which aims to help others. Key facets of facilitation are organized in three sub-elements of purpose, role and skills and attributes. The purpose of facilitation can vary from a focused process of providing help and support to achieve a specific task to a more complex, holistic approach of enabling teams and individuals to analyze, reflect, and change their own attitudes, behaviors, and ways of working. The role can range from a practical hands-on role of assisting change to a more complex, multifaceted role. To fulfill the potential demands of the role, facilitators are likely to require a wide repertoire of skills and attributes (Rycroft-Malone, 2004). Some skills and attributes of facilitators that have been identified in recent years as important to research utilization are communication skills, content knowledge, and motivation (Squires at al., 2012).

In summary, the PARIHS framework suggests the three elements that are keys to successful implementation. They are *evidence*, *context*, and *expert facilitation.* Each of

these elements is made up of sub-dimensions. *Evidence* is characterized by research evidence, clinical experience, and patient experience; *context* by culture, leadership, and evaluation, and last, *expert facilitation* by purpose, role, and skills and attributes. Each sub-element is on a continuum of weak to strong. If each sub-element can be judged to be towards strong, implementation is more likely to be successful. Therefore evidence needs to be robust, match professional consensus and patient needs/ experience (strong evidence). The context will be more receptive to change when there are systemic cultures, strong leadership, and appropriate evaluation systems (strong context). Finally, implementation should be supported by appropriate facilitation (strong facilitation) (Rycroft-Malone, 2004).

Chapter Three

Program Description

The Centers for Disease Control and Prevention (CDC) reported in 2011 that in the United States, a total of 250,000 cases of blood stream infections (BSIs) have been estimated to occur annually. To improve patient outcome and to reduce healthcare costs, involvement of healthcare workers should be considered in reducing the incidence of these infections. The aim of this study is to develop an evidence-based educational program on intravascular catheter maintenance for the prevention of intravascular catheter-related infections.

According to the CDC (2011), well-organized programs that enable healthcare providers to become educated and to provide, monitor, and evaluate care are critical to the success of this effort. The CDC (2011) notes that reports spanning the past four decades have consistently demonstrated that the risk of infection declines following standardization of aseptic care. The maintenance of intravascular catheters by inexperienced staff might increase the risk for catheter colonization and catheter related blood stream infection. The development of the educational program will integrate the CDC (2011) recommendations. They include educating healthcare personnel regarding indications for intravascular use, proper procedures for the maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections (IVCRI).

Two additional recommendations are designating only trained personnel who demonstrate competency with peripheral and central intravascular catheters care and periodically assessing knowledge of and adherence to guidelines for all personnel

involved in the insertion and maintenance of intravascular catheters. For the purpose of this study, personnel will be limited to Registered Nurses (RNs) and will focus on the maintenance rather than the insertion of intravascular catheters. The overall structure of the chapter will introduce the teaching and learning strategies to be used to conduct the educational program with the expected learning outcomes supported by content, and how the program should be evaluated.

Teaching and Learning Strategies

The teaching and learning strategies for the educational program is based on a preconceived notion that a healthcare organization should be a place in which learning is constant, and in which all workers participate. This is consistent with the organizational learning model publicized in *The Fifth Discipline: The Art & Practice of the Learning Organization* (Senge, 2006). There are five disciplines of the learning organization. *Systems Thinking* is a conceptual framework to make patterns clear. *Personal Mastery* works to continually clarify and deepen our personal vision. *Mental Models* are deeply ingrained assumptions that require us to turn the mirror inward and scrutinize what we see. *Building Shared Vision* requires the skills of unearthing shared pictures of the future that foster genuine commitment and enrollment. Finally, *Team Learning* is vital because teams, not individuals, are the fundamental learning unit in organizations. The educational program begins with a set of competencies converted to practical curriculum and training modules. This learning process will benefit from the approach of the five disciplines of the learning organization (Competency-to-Curriculum Toolkit, 2008).

Competencies can be simply defined as applied skills and knowledge that enable people to perform work or actions that are observable in the execution of one's work (Competency-to-Curriculum Toolkit, 2008).

A description of a competency should include observable or measurable performance, content performance and the context of the environment. A competency may also be applied to a wide range of workers who are expected to perform at different levels according to experience, professional role, level of education, or job function. Looking at expected level of performance and the level of responsibility of the audience that the competency is written for is important as well (Competency-to-Curriculum Toolkit, 2008). It is necessary to state the expected standard competencies when developing them which in turn aids in the process for review. Updating competencies, one should involve some combination of description of current practices in the field, to identify what new competencies or variations in competencies practitioners have added, and expert consultation regarding the latest view of that area of practice (Competency-to-Curriculum Toolkit, 2008).

Competencies do not address the details of how the knowledge and skills are to be packaged, the best methods for learning, or the criteria for attainment. Competencies do provide a framework based on performance outcomes on which curriculum and training are developed and delivered and against which performance can be measured. The traditional approach to education is for teachers to determine what content needs to be learned, teach it, and then test to see if the content was learned (Competency-to-Curriculum Toolkit, 2008).

Current research in education supports the transition to competency-based training. This is the alignment of training with the outcomes and assessment of worker performance in relation to specific work conditions on professional expectations. This competency-based approach to training requires that educators and workers identify the necessary knowledge, skills, and behaviors as applied in real working conditions and settings (Competency-to-Curriculum Toolkit, 2008). An approach to achieving the learning outcomes is by placing them into a curriculum with methods and resources. A curriculum is a complete set of learning experiences, including classroom, experiential and self-guided, that taken altogether lead to the achievement of a desired set of competencies. Any one competency, if complex, may require several learning experiences to achieve mastery. Any one course or learning experience may be directed at learning one competency or several (Competency-to-Curriculum Toolkit, 2008).

The three learning experiences used in the development of the educational program are action learning, problem-based learning and skills training or psychomotor training. Action learning is a common feature of work-based learning programs and can act as a useful mechanism for helping individuals to maximize learning, knowledge and skill development. Action learning is an umbrella term used to describe a set of activities that create a context for creative decision making in uncertain situations (Jackson, 2011). Some of the benefits of action learning are increasing self-awareness and ability to identify personal development challenges, Enables individuals and teams to learn while working and helps individuals to relate to other people and communicate more effectively (Jackson, 2011).

Problem-based learning, described as an active teaching strategy, provides a framework for the development of self-directed learning, self-evaluation, interpersonal communication, critical thinking, and access and retrieval of information. This teaching method can be modified to fit almost any situation. Problem-based learning provides an opportunity to actively engage staff members in learning situations, making it a great asset for teaching in staff development (Jackson, 2011). The problem-based learning method has four basic stages which are problem analysis, brainstorming, self-directed learning, and solution testing. Problem-based learning advantages are that scenarios used in this learning experience encourage communication and is especially helpful to engage reluctant learners during continuing professional development activities. This active learning strategy also supports the principles of adult learning and promotes independent, self-directed inquiry skills that foster critical thinking (Jackson, 2011).

The psychomotor learning domain addresses skills that require physical action and neuromuscular coordination. To become proficient in a skill over time, an environment must be created where the skill is done in repetition through guided practice (Penn, 2008).

Learning Outcomes

The registered nurses (RNs) are responsible for the daily assessment, care and maintenance of the central line by preventing infection and mechanical complications. The assessment, care and maintenance competencies apply to the RNs on a medical-surgical floor. The RNs consist of front-line nurses or bed-side nurses, senior-level, supervisory and management. Table 1 illustrates the statement of learning outcomes that can fulfill the desired competencies.

Table 1 Breakdown of Competencies

COMPETENCY	SUB-COMPETENCY	LEARNING OUTCOMES
The registered nurse (RN) is responsible for the daily assessment, care and maintenance by preventing infection and mechanical complications	Demonstrate proper procedure of IVC maintenance/care	• The central line dressing kit will be used for IVC dressing change. • Encourage patients to report any changes in their catheter site or any new discomfort to the healthcare provider (e.g. RN) • Syringes greater or equal to 10 ml will be used at all times to access any IVC • Documentation of the IVC assessment will be done every shift
	Illustrate adherence to evidence-based guidelines	• Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled • Use chlorhexidine-impregnated sponge dressing for temporary short term catheters (Biopatch) • Periodic assessment of knowledge on care and maintenance done during yearly competency checks
	Exemplify infection control methods	• Perform hand hygiene before and after dressing change or other catheter manipulation • Wear either clean or sterile gloves when changing the dressing on intravascular catheters • The entry access must be cleaned with a Chlorascrub Swab for 15 seconds and allow time to air dry
	Assess proper indications for IVC use	• If patients have tenderness at the insertion site, fever without obvious source, or other manifestations suggesting local or bloodstream infection, the dressing should be removed to allow thorough examination if the site • Advocate the removal of the IVC when indications are not met

Program Content

Problem-based learning method, action learning, skills or psychomotor learning and lecture will be used for the overall framework for how the curriculum content will be disseminated (Table 2). In order to provide timely feedback on staff learning and to track staff learning progress, continuous assessment including skills test and written examination will be given. Only the written examination will assess individual effort while other components assess group performance within a restrictive timeframe. The educational program will be conducted in a one hour class. The first and last ten minutes will be dedicated to the pre- and posttest. The twenty minute power point presentation will be presented after the pretest (Appendix A). After the presentation, the return demonstration of a central line dressing change will be done by each nurse and checked off by an observer for the remaining part of the class.

The development of the curriculum content will integrate the CDC (2011) recommendations for the prevention of intravascular catheter-related infections. They include educating healthcare personnel regarding indications for intravascular use, proper procedures for the maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections (IVCRI). Two additional recommendations are to periodically assess the knowledge of and adherence to the guidelines for all personnel involved in the insertion and maintenance of intravascular catheters. For the purpose of this study, personnel will be limited to the RN who will maintain rather than the insertion of intravascular catheters.

Indications for intravascular catheter (IVC) use will be taught in lecture format where different types of catheters and their purpose will be discussed. Procedure for the

maintenance of the IVC will encompass group activity, role-playing and lecture format so that the large content of maintenance can be covered in a more efficient and effective manner. Infection control methods of prevention will be covered in a lecture format and problem-based learning so the information is formally stated and applied upon clinical situations. Adherence to evidence-base guidelines will take the action learning and problem-solving route since guidelines are only as good as if they are followed. The demonstration and assessment of IVC knowledge and maintenance will be evaluated with two different routes. A pre- and posttest will be performed before and after the program and a return demonstration on proper IVC maintenance will be assessed after the program.

Additionally, a double-sided care sheet will be provided to the nurses before the program to use as a reference about the care and maintenance (Appendix B). One side will consist of the definition of CLABSI, routes of infection, risk factors, and checklist with dressing change steps. The other side will consist of a summary of the CDC recommended guidelines pertaining to dressing change steps.

Table 2 Teaching and learning activities

IVC infection prevention and maintenance by nursing	Teaching and Learning Activities			
	Action Learning	Problem-based learning	Skill Training	Lecture
Indications for IVC use				Descriptions and types of catheter and purpose
Procedure for the maintenance of IVC	Group activity: Groups will visually show proper sequence of IVC maintenance	Role playing: How to educate patients on proper IVC care		Power point presentation and take home hand-out sheet
Infection control methods of prevention		Dealing with probable causes of infection in a hospital setting and creating plan of action		Power point presentation and take home hand-out sheet
Assessment of knowledge				Pre and post test before and after program
Adherence to evidence-base guidelines	Physical props will be used to identify non-adherence to guidelines	Role playing: How to address RN-RN non-compliance professionally		
Demonstrate competency of IVC maintenance			Return – demonstration on proper IVC maintenance	

Program Evaluation

The book titled *Evaluation in Education: Foundations of competency Assessment and Program Review* (Wolf, 1990) provided guidelines on program review and will be used to evaluate the educational program. The choices of methods were chosen based upon the length of time available, and the capacities of both the organization and the teaching team. A comparison of the infection rates between pre-education and post-education period for the designated unit will also be conducted through the institutional resources for monitoring infection rates through data collection on a monthly basis. The three evaluation tools created for this study to address the procedures are a Knowledge Test (Appendix C), Direct Observation Checklist (Appendix D) and Chart Review Tool (Appendix E).

Chapter Four

Project Evaluation

Design

This project will use pre-and posttest study design to evaluate the effectiveness of 1-hour educational program on nurses' knowledge and practice of intravascular catheter maintenance and central line associated bloodstream infections in the medical-surgical units. The knowledge and skills of intravascular catheter maintenance will be measured before and after the 1-hour educational session. A retrospective review of the hospital McKesson database will be used to collect the rates of CLABSI six months before and after the implementation of education.

Four mandatory 1-hour educational sessions will be provided over two consecutive weeks so that all staff nurses could participate. The educational session will include a combination of lecture and skills return demonstration of central line care. The first presentation contains an overview of central line maintenance recommendations such as central line dressing changes, replacement of IV administration sets, catheter hub cleansing, removal of lines, and education. The second presentation will detail the steps on proper central line dressings include frequency, equipment, and procedures. The third presentation will go over the guidelines to prevent central line associated bloodstream infections. The presentation discusses statistics, risk factors and evidence on CLABSIs. The knowledge test will be provided to all participants before and after the educational session.

Setting and Sample

The setting will be a 36-bed acute medical-surgical unit at a community hospital in San Diego, California. All registered nurse employed on this unit will be invited to participate in this project. The inclusion criteria included nurses who are: (a) male or female; and (b) employed part-time or full time on the medical-surgical unit. Exclusion criteria include registered nurses floating from other departments, registered nurses from the system's registry float pool, or nursing students.

Instruments

Knowledge test. The 10-item questions were developed from CDC and IHI current CLABSI prevention recommendations to assess nurses' knowledge on central line maintenance. The questions in multiple choice or true/false format will be covered on the PowerPoint slides and face validity testing will be conducted among a panel of expert nurses on infectious diseases. The pre- and posttest scores will be calculated in percentage by totaling the number of correctly answered questions divided by 10. The knowledge test will be obtained before and after the implementation of the 1-hour educational session.

Direct observation checklist. The direct observation tool will be used to assess nurses' practice in central line maintenance and contains observable nursing practices based on infection prevention best practice from the CDC and the IHI such as explaining the central line dressing change procedure to the patient and/or family, masking self during the dressing change, and labeling the dressing site with the date, time and initials. Each item will be scored by either a 'yes' or 'no' response option. A face validity testing of each item will be conducted among a panel of expert nurses on infectious diseases.

The bedside nursing practice on central line maintenance will be observed randomly for two weeks before and after the educational session.

Chart review tool. This tool will be used to measure nurses' compliance with the CDC recommendation for ongoing central line care such as date of when the site was inserted, dates of dressing changes, documented appearance of the dressing site, documentation of patient and/or family education, and dated IV administration sets. The random chart review will be conducted through either the paper charts or the electronic medical records for two weeks before and after the educational session.

Data Collection Procedures

The project proposal will be reviewed by the Institutional Review Board (IRB) of the hospital and the IRB approval will be obtained prior to the initiation of any data collection. Since participation in evaluating of the educational program is entirely voluntary, a waiver of consent will be used to protect the anonymity of participants without affecting the employment status. Random code number will be assigned to each observation and knowledge test to protect the confidentiality and privacy.

Following the IRB approval, bedside direct observation of nursing practice and char review will be conducted by the program director for two weeks prior to the educational session as the baseline data. At the beginning of the 1-hour educational session, each participant will be asked to complete the knowledge test to obtain the baseline data. After the 1-hour educational session, the same knowledge test will be distributed again to each participant to obtain the posttest knowledge. These tests will be labeled and randomly assigned code numbers to maintain the confidentiality and pre- and posttest will be matched with the same code number. One month following the

educational session, the bedside direct observation of nursing practice and chart review will be again conducted by the program director for two weeks to collect posttest data.

The CLABSI infection rates will be assessed for six months before and after the educational program rollout. The number of CLABSI infection on the medical-surgical unit will be obtained from the hospital McKesson database. The CLABSI rate per 1,000 central line-days will be calculated by the actual number of CLABSI per number of central line-days multiplying by 1,000 (CDC, 2011). Comparison of the infection rates before and after the program will help evaluate the effectiveness of the educational program.

Data Analysis

Descriptive statistics will be utilized to calculate the frequencies, percentage, means, medians and standard deviations. Paired t-tests and chi-square tests will be performed to compare the continuous and categorical variables, respectively. Data analysis will be performed using the Statistical Package for Social Sciences (SPSS) version 18.0. For the purpose of this study, the significance level will be set at $p < 0.05$.

Chapter Five

Discussion

Although many central line-associated bloodstream infections are preventable, measures to reduce these infections are not uniformly implemented. Some of the recommended preventive strategies with the strongest supportive evidence are education and training of healthcare providers who maintain central lines (O'Grady et al., 2002). Nurses being one of the largest healthcare provider workforces are positioned to influence many of the processes around prevention of CLABSI. The incidence of CLABSI in ICU patients across the United States has been reduced from an estimated 43,000 in 2001 to 18,000 in 2009 representing a 58% reduction (Dumont & Nesselrodt, 2012). The CDC estimates that this reduction represents 3,000 to 6,000 lives saved and a cost saving of $414 million in ICUs in 2009 alone (Dumont & Nesselrodt, 2012). This improvement can be replicated on other units of the hospital through successful implementation of an educational program based on evidence based intravascular catheter maintenance.

Prevention of CLABSI is a team effort involving all healthcare disciplines, patients, and patient families. However, nurses intersect at all the key points and are in the best position to assure that CLABSI prevention recommendations are incorporated into practice (Dumont and Nesselrodt, 2012). The clinical significance of the project highlights that no patient should suffer harm from a preventable complication while under the care of a nurse, regardless of the clinical area.

Implications for Nursing

Community hospital medical-surgical nurses have a limited understanding of the complexities of preventing CLABSIs (Morrison, 2012). The efforts to decrease the rate of CLABSIs and improve the quality of care are important. The Centers for Disease Control and Prevention (CDC), the Institute for Healthcare Improvement (IHI), and the Society for Healthcare Epidemiology of America have been recommending best practices for central line insertion for over a decade (Dumont & Nesselrodt, 2012). In 2005, the IHI 100,000 Lives Campaign introduced a "bundle" approach to prevent CLABSI and other HAIs. These initiatives have paid off and hospitals across the country are seeing results.

The implications to nursing education are that there is increasing emphasis on evidence-based nursing practice. In regards to nursing school curriculum, nurse educators need to more fully implement teaching strategies that help the students gain critical thinking skills related to inquiry and understand the importance of evidence-based nursing practice (Callister, Matsumura, Lookinland, Mangum, & Loucks, 2005).

Implications to nursing administration are to recognize barriers for the adoption of evidence-based practice in nursing that have been identified by researchers. The most common barriers were lack of time and lack of autonomy to change practice. Nurse educators must work with nurse managers to address organizational barriers and proactively support evidence-based practice (Brown, Wickline, Ecoff, & Glaser, 2009).

Limitation of the Project

There are several limitations in this project. The first limitation would be the number of nurses participating in the project. With the small sample size from the pool

of nurses in the medical-surgical unit, the results might be insignificant. The second limitation would be the lack of generalizable application of the findings from the project. Since the project will be conducted in a single hospital, the findings may not be applicable to other settings. The third would be the "Hawthorne effect" or commonly referred to as the observer effect on nurses' behaviors. The effect is described as the altered behavior or performance resulting from awareness of being a part of an experimental study (De Amici, Klersy, Ramajoli, Brustia, & Politi, 2000). Since this project will conduct bedside observations and chart reviews, the nurses might change their standard practice and/or behavior of central line care if they are aware of the review. This may alter the validity of the findings from this project. Finally, the fourth limitation would be the lack of randomization in this evidence based project. Since the project will be conducted in a specific unit with inclusion and exclusion criteria, obtaining an unbiased evaluation of the project may not be achieved.

Direction for Future Studies

Future studies can be directed in evaluating the effectiveness on the educational program against similar units in the same hospital setting. This may help discern if the program can be applicable to other units without modifying the main content of the program. The recommendations published by the CDC and IHI are applicable to units that care for central lines; in turn the educational program should be the same.

Conclusions

In summary, integrating evidence-based recommendations into practice require creating innovative, applicable, and cost-effective programs. Nursing participation in improving care under financial constraints of the organization is a reality but not

impossible. By working under one goal of improving patient care, implementing the gold-standard of evidence-based practice, and recognizing the barriers to implementation, hospital-acquired infections can be significantly reduce or eliminated.

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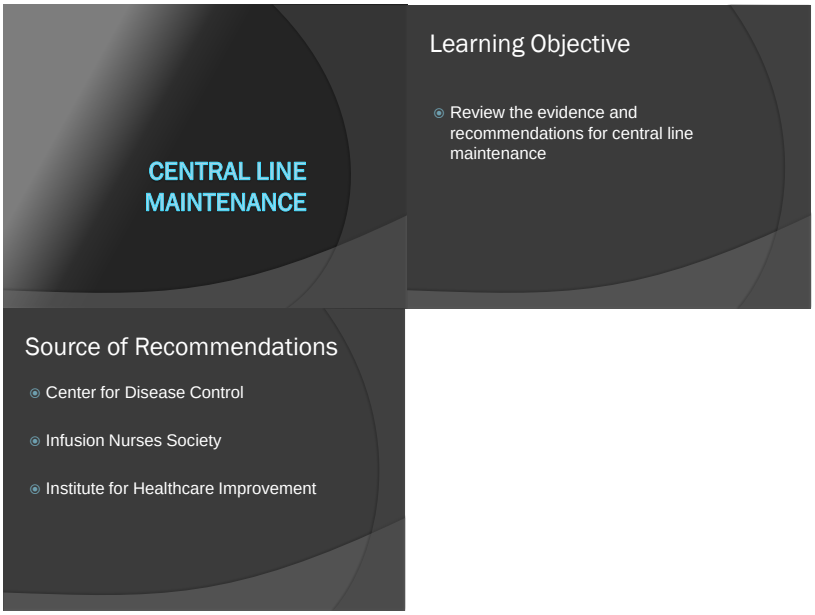
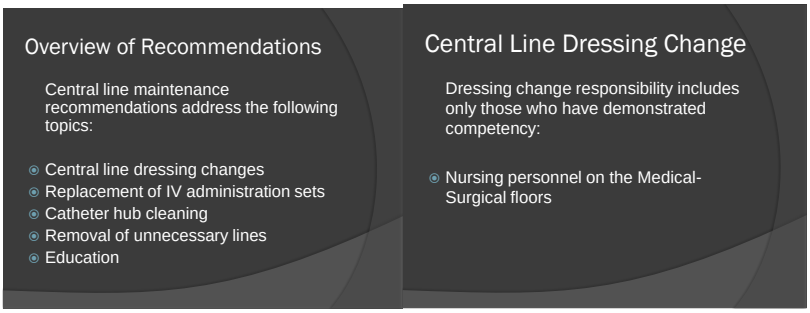
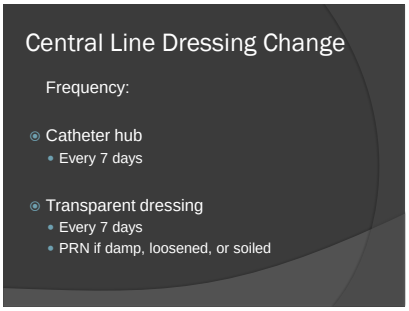
Appendix A

Presentation A1







Replacement of IV Administration Sets

- Lipids and blood products (enhance bacterial growth)
  - Change every 24 hours
- All other IV administration sets
  - No more frequently than every 72 hours
  - Not more than every 96 hours

Catheter Hub Cleansing

- Clean hub before accessing with Chlorhexidine or 70% alcohol
- No formal recommendations regarding how long to cleanse hub

Remove Unnecessary Lines

- Assess need for continued central line access during daily multidisciplinary rounds:
  - Add question to a Daily Plan of Care
  - Complete every day during rounds

Education

Educate all necessary staff:

- Guidelines to prevent catheter-related bloodstream infections
- Proper maintenance of central lines
- Ensure competency through yearly education and examination

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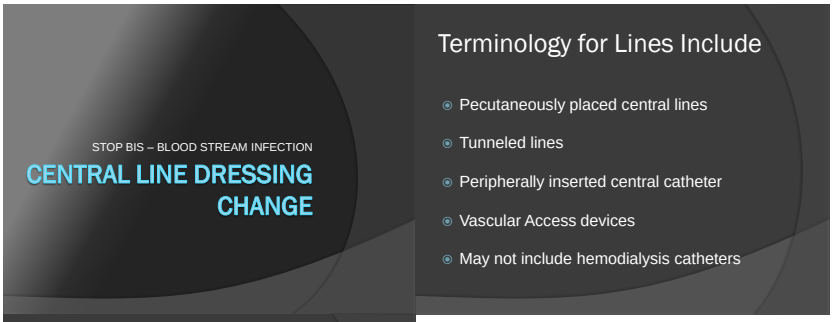
Presentation A2



Who Completes

- Nursing Personnel who demonstrated competency for central line dressing changes.

Frequency

- Once weekly if a transparent dressing is used.
- Any time a dressing is no longer occlusive, damp or visibly soiled.

Equipment Needed

- Chlorhexidine Gluconate 2% w/ Isopropyl Alcohol 70% (1 swab)
- Sterile Gloves (appropriate size)
- Clean Gloves (appropriate size)
- Transparent dressing
- Mask for person applying dressing
- Mask for patient
- Skin prep
- Chlorhexidine impregnated patch

Additional Supplies that May Be Needed

- Sterile cotton tipped applicator (needed to cleanse insertion site)
- Sterile cup to hold sterile saline
- Sterile normal saline
- Adhesive removal pads or alcohol wipes
- Sterile 2x2 gauze

Procedure: Preparation

- Explain procedure to patient/family.
- Wash hands.
- Don clean gloves and remove old dressing using alcohol swab or adhesive remover pads as needed.
- Inspect insertion site of catheter for signs of infection. Culture if needed. Assess security of sutures.
- Remove your gloves.
- Open sterile gloves and create a sterile field using sterile glove package.

Procedure: Sterilization

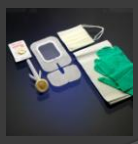
- Open Chlorhexidine Gluconate 2% with Isopropyl Alcohol 70% swab and drop in sterile field.
- Open transparent dressing and drop onto sterile field.
- Open skin prep and place on outer edge of sterile field.
- Don sterile gloves.

Procedure: Cleansing the Site

- Clean skin with Chlorhexidine Gluconate 2% with Isopropyl Alcohol 70% swab.
- Using friction or scrubbing motion to apply. Begin directly at the insertion site as you move swab outwards in a circular motion to cover all areas without retraction the area already cleansed.
- Allow Chlorhexidine Gluconate 2% with Isopropyl Alcohol 70% swab to air dry completely.

Preparing to Place Dressing

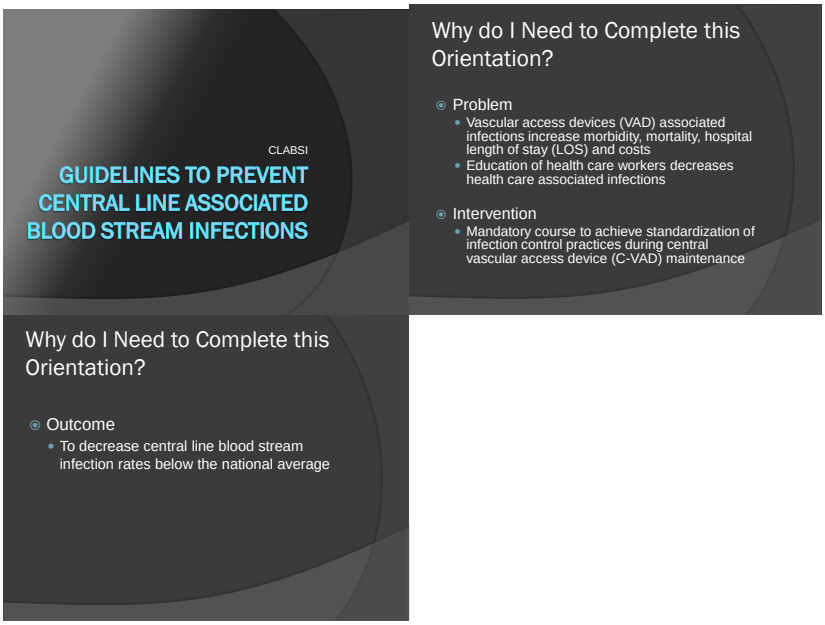
- Designate one hand to be he unsterile hand and pick up the skin prep packet.
- Remove skin prep with sterile hand.
- Apply skin prep on outer perimeter of skin where dressing edge will touch patient.
  - Do not put skin prep over the catheter insertion site or the immediate surrounding area. Allow to completely dry.



Placing the Dressing

- Apply Chlorhexidine impregnated patch onto the catheter insertion site.
- Using your sterile hand, apply transparent dressing per manufacturer recommendations.
- Label the dressing with date, time, and initials to identify when changed.
- Document the dressing change per protocol if indicated.

Presentation A3



Statistics for CLABSI

- 90% of all blood stream infections are associated with CVADs
- 400,000 CLABSIs occur per year in U.S.
- CLABSIs are
  1. Associated with increased morbidity
  2. Associated with mortality rates of 10% to 20%
  3. Associated with prolonged hospitalization (mean off 7 days) and increase in medication costs >$28,000

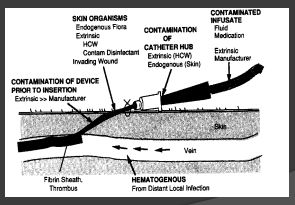
Risk Factors for CLABSIs

- Site of insertion; subclavian vein poses less risk than internal jugular or femoral vein
- TPN and/or lipids
- Multiple lumen catheters
  - Increased tissue trauma predisposes to CLABSI
  - More manipulation and contamination of multiple ports/hubs

Risk Factors for CLABSIs (Cont.)

- Infection elsewhere (remote, eg UTI or wound) – secondary source
- Colonization of catheter with organisms
- IV catheterization longer than 72 hours

Process of Catheter Related Infections



Evidence Based CDC Steps to Preventing CLABSI

- Clean Hands (waterless alcohol based hand sanitizer or wash hands with soap and water)
- Site maintenance
- Remove catheter as soon as possible

Hand Hygiene: When and Where?

- Wash hands with soap and water or use a waterless hand sanitizer
  - Before and after invasive procedures
  - Between patients
  - After removing gloves
  - Before eating
  - After using the bathroom
  - If contamination is suspected

Infection Prevention Waterless Hand Hygiene Steps:

- Coat all surface of your hands thoroughly with waterless hand sanitizer, including your palms, in between fingers and under fingernails, backs of hands and around wrists.
- Rub your hands briskly until they feel comfortably dry.
- It takes about 15 seconds, and no water or towels are needed.

Infection Prevention Handwashing Steps:

- Wet Hands
- Obtain soap
- Lather for 10-15 seconds
- Rinse hands
- Turn off faucet handle with paper towel

Post Insertion: C-VAD Care

- Transparent dressings are preferred to allow visualization of the site
- Replace C-VAD dressing when the dressing becomes damp, loosened, soiled of after lifting the dressing to inspect the site.

Suspected C-VAD Infections

- Remove the C-VAD in apatien with proven CLABSI (i.e., blood culture positive for a recognized pathogen with no identified secondary source)
- If a BSI is only suspected, or the C-VAD is not known to be the source, or the C-VAD cannot be removed, clinical judgment is necessary.

Suspected C-VAD infections (Cont.)

- Draw two sets of blood cultures from a patient with new episode of suspected C-VAD infection, preferably both sets peripherally
- It is not always necessary to remove the C-VAD in a mildly ill patient with unexplained fever

Suspected C-VAD infections (Cont.)

- If the catheter is the suspected source of the infection, it can be cultured. If the catheter culture grows >= 15 colony forming units of organisms, remove it and place at a different site
- Tailor antimicrobial therapy to the individual patient, based on severity of illness, suspected pathogen, and presence of complicating factors

Blood Cultures

- Patients with a new episode of suspected catheter-related infection should have two sets of peripheral blood samples drawn for culture. In rare instance where access for peripheral blood draws is limited, one set may be drawn from the line and one percutaneously

References

- O'Grady NP, Alexander M, Burns LA, Dellinger EP, Garland J, Heard SO, Lipsett PA, Masur H, Mermel LA, Pearson ML, Raad II, Randolph A, Rupp ME, Saint S, Healthcare Infection Control Practices Advisory Committee (HICPAC). Guidelines for the prevention of intravascular catheter-related infections, 2011. Atlanta (GA): Centers for Disease Control and Prevention (CDC); 2011. 83 p. [370 references]
- http://www.cdc.gov/hai/pdfs/toolkits/clabsitoolkit_white020910_final.pdf
- *How-to Guide: Prevent Central Line-Associated Bloodstream Infections*. Cambridge, MA: Institute for Healthcare Improvement; 2012. (Available at www.ihi.org)

Appendix B

Care Sheet

CLABSI: Central-line associated bloodstream infection

Central Line (ABSI): An intravascular catheter that terminates at or close to the heart or in one of the great vessels which is used for infusion, withdrawal of blood, or hemodynamic monitoring.

CLA – Bloodstream infection (BSI): A laboratory-confirmed bloodstream infections (LCBI) that are not secondary to an infection at another body site.

Common routes of infection

- Skin colonization
- Catheter contamination

Risk factor

- Extrinsic / Modifiable factors
  - Multiple lumen
  - Multiple Lines
  - Femoral / Internal Jugular Site

The content of the CDC's recommendations can be organized into three areas meaningful to nursing:

- Education, training, and staffing
- Appropriate selection of catheter site
- Hand Hygiene and sterile technique

Procedure

1. Wash hands
2. Apply mask to patient
3. Don mask
4. Don clean gloves
5. Remove old dressing
   a. Visually inspect insertion site of catheter for signs of infection, being careful not to touch site with gloved hand.
6. Remove gloves
7. Open central line dressing kit and use as sterile field
8. Don sterile gloves
9. Clean skin with Chlorhexidine Gluconate 2% with Isopropyl Alcohol 70% swab. Begin directly at the insertion site and move swab in a circular fashion without retracing the area already done. Use friction when cleaning area.
10. Allow Chlorhexidine to dry for 1-2 minutes
11. Using unsterile hand, pick up skin prep packet. Remove skin prep pad with sterile hand.
    a. Apply skin prep on outer perimeter of skin where dressing edge will touch patient. Do not put skin prep over catheter insertion site of the immediate surrounding area. Allow to completely dry.
12. Apply Chlorhexidine impregnated sponge over insertion site per manufacturer recommendation.
13. Apply transparent dressing per manufacturer recommendation.
14. Remove gloves, unless indicated by isolation policy.

15. Label dressing with date/time/initials and if PICC dressing, length of internal/external catheter segments

How the CDC categorizes recommendations

Category IA: A strong recommendation strongly supported by well-designed experimental, clinical, or epidemiologic studies.
Category IB: A strong recommendation supported by experimental, clinical, or epidemiologic studies and a strong theoretical rationale; or an accepted practice (for example, sterile technique) supported by limited evidence.
Category IC: Required by state or federal regulations, rules, or standards.
Category II: Suggested for implementation and supported by suggestive clinical or epidemiologic evidence or a theoretical rationale.
Unresolved issue: An issue for which evidence is insufficient or no consensus regarding efficacy exists.

Here are some highlights of CDC recommendations pertaining to central venous catheter (CVC) care. See the guidelines for complete recommendations.

Recommendation	**Recommendation category**
Sterile technique with insertion and ongoing care	
Perform hand hygiene with soap and water or an alcohol-based rub before and after working with a CVC or dressing.	IB
Use either a sterile gauze dressing or a sterile, transparent, semipermeable dressing.	IA
Replace the dressing if it becomes loose, damp, or soiled. Replace gauze dressings on short-term CVCs every 2 days. Replace transparent dressings on short-term CVCs at least every 7 days. Regularly monitor catheter sites visually when changing dressings or by palpation through an intact dressing. If indicated (for example, because of signs/symptoms of infection), remove the dressing to inspect the site thoroughly.	IB II IB IB
Use a chlorhexidine-impregnated sponge dressing for short-term CVCs in patients older than 2 months if the CLABSI rate isn't decreasing despite adherence to basic prevention measures.	IB
Don't apply topical antibiotic ointment or creams to insertion sites (except for hemodialysis catheter insertion sites). These ointments are thought to promote fungal infections and antimicrobial resistance.	IB
For CVCs not tunneled or implanted (and for tunneled CVCs that aren't healed), tell patients not to submerge the catheter site in water. Patients may take showers if they protect the catheter and dressing from the water with an impermeable cover.	IB
Before accessing a CVC port, scrub it with an appropriate antiseptic	IA

(chlorhexidine, povidone iodine, an iodophor, or 70% alcohol). Access it with sterile devices only	
Antimicrobial/antiseptic-impregnated catheters and cuffs (chlorhexidine) should be used when the CVC is expected to remain in place >5 days.	IA

Appendix C

Knowledge Test

1. The mortality rate associated with CLABSI is 10% to 20%
    a. True
    b. False
2. The femoral site is the best site for a central line if the subclavian site cannot be used
    a. True
    b. False
3. Infections related to the use of central VADs can increase
    a. Morbidity
    b. Mortality
    c. Hospital length of stay
    d. Costs
    e. All of the above
4. All of the following factors increase the risk of CLABSI except:
    a. Insertion into the femoral site
    b. TPN and/or lipid administration
    c. Multiple lumen catheters
    d. All of the above increase the risk of CLABSI
5. Hand hygiene is not required if you are wearing clean gloves when changing the dressing of a central line
    a. True
    b. False
6. After cleaning the insertion site, one should wait until the site is completely dry without fanning or blotting before proceeding
    a. True
    b. False
7. Ms. Doe has an unexplained fever and you suspect a blood stream infection. Upon inspection of her internal jugular central line insertion site, you see erythema and a small amount of pus. What should be the next step?
    a. Give vancomycin only
    b. If a central line is still necessary, change the dressing site and assess the need for antibiotics
    c. If a central line is still necessary, remove the current line and place another in a new site and assess the need for antibiotics
8. If a catheter culture comes back positive, but the blood sample cultures are negative, reassess the patient before giving antibiotics
    a. True
    b. False

9. When attempting to diagnose a CLABSI, two sets of blood samples should be drawn for culture. The proper sites to culture are:
    a. One from a catheter hub, the other from a peripheral source
    b. Two different peripheral sources
    c. Both from a catheter hub
10. Central line dressing should be changed:
    a. Every 7 days
    b. Every day
    c. As needed of damp, loosened, or soiled
    d. A and C

Appendix D

Direct Observation Checklist – Central Line Dressing Change

Patient initials_____ Date of line insertion_____ Unit_____ Date/Time_____/_____

Type of line being changed_____ Location of line_____ # of lumens____

Critical Steps	Yes	Yes with reminder	Procedure Deviation	Comments
Before the procedure, did the nurse:				
Explain procedure to patient/family				
Wash hands				
Don clean gloves to remove dressing				
Inspect site				
During the procedure, did the nurse:				
Create a sterile field				
Mask self				
Mask patient if cannot tolerate to turn head away from site				
Don sterile gloves				
Use friction/scrubbing circular-outward motion to clean the site				
Apply skin prep at outer perimeter of site				
Place chlorhexidine-impregnated sponge dressing (bio-patch) at insertion site				
Access ports changed				
After the procedure, did the nurse:				
Label dressing site with date, time and initials to identify when changed				
Document dressing change in nursing documentation				
Educate patient/family if seen dressing damp, soiled or pain at site to notify the nurse				

Nurse_____ Observer_____ Shift_____

Appendix E

Chart Review Tool

Date of line insertion_____ Unit_____ Date/Time_____/_____

Location of line_____ # of lumens____

Nurse Documentation	Yes	No	Comments
1) Documented date of insertion site			
2) Documented change of dressing site post 24 hours of insertion			☐ N/A
3) Documented dressing change every 7 days			
4) Documented reason for dressing change if dated before the 7th day mark			
5) Documented site abnormalities			
6) Documented daily if dressing dry and intact			
7) Documented last date of dressing change			
8) Documented education of patient/family about the central line			
9) Check in room if IV administration sets are dated appropriately			

Chart review #_____ Observer_____ Shift_____