Abstract of thesis entitled

“The evidence based guideline on implementing chlorhexidine impregnated sponge in preventing catheter related bloodstream infection in PICU patient with central venous catheter”

Submitted by

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Central venous catheters (CVCs) are an essential tool in pediatric patients under Intensive Care Unit (PICU). However, the complications arising from the use of CVCs in causing central line-associated bloodstream infections (CLABSIs) is alarming. It is one of the most common nosocomial infections in PICUs resulting in significant morbidity, mortality and extra health care costs. There is a need to eliminate the possibly of CRBSI.

To minimize the consequences of CVC infection, it is crucial that all appropriate measure for reduction of infection should be implemented. Studies have been proven that effective catheter site dressings is a vital element in preventing the risk of contamination and discouraging the microorganism growth around the exit site when working with other preventive strategies which may decreased CLABSIs rates. Many
studies have supported the effectiveness of chlorhexidine gluconate-impregnated
sponge (CHGIS) is promising. In order to bring the optimal method of CVC dressing
care in local settings, there is a need to develop new evidence-based guidelines on
CVC dressings with the implementation of CHGIS in preventing CRBSI.

This paper will be a translational nursing research presenting that CHGIS is a safe and
effective dressing material for CVC dressings in PICU patients.

Articles have been identified through literature searches on comparing the
effectiveness on the use of CHGIS in CVC dressings as compared to traditional
dressing. The Scottish Intercollegiate Guidelines Network (SIGN 50) was used to
appraise the level of evidence and quality of the selected studies. Six selected studies
rated from 1++ to 1+, supported that CHGIS is effective in reducing the rate CRBSI.

After a comprehensive analyze, it is proven that the new implementation of using
CHGIS can be transferable and it is feasible to be implemented to the local settings.
Therefore, an evidence-based guideline on implementing chlorhexidine dressing
sponge in preventing catheter related bloodstream infection in patient with central
venous catheter in PICU was created with a thorough implementation and evaluation
plan for definite implementation of the guideline
"An evidence-based guideline on implementing chlorhexidine impregnated sponge in preventing catheter related bloodstream infection in PICU patient with central venous catheter"

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DECLARATION

I declare that this thesis represents my own works, except where due acknowledgement is made, and that it has not been previously included in a thesis, dissertation or report submitted to this University or to any other institution for a degree, diploma or other qualifications.

Signed___________________________________

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Chapter 1 Introduction

In this chapter, the background and affirming need of implementing chlorhexidine gluconate impregnated sponge (CHGIS) in dressing care while prolonging the frequency of dressing of central venous catheter will be discussed. The objectives and the significance for reducing the incidence rate of central line-associated bloodstream infections (CLABSIs) together with decreasing the frequency of dressing and in consequence reduce the length of stay in hospital and the cost will also be discussed.

1.1 Background

Central venous catheters (CVCs) are an essential tool in pediatric patients under Intensive Care Unit (PICU). Under most circumstances, PICU patients is in acute phase of chronic life-threatening illnesses and injuries; which in turn have the need of close observation and requires intensive care with advanced equipment and medication in order to sustain life. In ICU, more than 40% of the patients including both adult and pediatric were inserted with CVCs, because of its convenience and multiple functions. (Pittet, Tarara, & Wenzel, 1994)

According to the National Healthcare Safety Network, a CVC is a venous access device where the tip lodges in the large vessels. There is a variety types of central line
including tunneled and non-tunnel catheter, central catheter which is peripherally inserted (PICC), and inserted port. It can be maintained in site for a longer period of time when comparing with other venous access devices. It is a catheter which consists of either single or multiple lumens at the end tip. The place of insertion involves large vein such as internal jugular vein and femoral vein are the common site of selection. The central line is usually sutured in at the entry point to the blood vessels and is secured with a transparent dressing to keep the line clean and visible. It has a wide range of indications which include monitoring of the central venous pressure, to quantify fluid balance, for patients who require long term intravenous medications, parenteral nutrition or requiring chemotherapy. Patient requiring frequent blood taking, have the need for long term intravenous access or when the need for intravenous therapy which intended for blood and blood product transfusions, medication and rehydration is hindered due to the difficulty in venous access via peripheral. Other than these benefits, CVC also help to minimize patient’s discomfort by decreasing the necessary skin punctures and risk of phlebitis in peripheral veins due to certain types of medications.

Although there are lots of benefits from CVCs, it also has its downside. It can cause a considerable health care costs and increased morbidity and mortality. The risks of
CVC insertions include hematoma, arterial puncture and local or systemic infection. (Chuengchitraks, Sirithangkul, Staworn, & Laohapand, 2010) One of the most common complications arising from the use of CVCs is central line-associated bloodstream infections (CLABSIs). The use of CVC and infection rate are well documented, it is predicted that in each year in ICU, there is around 15 million CVC days occurring, and that approximately 80,000 CLABSIs occur each year. (Schwebel et al., 2012) There are data indicating that about 40% of the BSIs are associated with a CVC in the ICU. (Rosenthal et al., 2012) And it is noted that the longer the central line is kept in place, the higher the risk of infection. Approximately 90% of the catheter-related bloodstream infection occur with CVCs. (Mermel, 2000) As CVCs can also be a media for bacteria to move into the bloodstream. Catheter infection involves colonization of the endovascular tip. It can be caused by colonization from skin at the insertion site of the catheter by micro-organism, which then can migrate into the bloodstream. One of the most common microorganisms associated with CLABSIs is Coagulase-negative staphylococci, following by Gram-negative aerobic bacilli and Staphylococcus aureus. (Herrmann, Lai, Albrecht, Mosher, & Proctor, 1993) The treatment for CLABIs include giving antibiotics and most often the CVC will need to be removed and if necessary be replaced with a new catheter.
The high incidence rate have raised the awareness on research in studying the best kind of dressing or antiseptics used for maintenance of CVCs, together with the cause of blood stream infections. It is noted that the insertion sites of CVCs is the most common area where organisms originates and responsible for CLABSIs. For that reason, reducing the skin’s chance of bacterial colonization at the insertion site might decrease the risk of blood stream infection (BSI). For the above facts, new dressing materials have been developed to decrease colonization and a new type of dressing known as chlorhexidine gluconate-impregnated sponge (CHGIS) which is used to place over the CVC insertion site is developed. (Ruschulte et al., 2009) Chlorhexidine has been proven with the ability to prevent CLABSIs as skin disinfection during insertion and for regular dressing antiseptics. Therefore, chlorhexidine impregnated sponge works as a wound dressing which continuously release chlorhexidine gluconate at the insertion site which aims to decrease CLABSIs. (Timsit et al., 2009)

1.2 Affirming the Needs

According to the Centers for Disease Control and Prevention guidelines, it is estimated that each year, CVCs-releated BSIs affect around 250,000 hospitalized patients. (Crawford, Fuhr, & Rao, 2004) The attributable mortality of CLABSIs ranges from 3%-35% for all hospitalized patient. It is estimated that every year,
central line infections causes approximately 14,000 deaths, some even raised the figures to 28,000 deaths per year. With CLABSI are preventable, given the current emphasis on increasing patients’ safety in hospital, the high incidence rate has raised the concern to tackle the matter. (Berenholtz et al., 2004)

In Hong Kong, a study support by the Hospital Authority in 2002 on care of central lines showed that Hong Kong consists of a higher catheter related infection rate than international data, 2.5 per 1000 catheter days as compared to 1.9 per 1000 catheter days. The figures showed that there is a need for change to tackle this problem.

Other than that, CLABSI is also significantly associated with increased hospital stay and cost. It is estimated that the attributable cost per CLABSI have ranged from $34508 to $56,000. Plus including the additional 9-12 days required continuing stay in ICU due to the infection. (Pittet, Tarara, & Wenzel, 1994) In the ICU, with the high turnover rate and overflow of patients, CLABSI not only endangers ICU patients safety but also increase the staff’s and finical burden. Moreover, it increases the risk to potential ICU patients which should be under ICU care, but due to lack of bed available have to maintain care in general ward. For these reasons, improving patient’s outcome and reducing health-care costs is critical, active approaches should be suggested to decrease the incidence rate of CLABSI.
Dressing materials and frequency of change

The types of dressing materials and its frequency of changes are identified as risk factors relating to the incidence of CLABSIs. There are various dressing material accepted for dressing CVC, however there are different effects regarding the interactions of microbial growth to which type of dressing used and its risk to infection. According to the Centre for Disease Control and Prevention, they did not provide any guidelines on the changing frequency of the dressing nor the preferred dressing materials. (O'Grady et al., 2002)

Current CVC dressing practice in ICU setting

During dressing changes, 2% chlorhexidine based preparation is recommended as antiseptic solution for CVC in pediatric patients, as compare to tincture iodine, an iodophor, or 70% alcohol,due to risk of skin toxicity. For dressing materials, nil specific types are suggested. Both gauze, transparent or semipermeable dressing can be used based on nurse preferences. Change of dressings can vary from at least once weekly to few times each week for all types of patients depending on the needs of the patient by assessing their skin condition. Most often, CVC dressing requires more than once because the dressing may become moist or loosened due to oozing, sweating or bathing. In the local settings, the types of which solution or dressing to
use mentioned are based on each hospital’s or wards’ preference. Under most circumstances, the CVC dressings are done by nurses, under heavy workload, nurses may not be able to provide CVC dressing when necessary or properly which result in another risk factor leading to CVC infections.

**Potential innovation of implementing chlorhexidine impregnated sponge**

Studies have been proven that effective catheter site dressings is a vital element in preventing the risk of contamination and discouraging the microorganism growth around the exit site when working with other preventive strategies which may decreased CLABSIs rates to less than 2 per 1000CVC days. (Timsit et al., 2009) By implementation CHGIS, it can be a potential strategy for decreasing CLABSIs, decrease the frequency of CVC dressing and can act as a material to anchor the CVC in place, which in turns lowers health care practitioner’s workload and be cost effective.

With the high demand use of CVC and the emphasis on CVC related BSI prevention, a review of the effectiveness of implementing the chlorhexidine impregnated sponge as a regular dressing material for CVC and the development of a standardized evidence – based guideline of it use as well as how it can integrate with other dressing materials is necessary for PICU patient with CVC.
1.3 Research question, Hypothesis, Objectives and Significance

Research Question

Does the placement of a chlorhexidine gluconate–impregnated sponge (at CVC insertion site) decrease the incidence rate of central line associated bloodstream infections?

Objectives

1. To assess the implementation potential of the research findings into local hospital in Hong Kong.

2. To develop evidence-based clinical practice guidelines on implementing chlorhexidine gluconate imprenged sponge as a dressing material and its frequency of change for PICU patient with CVC.

3. To evaluate the evidence on the effectiveness and safety of using chlorhexidine gluconate-imprenged sponge as compared to traditional dressing in decreasing the risk of bloodstream infections in PICU patients with CVC.

Significance
From patient’s point of view, a useful intervention to prevent CLABSIs can help improve their comfort and quality of life, by minimizing the discomfort caused by symptoms of infections, such as fever, removal of line, reducing the risk of suffering from the illness and prevents the threat to death caused by CLABSIs and the length of hospital stay. (Caruso et al., 2006)

From nursing staff’s view, having a strong and reliable evidence based guideline can help standardize the care, improve efficacy and prevent misunderstanding for patient with CVC. (Labeau et al., 2009)

Chapter 2 Critical Appraisal

In this chapter, the searching strategies for relevant studies related to CVC dressing interventions will be shown. The evidence extraction, critical appraisal, quality assessment of the selected papers will be addressed, together with the summary and synthesis of data will be explained.

2.1 Searching strategy
Inclusion and Exclusion Criteria

The studies are limited to randomized controlled trails in English or Chinese only.

The studies included all age groups and both genders. All consists of CVC with no specific limits to which type of CVC, either tunnel or non-tunneled are included. It also required having a CVC for more than 48 hours were eligible to participants. The interventions are related to the use of chlorhexidine impregnated gluconate dressing to CVC in the intervention and comparison groups, also the difference in frequencies of dressing changes from both groups were as well compared. The main outcome is catheter related infections. The studies must consist of the main outcome indicators on incidence rate or hazardous rate of infection. The studies’ target other than ICU patient was also included because ICU involves patients from all medical or surgical backgrounds.

The exclusion criteria are studies on animals or other outpatient population as the target setting is ICU settings. Studies with no full text are also excluded.

Keywords used

The keywords used were Central venous catheter, chlorhexidine impregnated dressing or chlorhexidine dressing, catheter related bloodstream infection or central venous colonization or catheter related infection. The keywords are searched using “OR” then
“AND” was used to link among different groups.

Electronic database search

A comprehensive literature search was performed in two electronic databases. It included PubMed and ProQuest. In order to search for the updated paper; the searching year was limited from January 2000 to the end of August 2013.

There are a total of 185 articles available. First, all the titles and abstracts relevant to the topic were screened. 58 articles were chosen to be related to the study. Full papers were then obtained and read to evaluate in details according to the selection criteria. After eliminating identical papers, 6 articles were recognized with 5 from PubMed and 1 from ProQuest library.

The search combinations will be shown in appendix 1

Data extraction

The following target population, intervention variables, outcome measure and the result were extracted from each study and translated into the table of evidence

The six papers’ Table of Evidence is presented in appendix 2.
2.2 Appraisal strategies

For the critical appraisal of the six selected studies, the Scottish intercollegiate guidelines network (SIGN) “SIGN 50” framework will be used to grade the level of evidence for each of the study.

The appraisal of the selected studies will be shown in Appendix 3.

2.3 Summary of Quality assessment

As all the studies are RCTs, the methodology checklist on RCTs will be used. There are ten aspects in the checklist to test the internal validity of the selected studies.

Using the SIGN Levels of Evidence and Grades of Recommendations, the studies were then classified into different levels of evidence, ranging from (1++) to (1-). Where (1++) represents the paper consists of highest quality in which the study can fulfill most or all of the criteria in the checklist and the conclusion of the studies won’t be affected by any unsatisfactory items. For studies with (1+), it stands for fair quality. It means the study only fulfilled some of the criteria, while the unfulfilled or inadequately described were thought questionable whether the conclusion was altered. For studies with (1-), means the study is in poor quality, as only few or no criteria fulfilled which causes the conclusions can be varied.
Giving the quality assessment of SIGN (2008), among the six selected studies, three were rated as good quality(1++), (Timsit et al., 2009, Garland et al., 2001, Arvaniti et al., 2012), and the other three were rated fair quality(1+) (Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005).

All the selected papers consist of a clearly focus question, which focused on the use of chlorhexidine –impregnated dressing on its effectiveness in decreasing the CLABSIs. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012) Five studies described the randomization process adequately ((Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Garland et al., 2001, Arvaniti et al., 2012). All studies showed an equalization effect of randomization among the controlled or compared groups. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012) The randomization methods mostly used the computer – generated randomization sequence among most studies. (Ruschulte et al., 2009, Garland et al., 2001, Arvaniti et al., 2012) Other studies used web based random-number generator to select permuted block (Timsit et al., 2009) and random number generator. (Levy et al., 2005) The concealment allocation methods were not mentioned in all the six studies. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers
et al., 2005, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012) Blindings for
treatment allocation was not possible due to the fact that the dressing materials are
different in appearance, which the target can see and for that reason, blinding of
nurses who perform the dressing of CVC was not possible. Five studies did not have
blinding allocation. (Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005,
Garland et al., 2001, Arvaniti et al., 2012) Expect for Timsit et al. (2009) and Levy et
al( 2005) their study were blinded for the microbiologists who processed the skin and
catheter cultures. All studies, the intervention and control groups were similar at the
beginning of the trails, the only difference between groups is the treatment under
investigation. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Levy
et al., 2005, Garland et al., 2001, Arvaniti et al., 2012) All the relevant outcomes are
measured in a standard, valid and reliable way by using the form of catheter cultures,
number of catheter removal due to infection. (Timsit et al., 2009, Ruschulte et al.,
2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001, Arvaniti et al.,
2012)

All the dropout rate of the studies have been reported and in detail on its reason to
drop out, most common causes are due to patient withdrew from consent, transfer to
other places or earlier removal of the central venous catheter due to causes other than
infection, and sudden death. (Timsit et al., 2009, Chambers et al., 2005, Arvaniti et al., 2012) The dropout rate of the six studies varies from 0%-19.1%. Three studies with 0% dropout rate. (Ruschulte et al., 2009, Levy et al., 2005, Garland et al., 2001) Only one study had significant dropout rates. (>10%) (Arvaniti et al., 2012) Three studies have intention to treat analysis which ensure the initial treatment intent and avoid the effects of dropout and crossover ((Timsit et al., 2009, Garland et al., 2001, Arvaniti et al., 2012)

2.4 Data summary

Study characteristics

All the six paper’s study type was controlled trial consisting control or compare group and intervention group. The methods used in allocating the participants were based on randomization. The level of evidence of the studies ranged from (1++) to (1+). The publication year of the papers was from year 2000-2012. The studies were conducted in France, (Timsit et al., 2009) Germany, (Ruschulte et al., 2009) New Zealand, ( Chambers et al., 2005 ) Israel,(Levy et al., 2005) , USA(Garland et al., 2001)) and Greece. (Arvaniti et al., 2012)

The six studies included 3,592 numbers of participants. The number of participants in each study ranged from 95 (Chambers et al., 2005) to 1636(Timsit et al., 2009).
Patient characteristics

Four studies involved in adults, consisting two papers in ICUs (Timsit et al., 2009, Arvaniti et al., 2012), one paper in High dependency unit (Ruschulte et al., 2009) and 1 paper in Hematology unit (Chambers et al., 2005). The other two studies involved infants and children in PICU (Levy et al., 2005, Levy et al., 2005). Five studies reported similar percentage of male to female participants (Timsit et al., 2009, Ruschulte et al., 2009, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012); one study show the female proportion was larger than male. (Chambers et al., 2005)

All the selected studies reported the mean age value ranged from age 0 days to 62 years.

For the site of CVC locations, six studies involved locations at the subclavian and jugular (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001), while one study was mostly located in femoral. (Arvaniti et al., 2012) Three studies included both tunneled and non-tunneled catheters (Timsit et al., 2009, Garland et al., 2001, Arvaniti et al., 2012) Two studies included either tunneled or non-tunneled catheters only (Chambers et al., 2005, Levy et al., 2005) One study did not mentioned which types of catheter involved. (Ruschulte et al., 2009)
Intervention and Control

1. The types of dressings

The entire intervention group used the chlorhexidine-impregned sponge to be placed at the catheter’s insertion site together then covered site using polyurethane dressing. The control group’s uses only used the polyurethane dressing. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012) It involved 1736 participants with chlorhexidine –impregnated dressing and 1928 participants as control group or comparing to another antiseptic dressing solution.

2. Frequency of dressing

For both intervention and control group, the frequency of dressing change was once per week or when necessary in 2 studies (Chambers et al., 2005, Garland et al., 2001) Two studies change every 3 to 7 days (Timsit et al., 2009, Arvaniti et al., 2012) One study did not change dressing unless oozing or soiled dressing involved. (Levy et al., 2005) Only one study didn’t mentioned the frequency of change. (Ruschulte et al., 2009)
3. Antiseptics solutions

The antiseptic solutions for both groups, two studies used alcohol based solution (Timsit et al., 2009, Garland et al., 2001) two studies didn’t mention what antiseptic used (Ruschulte et al., 2009, Chambers et al., 2005) one study used chlorhexidine solution (Levy et al., 2005) while another study used 10%povidine solution. (Arvaniti et al., 2012)

4. Measure outcomes

Four studies have shown that CHGIS can significantly decrease the incidence rate of catheter colonization and CLABSIs (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Arvaniti et al., 2012) ranging from a decrease rate from 20% (Chambers et al., 2005) to 60% (Timsit et al., 2009).

One study showed that CHGIS can reduce the colonization rate in children, with minor decrease on reducing CLABSIs. The study in neonates, CHGIS reduces both the incidence rate of colonization and CRABSIs, yet suggested that CHGIS are not recommended to be used in the low birth rate neonate during the first two weeks of life, with the risk of developing dermatitis. (Garland et al., 2001)

2.5 Data Synthesis
The target population’s age in the selected studies involved all age range, including adult and pediatric patients in ICU. According to the Centers for Disease Control and prevention, it suggests that for CVC dressing procedures, both adult and pediatric are the same. (O’Grady et al., 2002) Therefore, the implementation of CHGIS can be implying to both adult and pediatric ICU. In the chosen studies, it included both tunnel and non-tunneled catheters at different sites of insertion, therefore there is evidence supporting that CHGIS have effects in all insertion area. Although it is noted that subclavian site are preferred when comparing to jugular or femoral site in reducing the risk of infection, yet in pediatrics, femoral site are common area for catheter insertion (Garland et al., 2001).

Timsit et al( 2009), Chambers et al(2005) and Garland et al(2001) suggested that the frequency of dressing change can be prolonged to once per week, without causing a significant difference in the infection rate. Yet, it is reported that there was a reduced mean interval in the dressing frequency due to soiled, oozing or detached dressing at the catheter site.

For the types of dressing, all the studies supported the use of CHGIS is recommended to decrease risk of catheter-related infections, particularly in high-risk groups such as
patient in ICU; however, relative benefit and increased cost must be carefully considered before they are routinely used.

The types of dressing suggested for combine use with CHGIS is transparent polyurethane dressing. The reason is that polyurethane dressing can allow longer time intervals of frequency change and visualization of the catheter’s exit site for better inspection. It is supported by four studies.

There are different forms of antiseptic solutions that have been used for CVC site care, including iodophores, chlorhexidine, and isopropyl alcohol. 10% povidone-iodine had always been one of the most common antiseptic agent used for CVC site care in both children and adults. Among the selected studies, only one studies mentioned the use of chlorhexidine as antiseptics (Levy et al., 2005) while other used mostly povidine solution. (Timsit et al., 2009, Arvaniti et al., 2012)

However, according to the U.S. Food and Drug Administration, they approved that 2% tincture of chlorhexidine gluconate are to be used for skin antisepsis for CVC as it is proven to be more effective in reducing colonization of bacteria. (Miller & O'Grady, 2012) Since then, there has been an increase in the use of chlorhexidine as a substitute for povidone-iodine in the site care of CVCs. (Carson, 2004) Also, as the
2% aqueous chlorhexidine gluconate solutions are milder for pediatric patient’s skin causing lesser chance in irritating the skin leading to rash and itchiness, therefore, it is recommended for skin antisepsis for CVC. (O'Grady et al., 2002).

The use of CHGIS have shown a significant effect in reducing catheter related infection which is shown to be safe to use and can prolong the frequency of dressing change, so that benefits patient in quality of life and at the same time benefits health care practitioners on lessen their workload. It can also bring a reduction in costs expance relating to treatment caused by catheter related infection

### Chapter 3

**Implementation Potential**

In the previous chapters, the evidence showing that on using chlorhexidine gluconate - impregnated sponge (CHGIS) not only reduce the incidence rate of central line associated bloodstream infections (CLABSIs) but also prolong the frequency of dressing. In this chapter, the potential of this new innovation will be explored. In the following, the targets over audience and settings, transferability of the findings, feasibility together with the cost-benefit ratio of the innovation will be deliberated. The research evidence will be translated into evidence-based clinical guidelines on implementing the CHGIS and its frequency of dressing change for CVC care.
3.1 Target setting/ audience

Target setting

The new guidelines are proposed to be implemented in local teaching public hospital with pediatric intensive care unit (PICU) under the Department of Pediatrics.

The PICU is the target setting, which includes both male and female in the ward. There are a total of 16 beds. The SCBU which is included in the PICU are excluded in this study as it won’t consist of patients requiring CVC. PICU involves all kinds of patients, including medical and surgical cases. The average length of stay can vary from 3 days to 1 month. The major treatments in the target setting is to continuously provide close monitoring and using advanced equipment and medication to maintain body function from life threatening illnesses and injuries.

The manpower involved in the management level includes the Department Operation Manager (DOM) and Ward Manager (WM). Nurses in PICU consists of 54 staffs including Nurse Specialist(NO), Advanced practice nurses(APN) and Registered nurses(RN) will directly participate in the implementation plan.
Target Audience

The target audience of the proposed innovation requires the following characteristics:

- are aged 0 or above;
- requires CVC insertion during their stay in the PICU or having it before admission/transfer to PICU
- requires having CVC for more than 1 week
- does not use antibiotic impregnated central venous catheter
- have no significant local skin toxicity
- have not known allergy to chlorhexidine or to transparent dressing

Number of clients benefited

The implementation will bring benefits to PICU’s patients who required CVC care. In PICU, approximate 80% of the patient required or consist of CVC. For the past year, basing on the annual admission rate of the Department, there were around 200 patients admitted for ICU care, therefore, each year it is estimated that more than 160 target patient will be benefited.

3.2 Transferability of the findings

In the following, the selected papers will be reviewed on its transferability of the findings by comparing the settings, philosophy of care, the number of patients who
will be benefit and the time required for implementation and evaluation.

**Setting and Audience**

All the reviewed studies were conducted in inpatient settings. Five of papers were conducted in university-based teaching hospital. (Timsit et al., 2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012)

The participants vary on age, from age 0 to above 18 years old. Though all the subjects were in an in-patient setting, most are under ICU settings and requiring CVC. Yet, the majority of the target population in the reviewed studies were adults, (Timsit et al., 2009, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012) only 2 papers involved pediatric patients. (Levy et al., 2005, Garland et al., 2001) The gender criteria were not involved in the reviewed papers as there is not relations on the difference in gender to the effect of the outcome. The subjects in the selected papers involved adult, however PICU also consists of patients aging 18 years old, therefore it can also be regarded as transferable to the target settings.

When comparing patients by their diagnosis, treatment of disease and catheter sites from the reviewed studies, 2 papers involved patients with hematological malignancy, while others involves all kinds of different diagnosis in ICUs. (Ruschulte et al., 2009,
Chambers et al., 2005) Most patients require having their catheter for more than 3 days. Thus, the characteristics of the patients are transferable to the patients in the target setting at all.

**Philosophy of care**

According to the philosophy of care from the Hospital Authority, it is based on service towards client-centered. It is to provide high quality of care to patient, where nurses play a role in encouraging and supporting patients and families in planning and towards the delivery of care. (Hospital Authority 1994)

Children under PICU care are certainly under a vulnerable position, their needs is through close observations and assessments by nurses to discover. The goal is to response to the patient’s needs; maintain their well-being and preventing them from risks on suffering.

By implementing CHGIS as a routine during CVC dressing, not only decrease the risk of CLABSIs, but also reducing the dressing frequency which in turns bringing more comfort to patients. Children’s skin is fragile and sensitive, lesser dressing frequency can prevent skin irritation. Moreover, CHGIS can be used as a way to secure the CVC
at the insertion site, so anchoring stitches is prevented, decreasing unnecessary pain and risk of skin rupture which increases the risk of infection to the patient. With the successful rate of reducing risk of bloodstream infection, it can significantly prevent it’s the consequences, such as antibiotics, increase length of stay in ICU and blood taking, or removal of CVC while required to insert a new peripheral or new CVC. The ultimate goal is to decrease morbidity and mortality. Hence, through the proposed innovation, it fits the target unit’s philosophy of care by promoting evidence-based practice.

**Implementation and evaluation**

The only additional material during CVC dressing is CHGIS, while other steps remains the same, no extra manpower is required. Hence, the findings can be easily transferable to the target settings by means of implementation and on its evaluation.

The proposed innovation will proceed after the implementation of a pilot program in PICU. The program will last for six months including the implementation period and evaluation. During the implementation period, feedbacks will be collected from nursing staff monthly on the difficulty on application or effectiveness and obstacles on assessing the CVC site. Afterwards, evaluation and modification will be made
during the evaluation period.

The duration for the implementation and evaluation is counting from the hospital stay of the patient. Extra hospitalization stay is not necessary. The proposed innovation is implemented on the day of their insertion of CVC and will continue throughout their stay in PICU until their removal. Patients’ diagnosis and general condition will not be considered as a factor affecting the innovation because the new clinical guidelines are appropriate for all target patients.

After the innovation is commenced, yearly audit will be done on the effectiveness of CHGIS in reducing the risk of infection, patient and staff compliance towards the intervention.

3.3 Feasibility

There are factors which is vital on its feasibility toward the proposed innovation. They are the ease to try, acceptance to current staff functions, administrative support, consensus, the development and skills from staff and the availability of resources and the evaluation tools.
**Organization climate**

A good organization climate is necessary for the implementation of innovation. Nowadays, evidence–based practice is the major trends in the health care parties to provide the most effective care to bring the highest outcome by providing the best care to patient. Therefore, by choosing the target setting from a hospital which is university-teaching based, it is easier and better acceptance on new opportunities for research and evidence–based practices.

**Administration support**

The proposed innovation is a simple implementation which requires an additional step in the dressing procedure of CVC. It does not require additional manpower for the procedure. Hence, it is likely to obtain administrative support. The only concerns to the manager level, is the cost of CHGIS and its effectiveness. Therefore, to gain support, it is necessary to provide a solid background on the evidence-based literature, an informative guideline with budget and schedule plan. These parts will be deliberated on the next chapter.

**Staffing of nurses**
Other than gaining the support from the administrative level, gaining the acceptance of the nursing staff that will be performing the task is vital to bring success to the innovation. For that reason, several considerations should be made on the workload of the staff, their acceptance level, and the skill and equipment requires with suitable training provided. It can be done by demonstrating values, providing ample training, show compassion, putting the patient as first priority and active listening to the nursing staff concern.

When considering the workload, the new innovation is highly feasible as the only difference in the dressing procedure is adding a piece of chlorhexidine impregnated sponge to the CVC exit site before applying the dressing. Also, the new innovation suggest prolonging the CVC dressing to once a week only which can decrease the workload of the nursing staff. Therefore it should cause minimal resistance to change. The only training on the new implementation is the techniques on applying the sponge, it have been stated in the selected studies on the difficulty on applying the sponge to the exit site. As our target audience is pediatric patients, therefore it will increase the difficulty on application as the CVC size may be smaller and as the patients will move or more easily irritated.
**Availability of resources**

All the dressing materials and equipment’s such as dressing materials and antiseptic solution are available in the target settings. The only additional dressing material is CHGIS. The dressing materials the proposed guidelines will recommend is transparent polyurethane dressing. Since the evidence concluded that use of chlorhexidine as antiseptic is preferred, therefore it will be used. The measuring tools for testing the effectiveness of the impregnated sponge is by clinical signs and sepsis workup such as sending the tip of the CVC to culture after removal.

**Potential barrier and strategies to tackle**

The potential barrier on implementing the new innovations is the increase risk of slipping out the CVC and the difficulty in application of the dressing at the exit site of CVC. In pediatric patients the CVC used will be smaller in size, and in some cases there will be no anchoring stitches of the CVC to the skin and as pediatric patients are unlike adult which can hold still during the procedure, it usually requires another nurse to hold the patient to maintain position. The longer the dressing time will lead to higher chance of slipping out the CVC or irritates the patient. The increased risk and prolonged time in dressing may cause the frontline staff reluctance to change. The possible solution is by practicing, workshops will be held to allow frontline staff to
practice applying the CHGIS, and sharing of techniques in applications will be given.

3.4 Cost/Benefit ratio of the innovation

Risks of patients

The risk to patients includes the possibility of promoting CLABSIs due to prolonging the frequency of dressing change and the adverse reactions to chlorhexidine dressing. These risks to patients are relatively low. As the CVC dressing are the same and prolonging the frequency of dressing change are shown in the selected studies that it won’t promote the risk of CLABSIs. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012)

The only concern is the age of the patient, it is suggested that there may be considerable possibility of contact dermatitis over the dressing site when using CHGIS in infants during the first 2 weeks of life or with low birth weight, and it is recommended that it should not be used on premature infants or on patients with a known sensitivity to chlorhexidine. (Garland et al., 2001)

Potential benefits

The target audience can benefit from quality of life as the new innovation can decrease the risk of CLABSIs, prevent them from prolonging the stay in ICU,
receiving more treatments and suffer from infection symptoms such as fever, most importantly decreasing morbidity and mortality. Also, it can promote patients comfort as the sponge can work as a securing device which can prevent the use of anchoring stitches to the patient’s skin directly. The frequency of dressing change are prolonged which decrease the pain caused during the removal of dressing as the skin of the audience are more fragile when comparing to adults.

The benefits to the department includes reducing staffs’ workload as the frequency of dressing changed prolonged. Also, by integrating evidence based practice, it can provide nurses with a clear guideline for unify the practice of the nurses instead of basing on own preference on practice and clear guideline on regular audit which help to develop a better professional image. It can also decrease the cost of hospital fee and resources.

**Material cost**

All the equipment is available in the target settings. The only extra cost of material is CHGIS. The costs of materials were calculated based on Hospital supplies and ward self-purchase items price. The cost of each CHGIS is HK$30. With the implementation of CHGIS dressing, the frequency of dressing change can prolong to
7-day scheduled changes instead of 3 days. Based on calculation, assuming the dressing maintained intact, with site clean and dry where no extra dressing is necessary. The cost on CHGIS dressing is HK$400/month on 7 days bases when comparing to standard dressing based on 3-days scheduled changes which are HK$700/month. There is approximate reduction in cost of dressing material by 42.8%.

When comparing to the cost for non-implementation, for each patient with CRBSI, the cost on treatment including the extra length of stay in PICU (approximately 10days per case), and the median cost will required HK$40000. With this amount of money, it can provide CHGIS dressing for nearly 100 patients for one month. Therefore, CHGIS saves money and bring benefits by preventing major catheter-related infections, even in ICUs with low baseline infection levels. (See Appendix 1)

**Non Material Cost**

For non-material cost, it is the extra time on promoting the innovation. There will be training sessions on the correct application of CHGIS, explaining the whole implementation plan, rationale behind the innovation and its benefits. It allows staff to comment or rise out their concerns and makes adjustments on protocols to improve
the smoothness of the program during implementation.
Chapter 4

Developing Evidence-based Practice Guidelines

With sufficient evidence from selected studies, it is necessary to develop an evidence-based clinical guideline on the implementation of chlorhexidine gluconate-impregnated sponge (CHGIS) into CVC dressings for PICU patients.

4.1 Aims of the guideline/Objectives/Target group

The aim

- To decrease risk of catheter related blood stream infection in PICU patients

The objectives are:

- To recommend intervention by applying CHGIS at CVC insertion site during dressings and extend the dressing intervals to seven days.
- To describe the guideline and support evidence for using CHGIS
- To present evidence based guideline for standardized CVC dressing care for patients in PICU.
- To decrease the incidence and risk of catheters related bloodstream infection

Target users

Nurses who perform the dressing changes in PICU.
4.2 Rating scheme of the guideline

The grading system of SIGN 50 (Scottish Intercollegiate Guidelines Network, 2008) are used to grade the level of evidence using the scale from 1++ to 4. The grades of recommendation will be presented from Grade A to D.

Recommendations

Recommendation 1.0 (Grade A)

*The guidelines recommended the sites for CVC insertion include subclavian and jugular veins.*

Evidence:

- In the selected studies, the subjects have their CVC insertions mostly over subclavian and jugular veins. It is suggested that these sites have lower risk of infection. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001) (1++;1+;1++;1++;1++)

Recommendation 2.0 (Grade A)

*Prolong the frequency in CVC dressing change to once per week if the exit site is maintained clean and dry with dressing intact.*
Evidence:

- In the review studies, there is no significant difference in the CRI rate when the change of CVC dressing frequency from 3 days to 7 days. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Garland et al., 2001) (1++;1+;1+;1+)

- The sponge is effective in sustaining maximally release chlorhexidine onto the skin in the first 3 days followed by steady state release during the next 7 days. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012) (1++;1+;1+;1++;1++)

 Recommendation 2.1 (Grade A)

*Chlorhexidine solution for cleaning exit site is recommended for pediatric patients.*

Evidence:

- Use of chlorhexidine solution has better effect in reducing colonization of organism as compared to povidine –iodine. (Timsit et al., 2009, Levy et al., 2005, Garland et al., 2001) (1++;1+;1++)

- Iodine based antiseptics have potential risk of causing hypothyroxemia in neonates less than 3months old. (Garland et al., 2001) (1++)
Recommendation 2.2 (Grade A)

Use of chlorhexidine impregnated sponge is safe and effective in reducing the risk of CRBSIs in patients with CVC.

Evidence:

- Though Chlorhexidine gluconate can be absorbed through skin, yet no adverse effect were noted from the studies. (Ruschulte et al., 2009, Levy et al., 2005) (1+;1+)

- The sponge is suitable for patient from age 0 or above, excluding premature neonate or low birth weight (<1000g) due to sensitive skin with risk of contact dermatitis or risk of pressure necrosis. (Garland et al., 2001) (1++)

- CHGIS dressing can significantly reduce the rate of catheter colonization and catheter-related bloodstream infection as chlorhexidine if effective in fighting against organisms such as staphylococcus, and canadais which is commonly found in cause of infection. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Levy et al., 2005, Garland et al., 2001, Arvaniti et al., 2012) (1++;1+;1+;1++;1++)

Recommendation 2.3 (Grade B)

Apply CHGIS dressing to CVC exit site as soon as possible after post insertion.
Evidence:

- If after a long period from post insertion, there is risk that infected organisms were implanted at the time of catheter insertion. (Chambers et al., 2005) (1+)

- With earlier application may improve successful rate in preventing infection. (Chambers et al., 2005) (1+)

Recommendation 2.4 (Grade A)

*Transparent polyurethane film dressings are suggested for CVC dressing.*

Evidence:

- Transparent polyurethane dressings can be changed at longer time intervals without increasing the incidents of CLABSIs. (Timsit et al., 2009, Levy et al., 2005, Garland et al., 2001) (1++;1+;1++)

- Transparent dressings allow inspection of CVC site without the need to remove the dressing. (Chambers et al., 2005) (1+)

Recommendation 2.5 (Grade B)

*CVC insertion site are to be inspected by nurse daily or during each shift.*

Evidence:

Inspect catheter site for cleanliness and dressing integrity and assess CVC site for complications such as redness, swelling. (Levy et al., 2005) (1+)
Chapter 5

Implementation Plan

In this chapter, the implementation plan along with the communication and pilot test plan will be formulated.

5.1 Identification of stakeholders

It is necessary to identify the people who can bring influence to others to make changes happen. In order to succeed in introducing new changes and to minimize the conflict in post implementation phase, it is vital to understand who the stakeholders are and that they are closely related. (Murray, Reidy, & Carnevale, 2010)

In the following, the listed are the potential stakeholders:

1. Nursing consultant (NC)

A nurse consultant plays a vital role as she not only have strong clinical backgrounds which requires them to provide suggestion on patient’s care and giving advice to doctors on clinical bases. They also conduct researches, set up or regular renew new protocols in clinical settings under evidence based. They have the highest power to allow or adopt for new changes. Thus, they will be the first to approach to see the possibility of change.
2. Department Operative Manager (DOM), Ward Manager (WM)

DOM and WM are people with the highest authority in the administrative level. They have the authority in resources allocation including both capital and human resources. They have the right to support or banned the project.

3. PICU doctors

As the implementation of the new dressing materials will require the doctor’s diagnosis in cases of suspected CVC-related infection during the implementation of new guidelines, hence, it is necessary to gain support and acceptance from them.

4. Advanced practice nurse (APN) and Ward nurses

APN’s role other than solely based on clinical setting, they also suggests to implemented evidence based proactive and facilitate changes. Whereas ward nurses is another major role in supporting the evidence based practice. They are the main career of the PICU patients and the dressings will be done by them.

5.2 Communication Process and Strategies

A communication plan acts as a tool to enable, to reach and fulfill the goal.

The communication process will start by showing the evidence of the benefits and
effectiveness of the change to the patients. With the use of the table of evidence, it summarizes the six reviewed articles on its aims, objectives and on the implementation which supports the change. It will be first submitted in a formal written proposal and power point presentation to the NC, in return, feed backs will be given.

The support of the NC will then help to seek support from WM and DOM, in decision making. With the assistance from the NC, a formal meeting will be held to promote the new implementation to the management staff which includes all the facts and costs of the whole implementations. It is through gaining their final permission to carry out the innovation.

After gaining the approval, an organizing committee will be formed. Its role is to facilitate in further communicating, implementing, planning and evaluating throughout the study, which is critical to bring smoothness to the study. The NC will act as the advisor for this new implementation development process. Working with the guideline proposer, 10 APNs will be invited to be members of the team which can either be assigned by ward manager or on volunteer bases. They will be the first to attend workshops and exercise on patients. After passing the audit by the NC or the guidelines proposer, they will then each be assigned to a group which consists of the
remaining staff and act as a mentor in provide training, auditing and support to the groups.

There is close relation between nursing and medicine, both parties not only practice side by side but will also interact with one another to achieve the highest outcome of health and well-being to patients. (Sweet & Norman, 1995) The doctors will provide medical advice and diagnosis; therefore it is necessary to facilitate them in better understanding of the new guideline along with the evidence based support for their reference.

With all the 3 parties agreement and finalize on the guidelines, it is then to the APNs on gaining their comments on their acceptance to change. By holding a workshop explaining the dressing usage, providing backgrounds and trial on dressing in dummies, then APNs will held a talk with demonstrations and samples of the dressing to introduce the implementation of the new guidelines, with all the evidence support shown to all ward nurses. As mentioned in the previous chapters, the only difference among the new dressing materials is by having one more step which is applying the CHGIS to the CVC insertion site and prolonging the dressing frequency, all other dressing procedures and techniques will remain the same.
As the PICU settings involves a large number of nursing staff, the workshop will be arranged for APNs first by the ward manager, then all nurses will be assigned into groups with the APNs will act as mentor to further acknowledge the nurses on the techniques, answers to questions and gain feedbacks from nurses. Regular audit will be done the APNs on the assessment of dressing of CVCs. It is through the APNs to act as a channel to rise out the concerns and feedbacks from the staff during regular meetings with the nursing consultant and the project proposer.

5.3 Pilot Study Plan

A pilot study is a small scale primary study which helps to evaluate feasibility, time, cost and adverse events in an attempt to predict an appropriate sample size and improve upon the study design prior to performance of a full-scale research project. Thus, a pilot study should be conducted before actual implementation of the new guideline to identify the possible problems and its feasibility (Polit & Beck 2012).

Design, Setting and Sample

The design of will be conducted using the pretest-posttest method.

The main outcome is based on the effectiveness in nursing compliance and the incidence rate of the catheter related bloodstream infection (CLABSI) which is compared to the existing rates with normal dressings and the rate after the
implementation of the new guidelines. In addition, the secondary outcome is to evaluate the risk of skin irritation in pediatric patients in using CHGIS.

The target setting will be the PICU in a local teaching hospital.

In recruiting subjects, the convenience sampling technique will be used. All the existing and new patients which require insertion of or consist of CVC will be recruited. It is estimated that 20 eligible patients can be recruited in three months.

The procedure

The CVC dressing will be done by ward nurse; they will follow the new EBP guidelines. Regular assessment on CVC site condition and risk of infection will be done by case nurse twice a day and during dressing change.

Outcome measures

The outcome measures include:

1. The feasibility of the new dressing method

2. Nurses’ acceptance levels and compliance.

3. The time required for the new dressing

4. Incidence and severity of skin irritation.
5. Implementation cost.

6. Unexpected difficulties associated with the guidelines.

**Evaluation**

Quantitative and qualitative methods will be used to collect data. The mentor of each group will be responsible for data collection.

The nurse’s acceptance level and its feasibility will be obtained by completing a questionnaire on their satisfaction level of the guidelines under anonymity. Nurses can always raise their comments and suggestion to their assigned mentor. Through regular audits on dressing skills and assessment together with the workshop’s attending rate, the nurse’s compliance level will be measured.

For patients, as the age range consists of verbal to nonverbal patients, opinions will be asked to patients who are communicable via face to face verbal and the nurses will report back. The cost is estimated for the budget planning and unexpected difficulties associated with the guidelines will be measured to provide data and assistance.

Basing on the information gained from the above, the EBP guideline can be modified according to the feasibility if necessary and bring the best outcome.
Chapter 6

Evaluation Plan

After the implementation of the evidence based guideline is supported by the pilot testing, before the actual implementation, an evaluation plan will be conveyed.

The evaluation plan is used to describe how the evaluation will be implemented which includes the resources available, the data will be gathered and a description of roles and responsibility of the stakeholders plus evaluators, it also consist of a timeline for accomplishing the task.

6.1 Outcomes to be achieved

Patient outcomes

The objective of the study is to identify the usefulness of CHGIS in CVC dressing with prolonging the frequency of dressing change when comparing with existing dressing with no sponge in minimizing the incidence rate of CLABSI. Data analyzed from the four selected revised papers with the guidelines suggested in the earlier chapter, the incidence rate is considered to be the primary outcome in determining the effectiveness of the innovation by the rate of CVC colonization because of its strong association with CRSBI without a source. A decrease in CVC relating infection means
the consequences on infection can be prevented and hence decreasing the rate of possible morbidity and mortality, leading to a better quality of life to patients. Thus it is considered to be the primary outcome in determining the effectiveness of the innovation.

The secondary outcome is identifying the risk of skin irritation with the use of CHGIS causing skin dermatitis or discoloration at the insertion site. The skin condition will also be evaluated for assessing the proposed guidelines.

**Healthcare provider outcomes**

For the outcome of the healthcare providers, the new guideline should lessen staff’s workload as the frequency of dressing changed decreased.

The goal of the new EBP guideline is to prove that one small step in changing can make a big difference in bringing a better outcome for both the patients and health care providers. However, without the support and acceptance of the nursing staff, the implementation won’t succeed. With the use of Job Satisfaction Questionnaire adapted from Schneider et al., 2003, the level of satisfaction and acceptance will be assessed in view of the new guideline and trainings provided.
**System outcomes**

The total cost and benefits of the whole implementation including expenditures on dressing materials, training program and manpowered required will be monitored. The benefits from decreasing the extra medical and equipment cost due to CVC infection will be calculated.

**6.2 Nature and the number of clients involved**

The nature of the clients are all pediatric patients aged 0 day and up to 18 years old, which consist of or required to have CVC which included peripherally inserted CVC during their stay in the PICU.

The primary outcome is the incidence rate of CVC infection will decrease with the use of CHGIS. The calculation on the sample size is by using the online program from Lenth, R. V.; the test for one proportion is selected. The level of significant is set at 0.05 whereas the power is fixed at 80%. The estimated sample size is 50. From the selected papers, the attribution rate is about 20%. Thus, it is estimated that the sample size for evaluation is around 60. The sampling will take around 12 months.

**6.3 Data collection and Analysis**

1. Patient outcomes
Incidence of CVC related infection

The subjects who are recruited and received the intervention from the new guidelines will all be under the observation to observe for CVC related infection.

The method for diagnosing CVC related infection include clinical signs such as inspection of the surrounding skin of the CVC on its tenderness, erythema or swelling around the insertion site, physical parameters from blood results such as blood culture and elevated CPR levels and CVC tip culture after removal will further confirm on the source of infection. The two-tailed paired t test is chosen because it evaluates to see if the number of infection would decrease by carrying out the new guidelines.

Severity of skin irritation

The purpose is to determine if the use of CHGIS will causes skin irritation or skin toxicity in pediatric patients. To assess the skin’s condition, the name nurse of the patient is required to assess the dressing site during each shift. During each dressing change to assess the skin underneath the patch for any signs of infection such as redness and swelling, and it should be documented. The one sample t-test is used to test for change of skin condition.

2. Health Care provider outcomes
Satisfaction and Acceptance level

A t-test will be used to determine the level of the health care providers as all participating staff is required to complete a Job Satisfaction Questionnaire at the beginning of and in end of the Guideline implementation period. Also, feedback and comments will be collected from staff from time to time during the whole implementation period.

Compliance

The compliance of nurses will be assessing through regular audit on CVC dressing.

The skills on dressing and skin assessments will be assessed by APNs.

The passing rate of the audit will evaluate and analyzed.

3. System Outcomes

Monthly calculation on expenses related to the implementation of new guideline will be assessed. It will include the additional expenditures on the new dressing material that is the CHGIS and the transparent dressing as compared to old dressing materials. Other cost expenditures include the cost for holding training workshops and materials prepared for staff usage will be included.

Other than that, the time required to perform the dressing will also be estimated so as
to evaluate the difficulty in performing the dressing.

6.4 Basis for an effective change of practice

The aim of the new guidelines is to reduce the incidence rate of CRBSI by implementing CHGIS into CVC dressing and prolonging the dressing frequency. The incidence of CVC infection rate is the primary outcome and is used to determine the effectiveness of the guidelines. From the selected reviews, the decrease in incidence rate of catheter colonization and CLSBSIS ranged from 20-60%. Therefore the new guidelines is significance when it can successfully reduce the incidence rate at least by 20%. (Timsit et al., 2009, Ruschulte et al., 2009, Chambers et al., 2005, Arvaniti et al., 2012)

In view of the healthcare outcome, the target is to gain significant increase in satisfaction among participating staff which is over 95% will able to perform CVC dressing with skin assessment done correctly which is the usual compliance rate in nursing audit.

6.5 Dissemination and Measure to sustain the change

To gain the support from stakeholders in working with the new guidelines, it is necessary to provide continuous communication in order to sustain the change. It is through their comments and feedbacks on the guidelines which then can be reviewed
and improved for better compliance.

With the evaluation results, a formal report will be made to provide information on effectiveness and practicability of the new guideline in the target settings for the management stakeholders such as DOM and WM so as to continually gain their support in long term.

The results will also be disclosed to all the staff during ward meetings to show their achievements in the development of the new guideline and the benefits they bring to patients and ward, so as to increase their satisfaction level and thus will continue on the guideline.
APPENDICES

Appendix 1

Search Strategy and Results

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<th>Database</th>
<th>Pubmed</th>
<th>ProQuest</th>
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<tr>
<td>1 Central venous catheter</td>
<td>13803</td>
<td>20282</td>
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<tr>
<td>2 Chlorhexidine dressing</td>
<td>260</td>
<td>953</td>
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<tr>
<td>3 Chlorhexidine impregnated sponge</td>
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</tr>
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## Appendix 2

### Table of Evidence

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Patient characteristics</th>
<th>Interventions</th>
<th>Comparison</th>
<th>Outcome measures</th>
<th>Results (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timsit et al., 2009</td>
<td>Adult in ICU requiring an arterial catheter/CVC/both inserted for 48 hours or longer</td>
<td>Use of CHIS followed by standard dressing of CVC. Dressing changed every 3-7 days</td>
<td>Standard dressing of CVC (cover exit site with tegaderm)</td>
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<tr>
<td>RCT (I++) 1</td>
<td>Mean Age: 62, 1052 male, 584 female (n=3778 catheters)</td>
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<td>1.CC</td>
<td>HR, 0.36 (0.28-0.46)</td>
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<td>2.CRBSI</td>
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<td>Adults admitted for chemotherapy of hematological malignancies. Expected to have their CVC for more than 5 days</td>
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<td>Standard dressing of CVC</td>
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<td>Chambers et al, 2005</td>
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<td>Standard dressing of CVC</td>
<td>Exit-site/tunnel/tip infections</td>
<td>OR, 0.13 (0.04-0.37)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Had tunneled cuffed CVC</td>
<td>followed by</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Median age: 49</td>
<td>standard dressing of CVC</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>35 male, 60 female</td>
<td>Dressing changed once every week</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(n=112 catheters)</td>
<td></td>
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</tr>
<tr>
<td>Levy et al, 2005</td>
<td>Pediatric patients admitted to cardiac ICU with CVC &gt;48 hours</td>
<td>Use of CHIS</td>
<td>Standard dressing of CVC</td>
<td>CRBSI</td>
<td>RR, 0.61 (0.37-1.0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Age: 0-18 y</td>
<td>followed by</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>72 male, 73 female</td>
<td>standard dressing of CVC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dressing changed only when bleeding, oozing or signs of exit site infection occurred</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.CC</td>
<td>IR: CH 5.4%, control 4.2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.CRBSI</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RR, 0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.5-0.9)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IR: CH</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.2%</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garland et al, 2001</td>
<td>NICU neonates with PICC or</td>
<td>Use of CHIS</td>
<td>Standard dressing of</td>
<td>CC</td>
<td>RR, 0.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>followed</td>
<td></td>
<td></td>
<td>(0.5-0.9)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
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</tr>
</tbody>
</table>
tunneled CVC for at least 48 hours
401 male, 304 female

by standard dressing of CVC
Dressing changed every 7 days

CVC (cover with transparent polyurethane dressing)

2.CRBSI
RR, 1.2
(0.5-0.27)
0.65

Arvaniti et al., 2012

RCT (1++)
Adult patient in ICU
Required CVC > 3 days
Median age: 59
342 male, 123 female

Standard catheter with CHIS
Dressing changed every 3 days

Standard catheter with standard dressing of CVC

1.CC
2.CRBSI
HR, 1.21
(0.56-2.61)
HR, 0.65
(0.23-1.85)
0.42

Remarks:
1 Level of Evidence as defined by Scottish Intercollegiate Guidelines Network (SIGN 50)
CHIS: chlorhexidine impregnated sponge
CVC: central venous catheter
CC: catheter colonization
CRBI: catheter related bloodstream infection
HR: hazardous rate
RR: relative risk
OR: odd ratio
IR: infection rate
CH: chlorhexidine
## Appendix 3

### Table of Quality Appraisal

<table>
<thead>
<tr>
<th>Critical Appraisal Skills Programme (CASP)</th>
<th>(1) Timsit et al., 2009</th>
<th>(2) Ruschulte et al., 2009</th>
<th>(3) Chambers et al., 2005</th>
<th>(4) Levy et al., 2005</th>
<th>(5) Garland et al., 2001</th>
<th>(6) Arvaniti et al., 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Addresses an appropriate and clearly focused question.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>2) The assignment of subjects to treatment groups is randomized</td>
<td>Yes</td>
<td>Yes</td>
<td>Can’t say</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>3) An adequate concealment method is used</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>4) Subjects and investigators are kept “blind” about treatment allocation</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>5) The treatment and control groups are similar at the start of the trial</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>6) The only difference between groups is the treatment under investigation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>7) All relevant outcomes are measured in a standard, valid and reliable way</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>8) What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?</td>
<td>7.7%</td>
<td>0%</td>
<td>2.1%</td>
<td>0%</td>
<td>0%</td>
<td>19.1%</td>
</tr>
<tr>
<td>9) All the subjects are analyzed in the groups to which they were randomly allocated (intention to treat analysis)</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>10) Where the study is carried out at more than one site, results are comparable for all</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Appendix 1

**POTENTIAL COST SAVINGS**

*The material cost of the implementation*

<table>
<thead>
<tr>
<th>Items</th>
<th>Costs</th>
<th>Subtotal 3-day scheduled changes</th>
<th>Subtotal 7-day scheduled changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHGIS</td>
<td>Cost of each CHGIS: HK$30</td>
<td>HK$300/month</td>
<td>HK$210/month</td>
</tr>
<tr>
<td>Standard Dressing#</td>
<td>Cost per dressing change: HK$70</td>
<td>HK$700/month</td>
<td>HK$280/month</td>
</tr>
<tr>
<td>Standard dressing + CHGIS</td>
<td>HK$70+30 = HK$100/dressing change</td>
<td>HK$1000/month</td>
<td>HK$400/month</td>
</tr>
<tr>
<td>Standard dressing(3-days) VS CHGIS dressing(7-days)</td>
<td>Net: HK$700-HK$400 = HK$300  ↓ 42.8% in dressing material costs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

# Standard Dressing materials including chlorhexidine antiseptics, disposable dressing set tegaderm
Material costs for Non implementation

Cost of treating CRBSI

<table>
<thead>
<tr>
<th>Items</th>
<th>Cost</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median cost of treating CRBSI</td>
<td></td>
<td>$7000</td>
</tr>
<tr>
<td>Extra hospital stay for treating CRBSI(10days/case)</td>
<td></td>
<td>HK$3300x10 = HK$33000</td>
</tr>
<tr>
<td>Total:</td>
<td></td>
<td>HK$40000</td>
</tr>
</tbody>
</table>

The cost of treating CRBSI can provide CHGIS dressing for approx.:

HK$40000 (cost of treating CRBSI) / HK$400 (CHGIS dressing/month)

=100 patients
References:


