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Effect of an Educational Program on critical care Nurses Knowledge and practice regarding Central line associated bloodstream infection prevention (CLABSI) in Jenin Hospitals: A Quasi-Experimental Study.

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This thesis was submitted in partial fulfillment of the requirements for the Master's degree in Critical care Nursing.

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Thesis Approval

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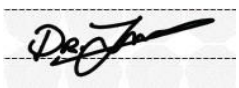
3. Dr. Jamal Qaddumi: External Examiner	

Declaration

I Declare that this study entitled with:

"Effect of an Educational Program on critical care Nurses Knowledge and practice regarding Central line associated bloodstream infection prevention (CLABSI)in Jenin Hospitals: A Quasi Experimental Study."

And the work which provided in this thesis, unless otherwise referenced, is the researcher own work and has not been submitted elsewhere for any other degree or qualification.

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Dedication

In the name of Allah, the Most Gracious, the Most Merciful

Praise be to Allah, who created land, created water and earth, and created everything with an atom. The crawling of ants does not lose sight of Him at night when it spreads. He chose Adam, then pardoned what happened, and sent Noah, who built the ark, and praise be to Allah , the Creator of darkness and morning, the cause of guidance and righteousness, and the Destine of sorrows and joys. He exalted and exalted, and dispersed and gathered, and connected and cut, and forbade and permitted, and reigned and determined, and folded and spread, and created human beings and blew away the winds. Praise be to Allah, who strengthened the resolve so that the winds would soften for them, and our windows seemed to be a lamp with which the morning would be illuminated. Praise be to Allah, who gave us and illuminated our world and extended our guidance so that we would be a mirror for all those who are guided, and in the depths of the night we appear to the eyes to be a lamp, and the prayer of my Lord is to the Prophet, the teacher of this world, guidance, who removed misguidance and advanced knowledge until it became a goal. Then, after that, he gave peace. His letters lowered their heads in shame and a greeting filled with love and pride for every martyr who offered his soul for the sake of the Lord...

To the one who taught me that the world is a struggle and its weapons are science and knowledge, to the one who instilled in my soul good morals, my first supporter in my journey, my support, my strength, and my refuge after Allah. I have my pride and Pride (my father).

To the one under whose feet Allah placed Paradise, whose heart embraced me before her hand, who kept me awake in adversity by praying to the tender heart and the candle that was for me in the dark nights, the secret of my strength and success, and the lamp of my path to the glow of my life (my mother).

Dedicate this work...

Acknowledgement

First and foremost, I thank ALLAH, by whose blessing I was able to complete this research. And I would like to express my deepest gratitude and appreciation to my supervisor: Dr. Imad Fashafsheh and to my upstanding examiners: Dr. Bahaeddin Hammad and Dr. Jamal Qaddumi for their support, understanding and patience while preparing and presenting this research. I would like, also, to address our appreciation to our AAUP teachers and instructors who help, instruct and support us during our university years I address my thankfulness to my family: my mother for her unconditioned help and love, my father for his understanding and brothers and sisters for their tremendous support and care.

Yazan Yasin.

Abstract

Background: the intensive care Unit is frequently plagued by central Line Associated Blood Stream Infections, which stand as one of the most common healthcare associated infections. The nurse assumes a pivotal position in ensuring the implementation of infection control protocols specifically regarding insertion, maintenance and follow-up care procedures of Central venous catheter, optimal nursing performance is achieved through adherence to evidence-based protocols and the consistent enforcement of educational programs.

Aim of study: this study aimed to assess the effectiveness of implementing an evidence-based educational program on critical care Nurses Knowledge and practice regarding Central line associated bloodstream infection prevention (CLABSI) in Jenin Hospitals.

Methodology: The research is quantitative study, quasi experimental. The study involved a convenient sample with a total of 70 Critical Care Nurses who working in Hospitals that located in Jenin city (Jenin governmental hospital, Alrazi hospital and Ibn-Sina hospital) where one group of participated nurses were assigned: (pre-test & post- test measures) was adopted and the level of knowledge and practice for assigned nurses were assessed before and after educational program, study was carried out over five months based on similar previous studies and knowledge retention considerations, in the period from February 2024 to the end of July 2024.

Result: the result showed there is a statistically significant different in knowledge and practice level after educational program, the mean knowledge score increased significantly from 4.25 ± 1.37 (range: 0–15) before the intervention to 13.05 ± 1.58 after the intervention

indicated by the paired t-test ($t=35.35$, $P<0.001$) and the practice score showed a notable increase, rising from a mean of 2.45 ± 1.03 (range: 0–15) pre-intervention to 14.85 ± 2.09 post-intervention. Also, the paired t-test result ($t=45.75$, $p<0.001$) confirms that this improvement was highly significant.

Conclusion: The study demonstrated a significant improvement in nurses' knowledge regarding the prevention of central-line bloodstream infections (CLABSI) following the implementation of the evidence-based educational program. Additionally, the findings revealed variations in clinical practices, which, while indicating an overall improvement in nursing care, also highlighted the need for greater adherence to established prevention protocols, particularly in high-usage clinical areas.

Key word: Central line, central line associated blood stream infection (CLABSI), Educational program, Nurse, Critical care Nurses, Infection Control, evidenced based practice.

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List of Definitions of Abbreviations

Abbreviation	Meaning
CVCs	Central Venous Catheter
CLABSI	Central Line Associated Blood Stream Infection
IV	Intra -venous
ICU	Intensive Care Unite
CVL	Central Venous line
HAIs	Healthcare-associated infections
CAUTI	Catheter Associated Urinary Tract Infection
RCT	Randomize Control Trials
INICC	the International Nosocomial Infection Control Consortium
CDC	Central Disease Control
MOH	Ministry of Health
CCU	Coronary Care Unit

Chapter One: Introduction

1.1 introduction

Central venous catheters (CVCs) serve a critical purpose in the intensive care unit (ICU) by facilitating intravenous therapy and central venous pressure monitoring for critically ill patients. (Haddadin et al., 2022). there is other various clinical indication for CVC that commonly used in ICU setting including rehydration, blood sample withdrawal, administration of drug, parenteral nutrition, blood and blood product and monitoring of central venous pressure (Elbilgahy.,2019).

However, the incidence of complications associated with central venous catheter insertion remains high, which contributing significantly to preventable morbidity and mortality (Hanauer et al.,2020). They include catheter infection, pneumothorax, hemothorax, and guidewire loss (Lennon et al.,2012). Healthcare-associated infections (HAIs) are adverse outcomes commonly observed in healthcare settings, these infections typically manifest either 48 hours after a patient's admission to the hospital or within 30 days of receiving treatment (Larry et al., 2021). Among the most frequent HAIs is Central Line associated blood Stream infection (CLABSI), which significantly contributes to healthcare-associated bacteremia. Unfortunately, such infections lead to increased morbidity, mortality, prolonged hospital stays, and escalated medical costs (Larry et al., 2021).

To be classified as a CLABSI, the infection must be confirmed through laboratory tests and must not be associated with an infection at another site, it typically occurs within 48 hours after the placement of a central line (Haddadin et al., 2022).

CLABSI occurs when these 3 criteria exist: Clinical signs of infection: fever, rigors, altered mental status, hypotension; no alternate source of bloodstream infection; positive blood culture from a peripheral vein with any one of the following: catheter tip/segment culture that matches organism grown from blood; at least threefold higher number of organisms grown from the catheter versus the peripheral blood culture on simultaneously drawn cultures; and growth from the catheter-drawn blood culture occurs at least 2 hours before growth of the same organism from a percutaneously-drawn blood culture (Mermel et al.,2009).

In addition, CLABSI often occurs in patients being treated in an (ICU), and is a leading cause of death in ICU patients (Chi,2020). the frequency of CLABSI cases in ICUs still increase at a worrying proportion which also associated with higher rates of morbidity and mortality, longer hospitalizations, and greater overall healthcare costs (Rajandra et al.,2025).

As well, the risk of contracting an infection is determined by the predisposing factors present during ICU stay, which include surgery, interaction with other patients and hospital staff, and the hospital climate (Shao et al., 2019)

Furthermore, CLABSI present a particularly concerning scenario, as they carry a mortality rate ranging from (12%) to (15%), with an odds ratio for in-hospital death as high as 2.75 (Toor et al., 2022). this infection can lead to heightened patient illness,

increased mortality rates, and a considerable rise in healthcare expenses (Pearse et al., 2021)

The prevalence of CLABSI is specifically higher in resource-limited settings, such as upper middle-income countries, where healthcare infrastructure and infection-prevention practices vary (Vilar et al.,2017).

Also, according to study conducted in Jenin hospital, which assessed the incidence of HAIs, study raveled that half of patients (55%) in hospital developed HAIs which considered relatively high, same study finding pointed-out that (13.6%) of HAIs was classified as CLABSI (Nazzal,2021).

Among healthcare professionals, nurses represent a critical and sustained role in managing (CVCs), participating in both the insertion process and subsequent maintenance of these devices Consequently, their direct involvement positions them particularly to implement critical preventive strategies against CLABSI (Myatra,2019).

Also, nurses role in continues education can directly affect on prevention regarding CLABSI by accessing prevention resources within the CDC Implementation Guides and performing interventions to address identified gaps (Snyder et al.,2021).

Moreover, according to interventional study conducted in United states (US) assessed the effectiveness of educational program and bundle polices on CLABSI rate pointed out that nurses adherence to protocols and continues education eventually achieve (4%) reduction in CLABSI rate (2.2 per 1,000 device days) compared to the baseline period (Simoneaux &Guerra,2022).

CLABSI is a highly prevalent problem in the intensive care unit. These infections are associated with over 28,000 deaths yearly and cost over $2 billion. Only through best practices, protocols, checklists, and establishing a culture of patient safety in healthcare institutions can one reduce CLABSI to zero (Haddadin, 2021).

1.2 Problem Statement

CLABSI is one of the most common hospital-acquired infections among adult patients resulting in excess mortality, increased hospitalization stays and increased health care costs (Haddadin et al., 2022).

Furthermore, CLABSI result in prolonged hospitalizations, escalating healthcare expenses, and an increased risk of mortality, approximately 250,000 cases of bloodstream infections occur annually, with the majority linked to the presence of intravascular devices. In the US, the estimated CLABSI rate in ICUs is 0.8 per 1000 central line days. On a global scale, data from the International Nosocomial Infection Control Consortium (INICC) covering 703 intensive care units across 50 countries, reported a CLABSI rate of 4.1 per 1000 central line days (Rosenthal et al., 2020).

Also, according to study conducted in US revealed that the gaps in infection prevention practices regarding CLABSI that should be addressed including: the appropriate use of central lines, proper insertion of central lines, proper maintenance of central lines and the need of implementing continues evidenced based educational strategies (Snyder et al.,2021).

In addition, a multicenter cross-sectional study pointed out that there are a significant proportion of nurses who considered to have " poor knowledge " regarding CLABSI prevention polices, particularly (72%) of studied nurses were unfamiliar with the guidelines which reflecting the need for educational intervention (Muschitiello et al.,2024).

Moreover, Across CLABSI assessments it's have been demonstrated that nurses lack of adherence to polices and protocols concerning CLABSI prevention is also crucial aspect and its related to several aspects the most influencing ones including: the need for advocates, leaders, or influential individuals who actively promote, support, and drive initiatives to reduce CLABSI by performing continues education and Rewarding the dedicated nurses (Snyder et al.,2021).

Furthermore, alongside the consideration of nurses level of practice and knowledge regarding CLABSI polices, Educational interventions should be implemented to address the gaps regarding the prevention of CLABSIs and to ensure that nurses use evidence-based prevention strategies (Muschitiello et al.,2024).

1.3 Significant of study

There are only a few studies that have evaluated nurses' knowledge for the prevention of CVC related infections in a Palestine governorate (Nazzal,2021).

Also there were variations in nursing practice and absence of a uniform protocol for CLABSI prevention among nurses across the ICUs (Goldman et al., 2021), moreover multiple Randomize Control Trials confirm the importance and the positive effect of educational program regarding nursing practice in general and CLABSI specifically, like a quasi-experimental research conducted by (Zeyada et al., 2021).Concerning CLABSI control, research pointed out that the adoption of nursing educational guidelines has a beneficial effect, not only in enhancing nurses' understanding and proficiency in CVC care but also in reducing the incidence of CLABSI , so As a suggestion, it is advisable for nurses to participate in in-service training programs to boost their knowledge and further enhance their skills in this regard.

Another quasi-experimental study discussed CLABSI with regard to education of nursing staff to reduce the incidence of (CLABSI), emphasized that Educational interventions on hand hygiene can have a significant impact in CLABSI control particularly in ICUs with a high infection rate and resource constraints (Acharya et al., 2019).

In addition, this study conducted to be subsequently applied as a suggestion for Ministry Of Health (MOH) hospitals, universities , research centers and other hospitals in Palestine, which also reported by previous studies that highlighted the need for following a protocol for CLABSI prevention based upon current evidence-based guidelines (Dunstan et al., 2019).

in the other hand some hospitals in Palestine are recently started to apply bundle for infection prevention regarding CLABSI in there ICUS, but this can't be sufficient in the aspect of fully control of CLABSI ,periodic educational program are needed to fully understand the optimal care that should be provided regarding catheter related infection prevention and to create a nursing team who are updated in knowledge and practice aspects that should be provided in ICU (Clavier et al., 2019).

1.4 Aim of the study

1-To determine the relationship between sociodemographic data of critical care nurses and their knowledge and practice regarding CLABSI pre and post conducting of the educational program.

2-To assess level of knowledge regarding CLABSI prevention before and after educational program.

3-To assess nurses practice regarding CLABSI prevention protocols before and after the educational program.

1.5 Research Questions

1. is there a difference in the level of knowledge regarding CLABSI prevention of ICU staff nurses before and after the educational intervention?

2. Is there a difference in the level of practice regarding CLABSI prevention of ICU staff nurses before and after the educational intervention?

3. Is there a relationship between level of knowledge and practice regarding CLABSI prevention for ICU nurses and selected demographic data before and after the intervention?

1.6 Definitions of variables

- Independent Variable: Educational Program on CLABSI Prevention.
- Dependent variable: knowledge, practice.

1.7 Theoretical Framework

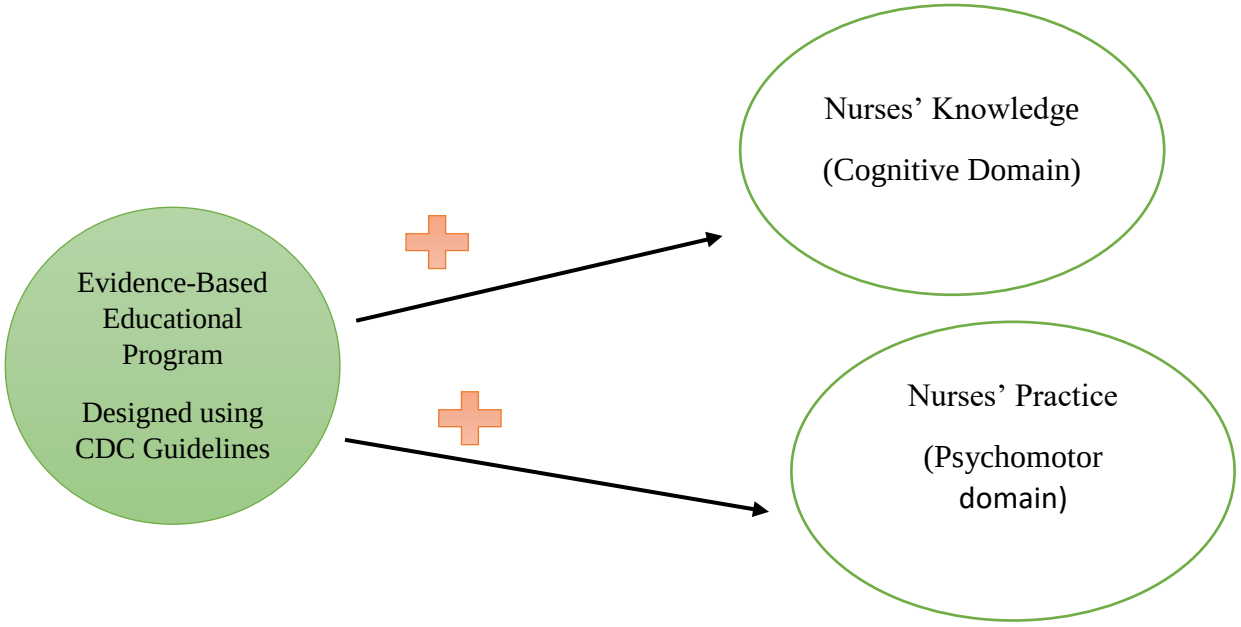
The study is founded on Benner's Novice to Expert theory and Kirkpatrick's Four-Level Training Evaluation Model. Benner's theory holds that nursing expertise is built upon the integration of experimental learning and structured education, progressing from novice to expert (Benner, 1982). This aligns with our study which focuses on enhancing nurses' knowledge and practice through targeted education.

In addition, Kirkpatrick's model assesses the effectiveness of training by exploring four levels: reaction, learning, behavior, and result (Kirkpatrick's ,1959). This framework provides a tool for these theories support the hypothesis that evidence-based education

bridges gaps in clinical competence and encourages adherence to CLABSI prevention protocols by evaluating nurses' knowledge (learning) and practice.

1.8 Conceptual Frame Work

The relationship between nurses' knowledge and practice and evidence-based educational program is demonstrated in the conceptual framework. The program, which is designed using CDC guidelines, provides structured content on CLABSI prevention. The framework assumes that the intervention directly enhances knowledge (cognitive domain) and practice (psychomotor domain) as nurses understand protocols., The process is facilitated through continuous enhancement and hands-on training. (figure.1)



1.8.1 Figure1: The relationship between nurses' knowledge and practice (conceptual frame work)

1.9 Operational Definition

1. **CLABSI**

   In this study, CLABSI was defined per CDC criteria, requiring a CVC in place >48 hours, positive blood cultures, and exclusion of secondary sources via clinical review and imaging, in the absence of any other identifiable source of infection. This operational definition is consistent with recognized guidelines and emphasize the connection between catheter placement and subsequent bloodstream infection (CDC,2017)

2. **Nurses-knowledge**

   Nurses' knowledge denotes the theoretical understanding and awareness of evidence-based protocols for CLABSI prevention, the questionnaire was adapted from the CLABSI Knowledge Assessment Tool (elbilgahy et al.,2019) including guidelines for catheter insertion, maintenance, and early detection of infections. It is measured quantitatively using a standardized assessment tool administered before and after the educational program.

3. **Nurses'-Practice**

   Nurses' practice encompasses the actual clinical performance and adherence to recommended CLABSI prevention measures. In this study, it is evaluated using an observational checklist the checklist tool was also adapted from the CLABSI observational Tool (elbilgahy et al.,2019) that captures the extent to which nurses implement proper procedures (e.g., aseptic technique, correct dressing changes) when caring for patients with central lines.

Summary

After reviewing the previous chapter, it can be verified that presented study problem statement was clear and reflected a set of aspect that emphasizing the need of educational program in order to improve knowledge and practice in MOH hospitals. In addition the conceptual framework clarified all variables and pointed out that those variables (educational program, knowledge, practice) were improved as study hypothesis suggested.

Chapter Two: Literature Review

2.1 Introduction

In this chapter, the search was performed in different international databases including Google Scholar, PubMed, Med Line, Science Direct, and Pub Med. Databases were accessed from different country. The following keywords was "CLABSI", " education program", "adult ICU nurses " these words were searched in combination with each other and in separated form. For example, during the initial search, the keyword "CLABSI" was combined with "educational program" and 'ICU. Later, during each new search a new keyword added until including all keywords in the last search. However, the searching process was limited to the following inclusion criteria: full text, written in English, published between 2019 and 2025.

2.2 Previous studies

This chapter provide a review of literature that is relevant to CLABSI prevention strategies. This review was used to guide the development of the plan for this administrative project. Search methodology, quality appraisal and research related to CLABSI prevention will be presented. In addition, a summation of dominant themes found in the literature is presented.

A Retrospective study conducted by (Alrebish et al., 2022)at a public hospital in Unaizah City, Saudi Arabia, the aim of the study was to investigate the prevalence of healthcare-associated infections and compliance to HAI preventive efforts pointed out that

CLABSI was the most prevalent device-associated HAI, with a 15.9 incidence rate per 1000 central venous catheter days, which reflect high numbers of CLABSI that should be controlled furthermore, study reported that the use of the HAIs preventive package decreased the rate of CLABSI from 2.0 cases per 1000 central line days to zero cases per 1000 central line days.

Another study done by Hammoud et al. in (2020) performed a systematic review regarding the use of educational interventions for the prevention of healthcare-associated infections. A total of 26 studies focusing on a variety of educational programs showed that implementation of educational interventions with a variety of strategies may result in significant reduction in CLABSI rates.

As well, a systematic review conducted by Kerr et al. in (2020) pointed out that Educational programs not only improving practice and knowledge but also aimed at improving nurses' communication skills with patients are demonstrating potential benefit including that educational programs also could made a better communication between patient and nurses which subsequently and positively effect on any targeted outcome that health sector provided.

Furthermore, a stepped wedged cluster-randomized unit clustered into 4 sequences research conducted by (Reynolds et al.,2021) with respect to prevention of central line associated bloodstream infections described that Utilizing evidence-based strategies that are customized to local factors can enhance adherence to evidence-based practices. Methods such as educational outreach visits and audit and feedback have proven effective in altering clinician behavior by offering performance feedback and tailored education based on their experiences. Looking ahead, it may be necessary to schedule additional booster sessions with

educational outreach visits and audit and feedback strategies to ensure the ongoing sustainability of this intervention. Moreover, champions who were part of the study and nursing leaders from the units will be invited to engage in focus groups to assess the effectiveness of the implementation strategies employed in the study. This input will provide valuable insights to support the continued use of these implementation approaches.

In addition a retrospective study conducted by Myatra (2019) emphasized that CLABSI bundle is a structured way of improving patient care and outcomes. The CLABSI bundle compiles evidence-based practices that are critical elements of care to provide an organized method of enhancing and surveilling the delivery of clinical care practices the importance of bundle education with each element is critical in ensuring all care steps are delivered to support this patient safety initiative.

Moreover, A single-center pilot RCT of ICU adult patients conducted by (Mitchell et al., 2020) for patient requiring CVL to test the feasibility of a randomized controlled trial (RCT) comparing standard care with three dressing and securement products, to prevent CVL failure. Secondary aims included comparing dressing and securement products on CVL failure, microbial colonization and intervention costs emphasized that integrated-securement-dressing is the highest superiority to test further as it had the lowest failure rate, which will provide for our study that united- dressing on CVL is a crucial aspect that can prevent microbial settlement which will subsequently decrease incidence of CLABSI rate.

Also, a non- randomized controlled trail conducted by (Sedrak et al., 2019)for comparing "Bundle precautions" to non- Bundle precautions pointed out that "Bundle precautions" should be regularly used during CVCs placing and also emphasize that Use of "Bundle precautions" during CVC insertion likely lowers medical costs and decreases the

incidences of Central line-associated bloodstream infections , bundle precautions considered one of the crucial educational pattern, that effect on CLABSI control.

Furthermore A Single-center pilot randomized controlled trial conducted by (Marsh et al., 2022)on Adults patients who admitted to intensive care requiring a central venous catheter for more than 72 hour, emphasizes that adequately powered randomized controlled trials are needed to test the infection prevention hypotheses, Patients were randomized to get standard central venous catheter dressings with/without poly-hexamethylene biguanide discs, study draw attention about using Poly-hexamethylene biguanide appear safe for central venous catheter infection prevention also study mentioned that Feasibility of a large efficacy trial was established with some modifications to screening processes.

In Addition An Observational, pre-post design study, conducted by (Clavier et al., 2019) in the surgical ICU of a tertiary care hospital regarding the connectors replaced all disposable caps used on infusion stopcocks and ramps and compared by needle-free connector. The primary parameter was to compare the incidence of catheter-related infections between the “before” period and the “after” period, study pointed out that needle-free connector are compatible, prolonged and safe use in ICU, but future prospective works will be able to confirm the value of these connectors for catheter related infection, which emphasizes that updated methods to prevent CLABSI are continuously provided in evidenced based way, so periodic educational program regarding those updated articles are needed.

As well A quasi-experimental study design, with a historical control and a prospective intervention for 13 months which conducted by (So et al., 2019), highlight that Additional patient care, such as the care of central venous catheter and the use of portable ventilator at

a patient's bedside are directly effect on deflecting ICU readmission in patients with respiratory problems after ICU discharge. It also highlighted the competent role of ICU nurses in planning and leading the implementation of a multidisciplinary program which reflect the importance of being updated nurse regarding the optimal care provided in ICU in order to improve patient quality of care.

In addition A narrative review of the literature conducted by (Dunstan et al., 2019) explored the current understanding of safety culture within Australian adult ICUs , The review revealed that ICUs characterized by conflicting and non-punitive safety environments were at a higher risk of (CLABSI) compared to those with a more positive leadership climate, Moreover, the research also examined how safety tools were assessed in terms of their impact on various aspects: the structural components, encompassing safety culture and healthcare protocols; the procedural aspects, focusing on improvements related to tool implementation; and the ultimate outcomes, including mortality rates, average length of stay, the incidence of (CLABSI), The findings indicated a noticeable and substantial enhancement in the safety climate with the consistent utilization of these safety tools, so as summary educational program, bundle control of CLABSI are absolutely considered from safety tool in ICU that should be used.

Furthermore A quasi-experimental study conducted by (Acharya et al., 2019)with regard to education of nursing staff to reduce the incidence (CLABSI), insist that Educational interventions on hand hygiene can have a significant impact on CLABSI control particularly in ICUs with a high infection rate and resource constraints.

Moreover, an interventional concerning the effect of optimal hand hygiene adherence in reducing CLABSI underscored that there was a significant reduction in the CLABSI rates

from 12.5 to 8.6 per 1000 catheter days before and after the education meeting This study outline the value of an educational intervention in reducing the CLABSI rates.

Another quasi-experimental research conducted by (Zeyada et al., 2021) concerning CLABSI control, research pointed out that the adoption of nursing educational guidelines has a beneficial effect, not only in enhancing nurses' understanding and proficiency in central line care but also in reducing the incidence of central line-associated bloodstream infections. As a suggestion, it is advisable for nurses to participate in in-service training programs to boost their knowledge and further enhance their skills in this regard.

Moreover, with respect to CLABSI knowledge assessment, a cross-sectional study in Poland also emphasized a that ICU nurses have sufficient cognition and knowledge regarding optimal care that should provide to reduce CLABSI rate and pointed out that the continuous training of personnel in this field should be provided in order to have satisfactory knowledge level same as Poland hospitals. (Dyk et al.,2021)

Summary

The researchers emphasized the necessity of establishing a protocol based on previous literature for CLABSI prevention that line up with the latest evidence-based guidelines and pointed out that those educational programs upgrading nurses' practice and knowledge from the moment of insertion until the following up and care on those CVCs. and also highlighted that those educational programs should be done periodically not just for once. Consequently this study can be provided for Palestinian MOH as suggestion in order to provide those interventions , also the compliance and effectiveness of implementing an evidence-based educational program are depending on multifactor aspects including, providing a continuous educational sector in health care systems that offering regularly a lectures and updated guidelines regarding nursing care, employing a quite enough numbers of nurses specially in ICU with an acceptable nurse to patient ratio, will help providing optimal care for patients.

Chapter Three: Research Methodology

3.1 Introduction

This chapter provides abbreviated description of the research methods. It involves the study's design, population, and sampling. The sampling methods, inclusion and exclusion criteria, site and setting, research instruments, data collection, data analysis method, and ethical considerations were all discussed.

3.2 Study Design

The research is quantitative study, quasi experimental. Where one group of participated nurses were assigned: (pre-test & post- test measures) was adopted and the level of knowledge and practice for assigned nurses were assessed before and after educational program.

3.2.1 Study Site and setting

The research was carried out in a separated room that already prepared for educational purposes in each hospital , the room in Jenin governmental hospital can contains 40 nurses and its well prepared , in ibn sina it’s a hall particularly prepared for continues education and can contain a large number of health care providers (around 80) and alrazi hospital have small room that could contain 20 person , other details regarding educational program phase is discussed in "interventional phase".

3.3 Population and sampling

The study was carried out in three hospitals (Al-Razi, Jenin governmental and Ibn-Sina) which they are part of jenin city hospitals that involve Jenin hospital consists of 2 ICU units which involve 35 ICU nurse, Ibn- Sina hospital consist of ICU and (Coronary Care Unite) CCU which involve 17 ICU nurse and 13 CCU and Alrazi consist of ICU and CCU that involve 18 Nurse. The rest of Nurses in critical care and CCU in Al-Razi and Ibn Sina were in part time contract (excluded), that made total number of participant (70), A convenient sample of 70 nurses was included in the study and a paper questionnaire was distributed, this type of sample is the most suitable in our case since it focuses on educational program for ICU nurses who meet the pre-determined inclusion and exclusion requirements for this study (ICU. Nurses who are working in Jenin city) during a specific time period Nurses who are officially in team staff in those ICU has been selected.

Questionnaire was explained appropriately alongside all research phases (pre-post questionnaire, educational program) then it was distributed for all participant by researcher in rounds that included mornings and evening shifts, which covers all participants in targeted hospitals.

3.3.1 Sample size calculation

The sample size for this study was determined using G*Power software for a paired t-test (pre-post design). A priori power analysis was conducted to ensure adequate statistical power. The following parameters were set: a two-tailed test, an α error probability of 0.05, and a power (1-β) of 0.80 to detect a meaningful difference in nurses' knowledge and practice regarding CLABSI prevention. Based on previous research, a medium effect size (dz = 0.5) was assumed. The analysis yielded a required sample size of 54 participants (27 paired). To account for potential dropouts or missing data, the final sample size was adjusted by 10–20%, resulting in a target of 60–70 participants (30-35 paired) to ensure the study's reliability and validity

3.4 Inclusion and Exclusion Criteria.

Inclusion criteria

- Adult ICU registered nurse
- Working in Jenin GOV, Al-Razi and Ibn- Sina-ICU hospital

Exclusion Criteria

- Any nurse who are not working in the ICU (Ward)
- Neonatal ICU nurses are excluded

3.5 Study Tool

The researcher adopted tool which is valid and reliable for data collection, this tool has been adopted from published research regarding CLABSI control which developed by (elbilgahy et al.,2019) the permission to use the tool was obtained after contacting with her via email.

Moreover, the questionnaire included sociodemographic information involving gender, age, work related information including years of experience, attendances of previous educational programs.

The educational program was adopted from an open-access Central Disease Control (CDC) guideline regarding CLABSI prevention list, which are valid and reliable, an educational intervention involving nurses were intended to reduce the catheter related infection rates, evaluation of intervention pre and post was carried out to assess the benefits.

PART 1: Profiling of participants including: Demographic Data (age, sex,), work related factors (level of education, years of experience and previous attendance) of training program about CLABSI prevention.

Part 2: The survey aims to assessing nurses' knowledge related to frequency of CVC change understanding regarding various aspects of central venous catheter (CVC) management. These aspects include the frequency of CVC change, the procedure for replacing CVC over a guide wire, the use of antiseptic-coated CVCs, skin antisepsis practices, the application of antibiotic ointment, the choice of dressing type, the recommended frequency of dressing change, the disinfection of the catheter hub, and administration set management.

Nurses' responses were scored as follows: Each correct answer was receiving a score of 1, while an incorrect answer was scored as 0. Based on their scores, nurses were

categorized into three groups based on 2 aspect, the first one is the adopted tool categorization guide (elbilgahy et al.,2019) and second aspect is based on the nature of participant responses: those with good knowledge if they correctly answered ≥80% of the questions, those with average knowledge if they answered ≥75% and < 80% correctly, and those with poor knowledge if their score was ≤70%.

Part 3: (daily care observational checklist) An observational checklist for central line insertion and daily care was provided created by (Elbilgahy et al., 2019) after reviewing evidence-based practices, this checklist was designed to assess and appraise how nurses implemented practices (after the educational program) to prevent CLABSI in ICU patients. The checklist served as a tool to observe nurses' actual practices during the insertion of (CVC) and the daily care of these catheters. The observations took place during both morning and afternoon shifts, by a nurse (who is not the researcher) the chosen nurse was the supervisor nurse on charge in order to ensure that other nurses are not aware about this phase, to evaluate the actual nurses' performance and for other rationales which mentioned in " data collection procedures " a scoring system was established based on valid and reliable tool by (elbilgahy et al.,2019) Each correct step in the procedure was rated as "complete, correct, done" and received a score of (2), while steps that were not executed were scored as (0). A nurse's practice was deemed competent if their score reached 80% or higher, while practice was considered incompetent if the score was less than 70%.

3.6 Data collection procedures

Study was carried out over five months in the period from February 2024 to the end of July 2024, the researcher was used two methods for data collection in this study. First, nurses were complete a self-administered questionnaire to evaluate their knowledge before the intervention, in pre- test phase profiling of participants including their demographic data work related factors was done also a pre-test questionnaire was distributed (to assess knowledge before the educational program).

The nurses received comprehensive education about research purpose and each phase of study was explained. In addition, prior to data collection, the data sheet was thoroughly reviewed and the questionnaire was clearly explained along with all research phases (pre- and post-intervention questionnaires, the educational program and the observational phase).

The questionnaire was then distributed to all participants in rounds covering both morning and evening shifts to ensure complete participation across the targeted hospitals. Moreover, all data records were securely stored in a protected location for future recovery if needed.

The baseline knowledge targeted nurses in the study were determined in pre-interventional phase throughout adopted tool by (elbilgahy et al.,2019), the adopted questionnaire contains 13 item (as explained in study tool in details) that measured nurses knowledge regarding CLABSI prevention which distributed before and after intervention (Appendix 2),concerning measuring practice competences for targeted nurses practice observational tool was adopted from same researcher (elbilgahy et al.,2019) which consist of

20 items grouped into 3 main categories (Appendix 2) to assess nurses practice by direct observation before and after educational program.

The baseline practice was assessed within 1 week before starting the intervention by the checklist tool, supervisors in each hospital accepted with pleasure to fill the checklist, then baseline practice was compared with post interventional phase in the same approach, also supervisors were chosen to collect observational data due to the fact of the nature of their work because they mainly supervise and responsible for all hospital wards including ICU while they are on charge which facilitate our research process, as well researcher position as staff nurse with a hectic schedule made the balance between managing shifts and research harder, Otherwise researcher would collect the data by himself.

The interventional phase included educational program which consist of 2 hours lecture in one day each week, until 4 weeks completed each week consist of 1 lecture. The lecture contains an evidence based educational program which is updated by CDC guidelines (Appendix 5) which suggest the optimal care that should be provided regarding CLABSI prevention, and to introduce appropriate CVC care for patient in ICU, the educational program was clarified and presented by power point slides which introduced the optimal guides, pictures, questions and answers and discussions.

In post-test phase which was after 2 months from intervention, the 2-month period preferred to probably assess nurse's knowledge retention" mid-term retention" this period is Suitable for assessing the application of knowledge in clinical settings and Helps identify areas that need reinforcement before knowledge decay sets in, this phase lasted for about 3 weeks of direct observation and included data collection for 2 aspect: knowledge which same

questionnaire was distributed by (elbilgahy et al.,2019) to assess enhancement in knowledge and practice assessment phase depended on direct observation via the checklist tool as mentioned previously , see (appendix 2).

3.7 The interventional phase

The “golden rule” is that only healthcare personnel who are qualified and adequately trained should undertake the tasks of inserting, maintaining, and care to (CVCs). Moreover, healthcare personnel must undergo consistent and periodic evaluations of their expertise, encompassing adherence to evidence-based guidelines for CVC management **(**Loveday et al., 2014).

On a global scale most of relevant studies regarding CLABSI prevention guidelines have a lot in common, all of those instructions could be separated to fields upon the period of care, which can be summarized in phases including: Insertion CVCs bundles, Maintenance CVCs bundles, scoring system for prediction of CLABSI risk, Antimicrobial catheter lock solutions, Antimicrobial-impregnated CVCs, suture less securement devices**,** all of those bundles and instructions are only Preventive measures for CLABSI reduction and applying those instruction was lead to significant reduction in CLABSI rate (Malek et al., 2020).

Moreover, a systematic review of preventive strategies for the reduction of CLABSI in adult intensive care units which done between 2016 and 2020 evaluated all available evidence-based interventions aimed at preventing and/or decreasing (CLABSIs) in (ICUs). Effective strategies for reducing CLABSI rates included the implementation of checklists for the placement and monitoring of the CVC care bundle, therefore, these approaches should be

considered in CVC care protocols within ICUs. Furthermore, the continual education of ICU personnel and regular real-time interventions were identified as crucial components for maintaining positive outcomes (star et al., 2023)

However, our educational program approach was including: Evidenced-based educational program regarding CLABSI prevention which is adopted from CDC guidelines, the last updated for CDC guidelines concerning CLABSI prevention was in 2017 and any significant research should do to those guidelines are taken under consideration, various well-known measures, such as procedures and protocols in hospital, have been established to eliminate CLABSI.

Our interventional phase included educational program which consist of 2 hours lecture in one day each week, until 4 weeks completed each week consist of 1 lecture, The lecture involved an evidence based educational program which is adopted from CDC that suggest the optimal care that should be provided to avoid CLABSI (appendix 5) , the educational program was presented by power point slides and introduced to participant in each hospital separately , Jenin governmental hospital included a 35 ICU nurse, those nurses were actually a staff in the hospital and part of them was on charge during the educational program therefore the researcher coordinate with nursing matron and administration in order to cover the charge nurses during the educational program (1- 2 hour) this is undertaken by administration but its worth to mention that its done through coordination with nurses on call who already had ICU experience but working in other wards in order to include all participant during educational program.

The educational program in Jenin governmental hospital took a place in separated room in ground floor in same hospital , this room chosen because all devices and equipment

including projector, laptop and chairs was already prepared there , primarily the room has been used before for continues education purposes which made it suitable for our educational program , all participant attended , the program addressed crucial aspects regarding CLABSI prevention including: Education Training and Staffing (Educate healthcare personnel regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent CLABSI) see appendix 5, also Hand Hygiene and Aseptic Technique has been addressed (Perform hand hygiene procedures, either by washing hands with conventional soap and water or with alcohol-based hand rubs) moreover maximal sterile barrier precautions, skin preparation, catheter site dressing regimens was discussed in first week.

On second week, in the same place, most of the nurses attended, the program addressed multiple aspect including the guidelines regarding nurses performance during CVC care to avoid CLABSI in particular: Patient Cleansing (Use a 2% chlorhexidine wash for daily skin cleansing to reduce infection), catheter securement devices, antimicrobial/antiseptic impregnated catheters and cuffs, systemic antibiotic prophylaxis, antibiotic/antiseptic ointments, antibiotic lock prophylaxis, antimicrobial catheter flush and catheter lock prophylaxis , anticoagulants, replacement of peripheral and midline catheters and catheters and pressure monitoring devices for adult.

On third week, in Jenni governmental hospital, same place was taken, all off participant attended, the educational program continued and discussed nursing care while handling CVC which included several polices: Replacement of Administration Sets, Needleless Intravascular Catheter Systems and Performance Improvement (see appendix 5).

Last week, same setting, most of participant attended, program discussed Strategies for Prevention of CLABSI in Adult (appendix 5).

Moreover, the organization and coordination of educational program in Ibn-Sina and AL- Razi hospital was approximately the same as Jenin hospital and in the same week, there were some variations in Ibn-Sina hospital which had a huge prepared hall for continues education, and they have a particular day in each week for continues education (Tuesday) , therefore each Tuesday the researcher went to Ibn-Sina to address the educational program , the consequence of lecture and content was the same as Jenin hospital which has explained previously , approximately all of participant in both hospital attended.

Post intervention phase depended on direct observation with a valid checklist tool filled by supervisors related to several aspect that mentioned previously.

3.8 The statistical analysis

Processing and analysis of data was done by using Statistical Package of Social Sciences (SPSS) version 20.0. Descriptive statistics (number, percentage, mean and SD) were used to describe the main variable. Association between categorical variables was tested using Chi-square test and Mc Nemar test. Paired t-test used for comparison within groups. The significance level for all tests were at $p < 0.05$.

3.9 Ethical Approval

IRB Approval with code: R-2024/A/36/N was obtained from the ethical committee at nursing faculty at AAUP and Ministry of Health (M.O.H), the study objectives and instructions clearly explained to the participants. Moreover, the participants informed of their freedom to withdraw and dropout completing the questionnaire without any penalties. To ensure anonymity, the participant's names was not entered on the questionnaire.

Summary

After reviewing this chapter, the researcher noted that selecting effective tool (elbilgahy et al.,2019) to measure the study variables (level of knowledge and practice) in pre/ post intervention design is crucial and directly affecting the nature of intervention for instance some studies which previously mentioned, revealed that knowledge level is sufficient but the practice level was incompetence so based on that the researcher should focus on enhancing practice adherence regarding CLABSI, which pointed what previously mentioned.in addition to effective tool selection .Also, choosing the optimal guidelines (CDC guidelines concerning CLABSI in our study) can effectively improve participated nurses knowledge and practice and giving them confidence while performing care to their patients.

Chapter Four: Result

4.1 Introduction

This chapter points out the results of the statistical analysis of the data,including descrptive analysis, that presents the study and the answers of study questiones before and after the educational program which reflect the variation in knowledge and practice. The study involved 70 ICU nureses in jenin hospitals. The researcher used a non randomised sample (Convenience sample), A single interventional group was included without a control group.the reseacher aimed to assess the level of knowledge and practice before and after the educational program to determine the effectiveness of the intervention.

4.2 characteristics of studied nurses

(Table1): characteristics of studied nurses

Characteristics	N=70	(%)
age in years		
18-24	18	25.7
25-35	44	62.9
+36	8	11.4
Educational level		
Diploma	5	7.1
Bachelor's degree	52	74.3
Master degree	13	18.6
Years of experience		
Less than 1 year	13	18.5
1-5 years	31	44.3
6-10 years	18	25.7
More than 10y	8	11.4
Department		

Medical ICU	41	58.6
Surgical ICU	2	2.9
Coronary ICU	4	5.7
Intermediate ICU	23	32.9
Attending of training program infection		
Yes	12	15
No	58	85
Attending of program on CLABSI prevention		
Yes	22	31.4
NO	48	68.5
Read or heard about CLABSI control policy		
Yes	27	38.6
No	43	61.4
Form to document patient with Central line		
Yes	61	87.1
No	9	12.9
Private	40	57.1
Governmental	30	42.9

(Table 1) describes the characteristics of studied nurses particpating in the study, majority of nurses(62.9%) where in age group between 25-35 years. Regarding educational attainment Most of nurses held a bachelor's degree (74.3%), nearly half of the participants (44.3%) reported having between 1 and 5 years of experience. in addtion, In relation to infection control training, only 15% of nurses had attended a training program on general infection control, whereas 51.4% of ICU nurses had participated in training specifically on CLABSI prevention. Despite this, a notable proportion (48.6%) had not received CLABSI specific training. Furthermore, 38.6% of participants reported being familiar with CLABSI control policies, while the remaining 61.4% were not.

4.2.1 Table 2 : Associations of Demographic data and Work-realted Factors with CLABSI Knowledge and Practice Scores Before and After Educational Intervention (Spearman's Rho)"

Variable	Spearman's rho	Total score pre-Knowledge	Total score post knowledge	Total Score Pre-practice	Total Score Post practice
age in years	R	0.187	0.202	-0.379	0.019
	P	0.121	0.094	0.39	0.001
	N	70	70	70	70
Gender	R	0.079	0.061	-0.051	0.171
	P	0.514	0.614	0.675	0.158
	N	70	70	70	70
educational level	R	0.201	0.082	-0.091	0.007
	P	0.096	0.499	0.454	0.954
	N	70	70	70	70
years of experience	R	0.233	0.198	-0.052	-0.216
	P	0.053	0.100	0.669	0.072
	N	70	70	70	70
is there a CLABSI protocol/policy in your institution	R	-.250-*	-0.007	-0.008	-.331-**
	P	0.037	0.955	0.945	0.005
	N	70	70	70	70
Form to document patient with Central line	R	0.144	-0.202	-0.007	.242*
	P	0.233	0.093	0.956	0.044
	N	70	70	70	70
CLABSI control training course in your hospital	R	-0.020	.278*	-0.100	-0.190
	P	0.869	0.020	0.410	0.116
	N	70	70	70	70
Read or heard about CLABSI control policy	R	-0.060	-0.140	-0.001	-0.052
	P	0.620	0.249	0.994	0.666
	N	70	70	70	70

Regarding age variable there is A statistically significant, moderate negative correlation was observed between age and pre-intervention practice scores ($\rho = -0.379$, $p = 0.001$), indicating that older participants had lower baseline practice adherence. However, age showed no significant associations with pre- or post-intervention knowledge scores ($p > 0.05$), suggesting that age may influence initial practical compliance but not knowledge

gaining or retention.

Furthermore, regarding gender and educational level Neither gender nor educational level had accomplished a significant correlation with any outcome measures (all $p > 0.05$)

Additionally, with respect to Years of Experience which demonstrated a near-significant positive correlation with pre-intervention knowledge ($\rho = 0.233$, $p = 0.053$), which suggested that experienced staff have a higher baseline knowledge. However, experience showed no significant associations with post-intervention outcomes.

Also, in terms of Documentation Practices Use of a standardized form to document central line patients correlated positively with post-intervention practice scores ($\rho = 0.242$, $p = 0.044$), which highlighting purpose of structured documentation in enhancing adherence to CLABSI prevention protocols.

Moreover, CLABSI Control Training Course Prior training correlated significantly with higher post-intervention knowledge scores ($\rho = 0.278$, $p = 0.020$), indicating that formal education programs enhance knowledge retention.

In addition, Prior exposure to CLABSI control policies demonstrated no significant correlations with any outcomes (all $p > 0.05$), the associated p-value did not reach statistical significance Therefore, more exploring in future studies with a larger sample size or more rigorous design to determine if a statistically significant relationship truly exists are needed.

4.3 The level of nurses knowledge pre & post intervention

4.3.1Table 3: Nurses knowledge about prevention of CLABSI

Variable	ITEM	PRE		POST		p- value
		N=70	%	N=70	%	Chi-squar
Recommended replacement of CVCs	Yes, every 7 days	23	32.9%	7	10.0%	χ^2 = 43.7
	Yes, every 3 weeks	19	27.1%	9	12.9%	P
	No, only when indicated	14	20%	46	65.7%	<0.001**
	I do not know	14	20%	8	11.4%	
Central venous catheter replacement technique	New catheter at a different site	20	28.6%	42	60%	χ^2 = 55.8
	Guide-wire insertion for malfunctioning CVC	24	34.3%	4	5.7%	P
	Fewer complications with guide-wire	18	25.7%	11	15.7%	<0.001**
	Existing site increases CLABSI risk	5	7.1%	4	5.7%	
	I do not know	3	4.3%	9	12.9%	
Replacement of CVCs over a guide wire	Yes, every 3 days	14	20.0%	1	1.4%	χ^2 = 37.52
	Yes, every 7 days	19	27.1%	2	2.9%	P
	No, only when indicated	30	42.9%	64	91.4%	<0.001**
	I do not know	7	10.0%	3	4.3%	
Replacement of pressure transducers and tubing	Yes, every 4 days	22	31.4%	51	72.9%	χ^2 = 23.10
	Yes, every 8 days	23	32.9%	5	7.1%	P
	No, only when indicated	17	24.3%	5	7.1%%	<0.001**
	I do not know	8	11.4%	9	12.9%	
Use of antiseptic-coated CVCs	Yes, for more than 5 days	26	%37.1	46	65.7%	χ^2 = 38.77
	No, not cost-effective	18	25.7%	12	17.1%	P
	No, no significant decrease in infections	17	24.3%	6	8.6%	<0.001**
	I do not know	9	12.9%	6	8.6%	
Change gauze dressing on insertion site	Daily	20	28.6%	12	17.1%	χ^2 = 19.01
	Every 2 days	28	40%	42	60%	P <0.05*
	Weekly or when indicated	15	21.4%	10	14.3%	
	I do not know	7	10%	6	8.6%	
Change transparent dressing on insertion site	daily	20	28.6%	3	4.3%	χ^2 = 27.25
	Every 3 days	15	21.4%	3	4.3%	P <0.05*
	Weekly or when indicated	23	32.9%	54	77.1%	
	I do not know	12	17.1%	10	14.3%	

Covering catheter insertion site	Polyurethane dressing	30	42.9%	49	70%	χ^2 = 69.50 P <0.001**
	Gauze dressing	19	27.1%	6	8.6%	
	Both recommended	19	21.4%	8	11.4%	
	I do not know	6	8.6%	7	10%	
Disinfecting catheter insertion site	2% aqueous chlorhexidine	17	24.3%	56	80%	χ^2 = 23.43 P <0.05*
	0.5% alcoholic chlorhexidine	12	17.1%	10	14.3%	
	10% povidone-iodine	32	45.7%	1	1.4%	
	I do not know	9	12.9%	3	4.3%	
Use of antiseptic solution on access hub	Yes, wipe with 70% alcohol for 15 sec	17	24.3%	54	77.1%	χ^2 = 36.35 P <0.001**
	Yes, spray with 70% alcohol	16	22.9%	1	1.4%	
	Not recommended, no evidence	33	47.1%	5	7.1%	
	I do not know	4	5.7%	10	14.3%	
Use of antibiotic ointment at insertion site	Yes, decreases infections	11	35.7%	7	10%	χ^2 = 58.82 P <0.001**
	No, causes resistance	25	32.9%	47	67.1%	
	No, does not decrease infections	23	15.7%	8	11.4%	
	I do not know	11	2.9%	8	11.4%	
Replacement of administration set for lipid emulsions	Within 24 hours	18	25.7%	36	51.4%	χ^2 = 24.84 P <0.05*
	Every 72 hours	29	41.4%	14	20%	
	Every 96 hours	14	20.0%	14	20%	
	I do not know	9	12.9%	6	8.6%	
Replacement of administration set for non-lipid and non-blood products	Every 24 hours	17	24.3%	9	12.9%	χ^2 = 39.35 P <0.001**
	Every 48 hours	12	17.1%	7	10%	
	Every 96 hours	30	42.9%	47	67%	
	I do not know	11	15.7%	7	10%	

chi square tests were used (*) statistically significant at P <0.05(**) highly statistically significant at p <0.001

Table (3) reports Nurses knowledge about prevention of CLABSI, it was noted that a minority of the nurses (20%) reported that CVCs should be replaced "only when indicated" before the program and this percentage was improved after the program to (65.7%) p < 0.001). Incorrect options, such as "every 7 days" and "every 3 weeks," showed significant reductions in selection post-intervention.

Twenty-eight percent of studied nurse (28.6%) gave the correct answer about CVC replacement Techniques Knowledge of using a "new catheter at a different site" before the intervention, comparing this after intervention percentage improved to 60% ($p < 0.001$). Other incorrect techniques, such as "guide-wire insertion for malfunctioning CVC," decreased in frequency post-intervention.

Regarding replacement of CVCs over a guidewire, it was found that approximately half of nurses (42.9%) reported that CVCs should be replaced "only when indicated" before the intervention, which was significantly increased to (91.4%) after the intervention ($p < 0.001$).

When the nurses asked about replacement of pressure transducers and tubing only twenty-four (24.3%) of them reported correctly that replacement should be performed "only when indicated" pre-intervention, compared to post intervention the percentage improved to 72.9% ($p < 0.001$).

In addition, concerning the use of antiseptic-coated CVCs part of nurses who realized the importance of using antiseptic-coated CVCs for more than five days increased from thirty-seven (37.1%) before intervention to (65%) after the intervention ($p < 0.001$).

Also, with regard to Changing Dressings on Insertion Sites (gauze dressing), forty percent (40%) of studied nurses correctly reported a replacement schedule of "every two days" before pre-intervention which had significantly increased to 60% post-intervention, for transparent dressings, awareness of the correct replacement schedule "weekly or when indicated" increased from 32.9% to 77.1% ($p < 0.05$).

Furthermore, concerning Covering the Catheter Insertion Site was correctly answered by a fewer nurses (42.9%) before the study, who reported that the use of polyurethane dressings was the best practice, have significantly increased after the intervention to 70% ($p < 0.001$).

Also, regarding the Disinfecting Catheter Insertion Sites and the awareness of which substance is recommended to use, only twenty-four percent (24.3%) of nurses answered the correct answer before the educational program which was "2% aqueous chlorhexidine" comparing it to post-intervention percentage increased to (80%) ($p < 0.05$).

In addition, concerning the use of antiseptic solution on access hubs, only 22% of nurses correctly answered by "wiping with 70% alcohol for 15 seconds" pre-intervention, which raised significantly to 77.1% post-intervention ($p < 0.001$).

Besides what previously mentioned, it's worth to mention that the idea of using of antibiotic ointments are not recommended according to guidelines, however only 32.9% of nurses correctly identified that "antibiotic ointments are not recommended in term of CLABSI due to resistance risks increased" before the educational program, in the other hand after the educational program the awareness percentage increased to 67.1% ($p < 0.001$).

Lastly, over and above the preceding results, with regard to the duration of replacement of administration sets, its separated depending on whether its lipid emulsion or non, with respect to lipid emulsion twenty-five percent 25.7% of nurses answered correctly before intervention that "replacement should occur within 24 hours" which has significantly increase post-intervention to 51.4%, ($p < 0.05$), for non-lipid emulsion and non-blood

products nearly half of nurses 42.9% answered correctly with replacement schedule ("every 96 hours") before the intervention , which increased after the intervention to 67% ($p < 0.001$).

The educational intervention had a statistically significant positive impact on nurses' knowledge regarding CLABSI prevention according to previous results, progress were observed throughout all studied variables, indicating enhanced understanding of optimum knowledge to achieve the best practices, including catheter replacement plan, dressing changes, site disinfection, and the use of antiseptic-coated CVCs. These findings emphasize the effectiveness of the intervention in addressing gaps in knowledge and encouraging evidence-based practices among ICU nurses.

4.4 The level of nurses practice pre & post intervention

4.4.1 Table 4: Nurses practice during insertion and daily maintenance care of CVCs

Steps	Pre				Post				P value
	Correct done		Not done		Correct done		not done		
	NO	%	No	%	NO	%	NO	%	
Care during insertion									
1. Hand washing	18	25.7	52	74.3	66	94.3	4	5.7	P <0.05
2. Wearing mask	21	30	49	70	63	90	7	10	P <0.001
3. Wearing sterile gloves	51	72.9	19	27.1	66	94.2	4	5.7	P <0.001

4. Wear gown	33	47.1	37	52.8	62	88.6	8	11.4	P <0.001
5. Place pt. in Trendelenburg position	26	37.1	44	62.9	65	92.9	5	7.1	P <0.001
6. Disinfect site of insertion with chlorhexidine and allow to dray	31	44.3	39	55.7	66	94.2	4	5.7	P <0.001
7. Apply large sterile body drape	31	44.3	39	55.7	36	51.4	34	48.6	P <0.001
8. Open the catheter kit using a sterile technique	18	25.7	52	74.3	54	77.1	16	22.9	P <0.001
9. Flush the lumens with normal saline after catheter insertion	49	70	21	30	50	70.2	20	29.6	P <0.001
10. Label the dressing with the time and date	48	68.6	22	31.4	48	68.6	22	31.4	P <0.001
Needless access device care									
1. Hand washing prior to access the line for medication administration, blood sample withdrawal and change the device	15	21.4	55	78.6	60	85.7	10	14.2	P <0.001
2. Scrub the line and the hub for 10-15 time or from 10-15 second and allow to dray	7	10	63	90	58	82.9	. 12	17.1	P <0.001
Dressing change technique									
1. Hand washing	5	7.1	65	92.9	61	87.1	9	12.9	P <0.001
2. Wearing mask and clean gloves to remove existing central line dressing	14	20	56	80	60	85.7	10	14.3	P <0.05
3. Wearing sterile gloves	4	5.7	66	94.3	64	91.4	6	8.6	P <0.05
4. Scrub the site with Chlorhexidine gluconate for 30 second and allow site to	5	7.1	65	92.9	56	80	14	20	P <0.05

completely dray before applying new dressing									
5. Put the gauze square over the exit site.	40	57.1	30	42.9	56	80	14	20	---
6. Remove gloves	26	37.1	44	62.9	55	78.6	15	21.4	P <0.001
7. Put tape ½ inch beyond the gauze pad on all sides.	19	27.1	51	72.9	50	71.4	20	28.6	---
8. Record date, time, dressing condition	37	52.9	33	47.1	62	88.6	8	11.4	___

McNemar Test was used

Table (4) reports nurses' practice during insertion and maintenance of central venous catheter. this table illustrated numerous result which reported that Twenty-five percent of the nurses (25.7%) were correctly performing hand washing and wearing gloves for catheter insertion before the program implementation. Instantly after the program, mostly all of nurses (94.3%) performed those steps correctly which demonstrates a substantial effect of the program in building basic hygiene practices.

In addition, when it comes to wearing mask Pre-program, only 30% of nurses wore masks during insertion, compared to (90%) post-program ($p < 0.001$), also with regard to Wearing Sterile Gloves, Fulfilment to this practice improved from (72.9%) to (94.2%) post-program ($p < 0.001$), however the pre-intervention level was already relatively high.

Furthermore, in terms of wearing gown which reflected enhanced awareness of sterile technique which increased during insertion from (47.1%)pre-program to (88.6%) post-program ($p < 0.001$), similarly, regarding Placing the patients in Trendelenburg position

during insertion before the educational program only thirty-seven percent of the nurses (37.1%) were correctly performing this practice which significantly improved post-program to ninety-tow percent of nurses (92.9%) which emphasized that the educational program is promoting knowledge and practice for ICU nurses with respect to CVCs optimal care.

Also, when it's come to optimal practice which keep CVCs sterilized, disinfect site of insertion with chlorhexidine and allow to dray is the best practice which performed correctly by (44.3%) of nurses before the intervention that significantly improved to (94.2%) after the intervention, moreover applying a large sterile drape: Compliance increased marginally from (44.3%) to (51.4%) post-program ($p < 0.001$).

As well, concerning sterile technique in opening catheter kits this practice showed a significant increase from (25.7%) pre-program to (77.1%) post-program ($p < 0.001$), highlighting improved procedural adherence, also Flushing Lumens with Normal Saline no change was observed in this practice, with adherence remaining at (70%) in both phases ($p < 0.001$), moreover, labeling the dressing adherence to labeling dressings with date and time was consistent at (68.6%) pre- and post-program.

Beside what previous results showed, concerning needless access device care included two important aspects, one of them is the hand washing before access which reflecting that the percentage of nurses who washed their hands prior to accessing the line increased from (21.4%) to (58.7%) post-program ($p < 0.001$). Although there was improvement, this remains an area for further enhancement, Moreover, the second aspect include the scrubbing the line and hub compliance with scrubbing for the recommended 10–

15 seconds increased significantly from (10%) pre-program to (82.9%) post-program ($p < 0.001$), reflecting a notable improvement in aseptic practices.

As well as, regarding dressing change technique which included 8 different aspects presented in table (4) which is a crucial aspect to achieve aseptic technique while caring CVCs, those variables addressed separately in educational program including: the emphasizing about hand hygiene before dressing change, the proportion of nurses who performed hand washing before dressing changes increase significantly from (7.1%) pre intervention to (87.1%) post-program ($p < 0.001$), showing a dramatic improvement.

Also wearing a mask and clean gloves compliance increased from (20%) to (85.7%) post-program ($p < 0.05$). in addition, Adherence to wearing sterile gloves enhanced from only about six percent of nurses (5.7%) before the educational program to ninety-one percent of nurses (91.4%) after the program.

As well, about disinfecting with Chlorhexidine only seven percent of nurses (7%) were perform this procedure correctly before the intervention by scrubbing the insertion site with chlorhexidine for 30 seconds and allowing it to dry, which had significantly increased to eighty percent of nurses post -intervention (80%) after the educational program.

Furthermore, concerning placing Gauze over the exit site correct practice performance improved from (57.1%) pre-program to (80%) post-program, however statistical significance was not reported.

Likewise, in relation to correct practice performance removing gloves after dressing change: The practice of removing gloves correctly increased from (37.1%) to (78.6%) post-program ($p < 0.001$), highlighting improved adherence to infection prevention measures.

In addition, securing dressing with tape respect to proper taping techniques remained consistent at approximately (71%) post-program, showing limited improvement.

Over and above, relative to nursing optimal practice to prevent CLABSI its worth to mention that recording dressing details was already correctly done by half of nurses pre-program (52.9%) which also increased significantly to (88.6%) post-program ($p < 0.001$).

The educational program significantly improved several aspects regarding knowledge and practice concerning CVCs optimal care and CLABSI control particularly in areas such as hand washing, use of sterile techniques, scrubbing of catheter hubs and dressing change technique, the results underscore that all of those various guidelines that nurses learned to carry out throughout their daily practice were dramatically improved after the educational program, which reflecting the effectiveness of the intervention in promoting evidence-based practices and reducing the risk of (CLABSI).

4.5 Mean scores of nurses' knowledge and practice pre & post intervention

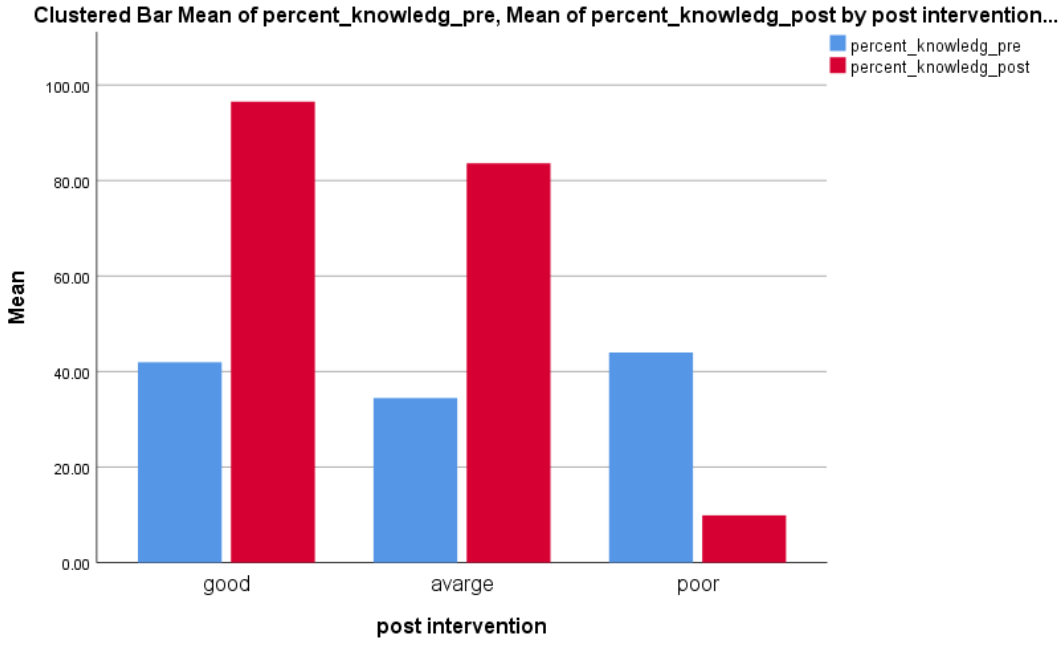
4.5.1 Table5: Mean scores of nurses' knowledge and practice about prevention of CLABSI before and after the intervention

	PRE	POST	Paired t test
Knowledge score	Mean ± SD 4.25± 1.37	Mean ± SD 13.05±1.58	t = 35.35 P <0.001
Practice score	2.45±1.03	14.85±2.09	t = 45.75 P <0.001

Table (5) demonstrates the value of the educational program that had been addressed for ICU nurses with an increase in the mean score of nurses knowledge and practice subsequent to the program accomplishment.

The mean knowledge score increased significantly from 4.25 ± 1.37 before the intervention to 13.05 ± 1.58 after the intervention. The difference was statistically significant, as indicated by the paired t-test ($t=35.35$, $P<0.001$).

In addition, the practice score showed a notable increase, rising from a mean of 2.45 ± 1.03 pre-intervention to 14.85 ± 2.09 post-intervention. Also, the paired t-test result ($t=45.75$, $p<0.001$) confirms that this improvement was highly significant.



4.5.2 Figure 2: Level of nurse's knowledge about prevention of CLABSI

Figure 2 is reflecting the Level of nurses' knowledge about prevention of CLABSI which describe a significant improvement after the intervention. Before the accomplishment of the educational program, the majority of nurses (approximately 50%) demonstrated poor knowledge, while only 40% had good knowledge. After the intervention, there was a substantial shift, with approximately 90% of nurses classified as having good knowledge and no nurses remaining in the poor knowledge category. This improvement highlights the effectiveness of the educational program in enhancing nurses' knowledge about CLABSI prevention.

Chapter Five: Discussion

5.1. Overview

The result of this study mainly revealed the effectiveness of implementing an educational program on ICU Nurses knowledge and practice concerning CVCs care and CLABSI control, those findings reflected that there was significant enhancement in both post-intervention, This in turn, will ideally lay the foundation for planners and supervisory staff in the West Bank and M.O.H. to adopt the guidelines that improve education for nurses and other health care providers, resulting in enhance healthcare conditions and becoming more efficient and successful for their patients and institutions.

5.1.1 Associations of Demographic data and Work-related Factors with CLABSI Knowledge and Practice Scores Before and After Educational Intervention.

Regarding gender and educational level Neither gender nor educational level had accomplished a significant correlation with any outcome measures (all $p > 0.05$). These results suggest that demographic characteristics did not moderate the intervention's effectiveness in improving knowledge or practice.

Additionally, with respect to Years of Experience which demonstrated a near-significant positive correlation with pre-intervention knowledge ($\rho = 0.233$, $p = 0.053$), which suggested that experienced staff have a higher baseline knowledge. However, experience showed no significant associations with post-intervention outcomes, highlighting that experience alone does not ensure awareness to training.

5.2. Nurses knowledge about prevention of CLABSI

The study demonstrated that knowledge level regarding CLABSI prevention improved post educational program, also concerning guidelines that addressing CLABSI prevention which particularly focused on several aspect that improved the knowledge including the frequency of CVCs replacement (65.7%), the site of CVC insertion in cases the need for replacement (60%), Change gauze dressing on insertion site (60%), Replacement of administration set for non-lipid and non-blood products (67%), Replacement of administration set for lipid emulsions (51.4%), on the other hand there are considerable aspect were knowledge gap was noticeable specifically concerning the frequency of CVCs replacement since only (20%) gave the correct answer before the educational program. also, regarding Use of antiseptic solution on access hub only (24.3%) gave the correct answer before the intervention. In order to have a sufficient level of knowledge and high quality of practice and optimal nursing care for patients, nursing practice must rely on approved protocols and guidelines which support this practice, this can be accomplished by enforcement of continues education regarding CLABSI prevention guides in those institutions which discussed with respect to previous studies in this chapter.

The majority of nurses (68%) reported not having participated in any educational programs related to CLABSI policies. As well, A study conducted in Yemen by (Alqalah, 2024) reported that more than two-thirds (65.7%) of critical care nurses had not received prior training in CLABSI prevention, similarly a study done by Muschitiello et al. in (2024) evaluated nurses' knowledge, attitudes, and practices regarding the prevention of CLABSI found that (72%) of those nurses were unaware of the established guidelines, highlighting a

notable deficiency in training, nevertheless those results was in contrary with (Mullings, 2022) who reported in a study that approximately (87.7%) working in intensive care units attended an educational program on CLABSI prevention. those finding can be interpreted in view of fact that significant variation in training practices for nurses across different settings concerning CLABSI, potentially reflecting differences in institutional policies, resource allocation, or regional priorities in healthcare education. nurses in low-resource settings often receive less frequent and less all-inclusive teaching compared to those in high-resource areas (Azad et al., 2020).

Regarding Recommended replacement of CVCs frequency, in the current study, more than half of nurses (65.7%) answered correctly after completing the program, compared to only (20%) before the program (table 3), our program emphasized that CVCs should be replaced only when indicated. Similarly, CDC guidelines recommended against routine replacement of CVCs as a method to prevent catheter-related infections. previous research, such as the study by (Shahbaz et al., 2024) emphasized that (68.5%) of nurses believed that CVCs should be routinely replaced, which contrasts with current guidelines recommending replacement based on clinical indications rather than routine scheduling. This disparity highlights a gap in knowledge regarding evidence-based practices for CVC management. The limited understanding of proper CVC replacement before the program is due to the absence of regular educational initiatives.

Furthermore, the present study verified that more than half (60%) answered correctly regarding Central venous catheter replacement technique post-intervention, which emphasizing that New catheter should be inserted at a different site, similarly CDC guidelines

regarding CLABSI control recommend against routine use of guidewire exchanges for non-tunneled catheters to prevent infection and advise using a new insertion site when catheter replacement is necessary due to infection, which confirming that our educational program revealed the optimal knowledge about CVCs nursing care.

In addition, our study finding demonstrated that the majority of nurses (72.9%) gave the optimal answer regarding timelines Replacement of pressure transducers and tubing after educational program sessions which is every 4 days according to CDC guidelines, in the other hand only (31.4%) of studied nurses answered correctly before the educational program, our finding regarding poor level of knowledge of studied nurses pre-program align with a previous cross-sectional study of ICU nurses' knowledge and practice in China conducted by Chi et al. (2020) emphasized that only (10.3%) of the nurses were aware that pressure transducers and tubing should be replaced at 96-hour intervals, those finding reflecting a knowledge gap and verifying the continues need for regular educational intervention.

Also, with respect to the Use of antiseptic-coated CVCs our current study finding suggest that more than half of studied nurses (65.7%) correctly answered the survey post-intervention concerning the indication of antiseptic-coated type, which is when CVCs expected to remain for more than 5 days according to guidelines, compared to a prospective study in Poland about Assessment of Knowledge regarding the Prevention of CLABSI among ICU Nurses which conducted by (Dyk et al., 2021) study result revealed that (56%) of studied nurses correctly determined that antiseptic-coated CVCs are recommended for patients whose catheterization is expected to exceed five days. This indicates that nearly half of the surveyed nurses may lack knowledge of this specific guideline which correspond to

our finding pre-program only (%37.1) of our nurses answered correctly, which also supporting the previous result regarding knowledge gap.

Over and above, there are crucial multiple finding in present study that reflecting knowledge level for studied nurses, just as CVCs dressing is one of the major tasks of nurses, our finding revealed a low level of knowledge concerning dressing change. The study showed that a few nurses (28.6%) and (32.9%) knew the frequency of change gauze and transparent dressing respectively before conduction of the program. those finding of present study was in in concurrence with (Chi et al.,2020) who verified that only (15.3%) knew that gauze dressing should be every 2 days. But in contradiction with (Dyk, 2021) who reported a higher nurse's knowledge in his study which verified that (87.18%) of studied nurses aware about frequency of CVCs dressing. This could be interpreted in the light of fact that gauze dressing procedure frequency is mostly differ in each institution according to hospital policy, with emphasizing that the optimal guidelines that should be followed in this manner.

In addition, our recent study demonstrated a poor level of knowledge about the Use of antiseptic solution on access hub, respectively before the educational program, the percentage of nurses who were in the loop about antiseptic technique hardly reached to (24.3%). Those result was in conjunction with a study conducted by (Chi et al., 2020) which revealed that nothing but (37.1%) of nurses were aware about the optimal method to CVCs hub aseptic technique care. But in contrary with a prospective study done in Poland conducted by (Dyk, 2021) which Assess the Knowledge about Prevention of CLABSI among ICU Nurses, finding of this study verified a high level of nurse's knowledge, (61.11%) of

nurses aware about aseptic protocols, those result is related to continues education in Poland comparing to other countries.

Regarding the Use of antibiotic ointment at CVCs insertion site, our study finding verifies that only (32.9%) of nurses already recognize that applying antibiotic cream at CVCs insertion site causes resistance, which is also not recommended practice by CDC guidelines. As well, a study conducted by (Almalki et al., 2023) confirmed that only half of studied nurses (55.20%) respondents were also aware about evidence-based practice guides regarding antibiotic ointment resistance when applying on CVCs. Similarly, a study conducted by (Dyk, 2021) indicated that only (27.56%) of nurses correctly identified that applying antibiotic ointment at the CVC insertion site is not recommended due to the risk of promoting antibiotic resistance. in contrary a study conducted by (Muschitiello et al., 2024) revealed that significant part of nurses believed that applying antibiotic ointment at the CVC insertion site was recommended. this is could be interpreted to nurses perception about applying topical antibiotics can offers additional infection protection, which outlined a significant knowledge disparity that could be enhanced by educational interventions.

Also, concerning Replacement of administration set for lipid emulsions which was correctly answered by half of nurses (51.4%) post-program ,in the other hand, before the intervention the present study pointed out a poor level of knowledge because only (25.7%) of studied nurses were aware about optimal frequency for IV lipid replacement, the previous findings was align with the a study conducted by (Al-Momani, 2022) which highlighted that only (42%) of participated nurses knew the correct replacement frequency for lipid sets. But in contradiction with (Dyk, 2021) who reported an upgraded nurses' knowledge in his study

which pointed out that (82%) of nurses were updated about the proper time to change IV set that contains lipid, those findings could underscore a general pattern of inefficient understanding in clinical settings. Such deficits may stem from inconsistent training, outdated institutional protocols, or lack of emphasis on evolving guidelines in routine practice.

Alongside previous findings, about Replacement of administration set for non-lipid and non-blood products relatively majority of nurses (67%) correctly answered post-intervention that those IV set should be replaced within 96 hours which also align with CDC guidelines and fit in with a cross-sectional study conducted by (Smith et al., 2022) pointed out that (68%) of involved nurses correctly identified the 96-hour replacement guideline for non-lipid, similarly an observational study done in South Korean hospitals conducted by (Lee & Park , 2021) demonstrated that (59%) of nurses adhered to the 96-hour replacement rule for non-lipid sets. in the other hand, same study findings pointed out that Compliance dropped to (43%) in units with high patient-to-nurse ratios, likewise our recent study reported that only (42.9%) gave correct answer before the intervention. those finding could be interpreted in light of fact that there are shared common theme and knowledge gaps that could be addressed including: Under-Compliance: Nurses in high-workload settings often missed scheduled replacements (Fernández et al., 2023), also in contrary Over-Compliance: could take place , Many nurses replaced non-lipid sets earlier than necessary (e.g., every 48–72 hours), Misinterpretation of guidelines (Smith et al., 2022) also Institutional policies not aligned with evidence (Lee & Park, 2021) also Regional Variability: European and Asian

studies reported lower baseline knowledge (52–59%) compared to U.S. studies (68%) (Smith et al., 2022; Fernández et al., 2023).

5.3 Nurses practice during insertion and daily maintenance care of CVCs

Our recent study showed that only Twenty-five percent of the nurses (25.7%) were accurately performing hand washing and wearing gloves for catheter insertion. Furthermore, the majority of studied nurses (72.9%) wore sterile gloves during insertion and only (47.1%) wore gown, respectively before the educational intervention, which were significantly improved after intervention to (94.2%) and (94.3%) but in window of 3-month observation. however, on the other hand, a study at tertiary hospitals in Saudi-Arabia conducted by (Almahmoud et al., 2020) pointed-out a high adherence to optimal practice, (94%) of studied ICU nurses were performing appropriate hand hygiene and wearing maximal sterile barrier precautions before insertion. However, previous finding was in concurrence with a study in brasil conducted by (Costa et al., 2020) demonstrated enhanced knowledge and practice compliance concerning CLABSI bundle, study findings revealed that (94,4%) of ICU nurses were stick to effective hand washing before CVC insertion producer and (68,7%) of them wear Maximum protective barriers correctly. Those previous finding can be interpreted in consideration of fact that there are contrast between present study pre-intervention findings and the international studies, which prompting deeper discussion regarding possible factors, such as differences in healthcare settings, baseline knowledge, cultural practices which could justify why nurses in other countries accomplished enhanced compliance rates. Moreover, the notable improvement after intervention further highlighting the possible positive effect of organized educational program on nurses practice.

In addition, regarding nurses' practice for Needless access device care and Dressing change technique, same items was included and measured in observational checklist tool with some variance in each specific practice, generally to avoid repetition of same aspect that previously mentioned regarding practice adherence , its noticeable that our finding suggest that there is low adherence practice regarding CLABSI policy before the educational intervention such as (wearing PPE, Scrub the site with Chlorhexidine gluconate for 30 second and allow site to completely dray before applying new dressing which was (7.1%) pre and (92.9%) post etc..) all those practice measures indicating a significant improvement post intervention and an initial low adherence rates before the program when compared to previous studies. Those findings highlighting both the challenges and the potential for advancement through focused interventions. This approach not only strengthens the reasoning for educational programs but also lay down a clear schedule for future research to explore the factors underlying such variance and to evaluate the long-term impact of these interventions.

As well, there is a significant post-intervention increases in knowledge (4.25 ± 1.37 to 13.05 ± 1.58; $p < 0.001$) and practice scores (2.45 ± 1.03 to 14.85 ± 2.09; $p < 0.001$) those finding point out the effectiveness of the formal educational program in enhancing ICU nurses' CLABSI prevention competencies. Those results consistent with prior study conducted by (Sharma et al., 2023) demonstrating knowledge enhancement in pre-test, post-test design which reflecting that knowledge improved from (11.31 ± 5.329 to 17.06 ± 5.680). The significant improvement in knowledge scores may reflect the program's emphasis on updated guidelines. However, the dependent on short period observational checklist tool

(3month only) which reported practice scores and the absence of long-term follow-up limit the generalizability of those results. Future research should evaluate holding over time and correlate these scores with actual CLABSI rate reductions in clinical settings.

5.4 Conclusion

This study demonstrates that the implementation of an evidence-based educational program significantly enhanced nurses' knowledge regarding CLABSI prevention. Additionally, the findings highlighted variations in nursing practices, with a significant improvement in compliance to CLABSI prevention measures, reflecting the importance of ongoing education in high-risk clinical settings.

5.5 Recommendation

- The researcher recommended the nurses to provide nursing care to critically ill patient based on updated guidelines rather than perceptions and experience dependence alone.
- Also, the researcher recommended the Palestinian M.O.H. hospitals, private hospitals and all related health care sectors to arrange inward teaching program for all health care team members as important to extend the performance approach for CLABSI prevention and CVC care.
- As well, Further studies with large and randomized sample sizes are needed to investigate the role and potential advantages of continuous educational programs in reducing CLABSI rates.

- Furthermore, the researcher recommended Policy-makers and health authorities to ensure that necessary resources, supplies and devices for continues education and best care regarding CLABSI control are available.

5.6 Strengths and limitations of the study

Strengths points

- The study rely upon on CDC guidelines on CLABSI control were included in the Evidence-Based Intervention program, which significantly enhanced its validity and clinical benefits.
- The study was a part of Contributions to Infection Control which addresses a vital patient safety issue, providing practical suggestions for decreasing healthcare-related infections.
- The researcher has extensive experience in the department in which the study was applied, and also experience in dealing with patients with CVCs.

Limitation of the study

- The risk of confounding variables increases with non-random allocation due to lack of randomization.
- Sample Size and Generalizability which is Small and single-site samples that may limit applicability to diverse settings (only Jenin hospitals was included in the study)
- The study did not determine the long-term feasibility of adhering to the CLABSI prevention protocol, which ensures that nurses adheres to the optimal guidelines (3 months of observation only).

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Appendices

Appendix (1): Questionnaire

Dear participation, I am a master student of nursing at Arab American University-Palestine, kindly invites you to participate in this research study. The study is carried out as part of fulfilling the requirements for master degree in Critical Care Nursing. The study aims to Effect of Educational Program on critical care Nurses Knowledge and practice regarding Central line associated bloodstream infection prevention (CLABSI)in Jenin Hospitals: A Quasi Experimental Study.

Your participation is voluntary, your cooperation is highly appreciated. You have the right to withdraw at any time during data collection process without limitation. Filling the questionnaire will not take more than 10 minutes from your time, and assuring that your answers will be kept anonymous and confidential and will be used for the research purposes only.

Thank you.

CLABSI Analysis Form Once each area has been informed by Infection Control of Unit CLABSI, this form is to be completed and sent to Infection Control and a copy kept on file with the unit manager.

Form completed by: _____ Date: _____

Appendix (2) : Data collection Sheet

Tool (I): Nurses knowledge about evidence-based guidelines for Preventing Central Venous Catheter associated blood stream infection

Part 1: Demographic characteristics' of studied nurses:-

1. Gender

   Male ( ) Female ( )

2. Age: -

3. Level of Education BSN( ) MSN( ) PHD ( )

4. Years of experience in ICU

5. Have you ever attended a research class about infection control?

   Yes ( ) No ( )

6. Have you ever attended a research class about CLBSIs?

   Yes ( ) No ( )

Part II:-Current nursing practice for prevention of CLBSIs:-

1. Hand washing before and after access the CVC

Always sometimes never

2. Wearing sterile gloves when changing dressing

Always sometimes never

3. Scrub the access port & catheter hub with alcohol 70% before and after access the catheter

Always sometimes never

4. Daily inspection of the catheter insertion site

Always sometimes never

5. Frequency of inspection of the catheter insertion site (%)

   A. I time

   B. 2 times

   C. More than 2 times

6. Change of administration set for blood & blood product
    A. Immediately after the end of infusion
    B. 24 h
    C. Others
7. Change of administration set for TPN
    A. Immediately after the end of infusion
    B. Daily
    C. 48 h
    D. Others
8. Change of administration set for clear fluid
    A. Daily
    B. 48 h
    C. 72 h
    D. Others
9. Needleless access device change (3 way)
    A. Daily
    B. 48 h
    C. 72 h
    D. Others
10. Frequency of changing CVC dressing
    A. Every shift
    B. One time/day
    C. Only when indicated as (soiled, loosened)
    D. Other
11. Type of sterile dressing used in the majority of patients
    A. Gauze

B. Transparent (semi permeable)

C. Transparent with chlorhexidine patch

D. Other

12. Unite protocol for prevention of CVC infection

A. Flush the lumens with normal saline after the end of care (saline flush)

B. Antibiotic lock

C. Application of heparin caps at the end of infusion therapy (anticoagulant flush)

D. Others

Part II: - Nurses knowledge about evidence-based guidelines for Preventing Central Venous Catheter- Related Infection

1. It is recommended to replace central venous catheters (CVCs) routinely

A. Yes, every 7 days

B. Yes, every 3 weeks

C. No, only when indicated

D. I do not know

2. Central venous catheter replacement, it is recommended to

A. Inserting a new catheter at a different site

B. Guide-wire insertion has been the accepted technique for replacing a malfunctioning CVC as it is

C. associated with significantly fewer mechanical complications and less patient discomfort than those inserted at a new site

D. The use of an existing CVC site is associated with an increased risk of CLABSI, as compared with the use of a new CVC site

E. I do not know

3. It is recommended to replace CVCs over a guide wire …

A. Yes, every 3 days

B. Yes, every 7 days

C. No, only when indicated

D. I do not know

4. It is recommended to replace pressure transducers and tubing routinely …

A. Yes, every 4 days

B. Yes, every 8 days

C. No, only when indicated

D. I do not know

5. In settings with a high rate of catheter-related infections it is recommended to use a CVC coated or impregnated with an antiseptic agent

A. Yes, in patients whose CVC is expected to remain in place for more than 5 days

B. No, because the use of such catheters is not cost-effective

C. No, because the use of such catheters does not result in a significant decrease in the rate of catheter-related infections

D. I do not know

6. It is recommended to change gauze dressing on the catheter insertion site

A. On a daily basis

B. When indicated and at least every 2 days

C. When indicated (soiled, loosened …) and at least weekly

D. I do not know

7. It is recommended to change transparent dressing on the catheter insertion site

A. On a daily basis

B. Every 3 days

C. When indicated (soiled, loosened …) and at least weekly

D. I do not know

8. It is recommended to cover up the catheter insertion site with …

A. Polyurethane dressing (transparent, semipermeable)

B. Gauze dressing

C. Both are recommended because the type of dressing does not affect the risk for catheter- related infections

D. I do not know

9. It is recommended to disinfect the catheter insertion site with …

A. 2% aqueous chlorhexidine

B. 0.5% alcoholic chlorhexidine

C. 10% povidone-iodine

D. I do not know

10. It is recommended to apply an antibiotic ointment at the insertion site of a CVC …
    A. Yes, because it decreases the risk for catheter-related infections
    B. No, because it causes antibiotic resistance
    C. No, because it does not decrease the risk for catheter-related infections
    D. I do not know

11. It is recommended to use an antiseptic solution to clean the access hub or connector before the connection of the administration set or after unscrewing the dead-end cap closes the catheter.

A. Yes, by wiping with 70% alcohol solution or alcohol and chlorhexidine solution for no less than 15 second
B. Yes, by spraying the access site with 70% alcohol solution or alcohol chlorhexidine solution
C. It is not recommended because no evidence has been found for the relation between the disinfections of the connecting site of the administration set and the contamination of fluids or the insertion hub
D. I do not know

12. When lipid emulsions are administered through a CVC it is recommended to replace the administration set

A. Within 24 hours
B. Every 72 hours
C. Every 96 hours
D. I do not know

10. When neither lipid emulsions nor blood products are administered through a CVC it is recommended to replace the administration set …

A. Every 24 hours
B. Every 48 hours
C. Every 96 hours
D. I do not know

Tool II: Central Venous catheter care during insertion and maintenance care observational checklist: -

Steps	Pre			Post		
	Correct	Incorrect done	Not done	Correct	Incorrect	Not done
Care during insertion						
1. Hand washing						
2. Wearing mask						
3. Wearing sterile gloves						
4. Wear gown						
5. Place pt. in Trendelenburg position						

6. Disinfect site of insertion with chlorhexidine and allow to dray						
7. Apply large sterile body drape						
8. Open the catheter kit using a sterile Technique						
9. Flush the lumens with normal saline after catheter insertion						
10. Label the dressing with the time and date						
Needless access device care						
1. Hand washing prior to access the line for medication administration, blood sample withdrawal and change the device						
2. Scrub the line and the hub for 10-15 time or from 10-15 second and allow to dray						
Dressing change technique						
1. Hand washing						
2. Wearing mask and clean gloves to remove existing central line dressing						
3. Wearing sterile gloves						
4. Scrub the site with Chlorhexidine gluconate for 30 second and allow site to completely dray before applying new dressing						
5. Put the gauze square over the exit site.						
6. Remove gloves						
7. Put tape ½inch beyond the gauze pad on all sides.						
8. Record date, time, dressing condition						

appendix (3)

IRB Acceptance letter

Arab American University
Institutional Review Board - Ramallah

الجامعـــة العربيـــة الأمريكيـــة
مجلس اخلاقيات البحث العلمي – رام الله

IRB Approval Letter

Study Title: "Effect of Educational Program on Critical Care Nurses Knowledge and Practice Regarding Central Line Associated Bloodstream Infection Prevention (CLABSI) in Jenin Hospitals: A Quasi Experimental".

Submitted by: Yazan Talal Abd Alraheem Yasin

Date received: 16th February 2024

Date reviewed: 16th February 2024

Date approved: 21th February 2024

Your Study titled **"Effect of Educational Program on Critical Care Nurses Knowledge and Practice Regarding Central Line Associated Bloodstream Infection Prevention (CLABSI) in Jenin Hospitals: A Quasi Experimental"** with the code number **"R-2024/A/36/N"** was reviewed by the Arab American University Institutional Review Board - Ramallah and it was approved on the 21th of February 2024.

Sajed Ghawadra, PhD
IRB-R Chairman
Arab American University of Palestine

الجامعة العربية الأمريكية - فلسطين
مجلس اخلاقيات البحث العلمي - رام الله
IRB-R
ARAB AMERICAN UNIVERSITY-PALESTINE
INSTITUTIONAL REVIEW BOARD - RAMALLAH

General Conditions:

1. Valid for 8 months from the date of approval.
2. It is important to inform the IRB-R with any modification of the approved study protocol.
3. The Bord appreciates a copy of the research when accomplished.

رام الله – فلسطين
Tel: 02-294-1999 **E-Email:** IRB-R@aaup.edu **Website:** www.aaup.edu

appendix (4)

emails from the author of the tools used

- **email: amal_ahmed568@yahoo.com**

Dr. Amal Ahmed Elbilgahy

Associated professor of pediatric nursing, Faculty of Nursing

Mansoura University, Egypt

15-2-2024

Yazan Yassen

Master student, Palestine

Dear Mrs. Yazan

Permission to use Evidence-Based Educational Intervention for Nurses about Prevention of Central Line Associated Blood Stream Infection questionnaire

As the original author of the Evidence-Based Educational Intervention for Nurses about Prevention of Central Line Associated Blood Stream Infection questionnaire. I write to grant you permission to use the questionnaire and to translate to Arabic for your study. Please note that the rights of use of the questionnaire is solely granted for you to carry out your study and is not transferable to anyone else without my prior permission. Naturally I would appreciate the usual respect for copyright with acknowledgement of my authorship of the Evidence-Based Educational Intervention for Nurses about Prevention of Central Line Associated Blood Stream Infection questionnaire in all related publications and presentations. I wish you a smooth and productive study

Best wishes

Dr. Amal Ahmed Elbilgahy

appendix (5)

Guidelines for the Prevention of Intravascular Catheter-Related Infections

Accessible version: https://www.cdc.gov/infection-control/hcp/intravascular-catheter-related-infection/index.html

Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011

Naomi P. O'Grady, M.D.[1], Mary Alexander, R.N.[2], Lillian A. Burns, M.T., M.P.H., C.I.C.[3], E. Patchen Dellinger, M.D.[4], Jeffery Garland, M.D., S.M.[5], Stephen O. Heard, M.D.[6], Pamela A. Lipsett, M.D.[7], Henry Masur, M.D.[1], Leonard A. Mermel, D.O., Sc.M.[8], Michele L. Pearson, M.D.[9], Issam I. Raad, M.D.[10], Adrienne Randolph, M.D., M.Sc.[11], Mark E. Rupp, M.D.[12], Sanjay Saint, M.D., M.P.H.[13] and the Healthcare Infection Control Practices Advisory Committee (HICPAC)[14].

1 National Institutes of Health, Bethesda, Maryland
2 Infusion Nurses Society, Norwood, Massachusetts
3 Greenich Hospital, Greenwich, Connecticut
4 University of Washington, Seattle, Washington
5 Wheaton Franciscan Healthcare-St. Joseph, Milwaukee, Wisconsin
6 University of Massachusetts Medical School, Worcester, Massachusetts
7 Johns Hopkins University School of Medicine, Baltimore, Maryland
8 Warren Alpert Medical School of Brown University and Rhode Island Hospital, Providence, Rhode Island
9 Office of Infectious Diseases, CDC, Atlanta, Georgia
10 MD Anderson Cancer Center, Houston, Texas
11 The Children's Hospital, Boston, Massachusetts
12 University of Nebraska Medical Center, Omaha, Nebraska
13 Ann Arbor VA Medical Center and University of Michigan, Ann Arbor, Michigan

⚠ **Updated Recommendations [July 2017]:**
See the ***Updated Recommendations on the Use of Chlorhexidine-Impregnated Dressings for Prevention of Intravascular Catheter-Related Infections***.
(https://www.cdc.gov/infection-control/hcp/c-i-dressings/index.html)

⚠ **Content Removed [October 2017]**
Content in the **Notice to Readers** section was removed to reflect the recommendation update and the evolution of CDC infection control guideline methodology.

1. * Education, Training and Staffing

1. Educate healthcare personnel regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections [7–15]. *Category IA*
2. Periodically assess knowledge of and adherence to guidelines for all personnel involved in the insertion and maintenance of intravascular catheters [7–15]. *Category IA*

3. Designate only trained personnel who demonstrate competence for the insertion and maintenance of peripheral and central intravascular catheters. [14–28]. *Category IA*
4. Ensure appropriate nursing staff levels in ICUs. Observational studies suggest that a higher proportion of "pool nurses" or an elevated patient–to-nurse ratio is associated with CRBSI in ICUs where nurses are managing patients with CVCs [29–31]. *Category IB*

2. * Selection of Catheters and Sites

2.1. * Peripheral Catheters and Midline Catheters

1. In adults, use an upper-extremity site for catheter insertion. Replace a catheter inserted in a lower extremity site to an upper extremity site as soon as possible. *Category II*
2. In pediatric patients, the upper or lower extremities or the scalp (in neonates or young infants) can be used as the catheter insertion site [32, 33]. *Category II*
3. Select catheters on the basis of the intended purpose and duration of use, known infectious and non-infectious complications (e.g., phlebitis and infiltration), and experience of individual catheter operators [33–35]. *Category IB*
4. Avoid the use of steel needles for the administration of fluids and medication that might cause tissue necrosis if extravasation occurs [33, 34]. *Category IA*
5. Use a midline catheter or peripherally inserted central catheter (PICC), instead of a short peripheral catheter, when the duration of IV therapy will likely exceed six days. *Category II*
6. Evaluate the catheter insertion site daily by palpation through the dressing to discern tenderness and by inspection if a transparent dressing is in use. Gauze and opaque dressings should not be removed if the patient has no clinical signs of infection. If the patient has local tenderness or other signs of possible CRBSI, an opaque dressing should be removed and the site inspected visually. *Category II*
7. Remove peripheral venous catheters if the patients develops signs of phlebitis (warmth, tenderness, erythema or palpable venous cord), infection, or a malfunctioning catheter [36]. *Category IB*

2.2. * Central Venous Catheters

1. Weigh the risks and benefits of placing a central venous device at a recommended site to

reduce infectious complications against the risk for mechanical complications (e.g., pneumothorax, subclavian artery puncture, subclavian vein laceration, subclavian vein stenosis, hemothorax, thrombosis, air embolism, and catheter misplacement) [37–53]. *Category IA*

2. Avoid using the femoral vein for central venous access in adult patients [38, 50, 51, 54]. *Category IA*
3. Use a subclavian site, rather than a jugular or a femoral site, in adult patients to minimize infection risk for nontunneled CVC placement [50–52]. *Category IB*
4. No recommendation can be made for a preferred site of insertion to minimize infection risk for a tunneled CVC. *Unresolved issue*
5. Avoid the subclavian site in hemodialysis patients and patients with advanced kidney disease, to avoid subclavian vein stenosis [53,55–58]. *Category IA*
6. Use a fistula or graft in patients with chronic renal failure instead of a CVC for permanent access for dialysis [59]. *Category IA*
7. Use ultrasound guidance to place central venous catheters (if this technology is available) to reduce the number of cannulation attempts and mechanical complications. Ultrasound guidance should only be used by those fully trained in its technique. [60–64]. *Category IB*
8. Use a CVC with the minimum number of ports or lumens essential for the management of the patient [65–68]. *Category IB*
9. No recommendation can be made regarding the use of a designated lumen for parenteral nutrition. *Unresolved issue*
10. Promptly remove any intravascular catheter that is no longer essential [69–72]. *Category IA*
11. When adherence to aseptic technique cannot be ensured (i.e., catheters inserted during a medical emergency), replace the catheter as soon as possible, i.e., within 48 hours [37,73–76]. *Category IB*

3. * Hand Hygiene and Aseptic Technique

1. Perform hand hygiene procedures, either by washing hands with conventional soap and water or with alcohol-based hand rubs (ABHR). Hand hygiene should be performed before and after palpating catheter insertion sites as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter. Palpation of the insertion site

3. * Hand Hygiene and Aseptic Technique

1. Perform hand hygiene procedures, either by washing hands with conventional soap and water or with alcohol-based hand rubs (ABHR). Hand hygiene should be performed before and after palpating catheter insertion sites as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter. Palpation of the insertion site

should not be performed after the application of antiseptic, unless aseptic technique is maintained [12, 77–79]. *Category IB*

2. Maintain aseptic technique for the insertion and care of intravascular catheters [37, 73, 74, 76]. *Category IB*
3. Wear clean gloves, rather than sterile gloves, for the insertion of peripheral intravascular catheters, if the access site is not touched after the application of skin antiseptics. *Category IC*
4. Sterile gloves should be worn for the insertion of arterial, central, and midline catheters [37, 73, 74, 76]. *Category IA*
5. Use new sterile gloves before handling the new catheter when guidewire exchanges are performed. *Category II*
6. Wear either clean or sterile gloves when changing the dressing on intravascular catheters. *Category IC*

4. * Maximal Sterile Barrier Precautions

1. Use maximal sterile barrier precautions, including the use of a cap, mask, sterile gown, sterile gloves, and a sterile full body drape, for the insertion of CVCs, PICCs, or guidewire exchange [14, 75, 76, 80]. *Category IB*
2. Use a sterile sleeve to protect pulmonary artery catheters during insertion [81]. *Category IB*

5. * Skin Preparation

1. Prepare clean skin with an antiseptic (70% alcohol, tincture of iodine, or alcoholic chlorhexidine gluconate solution) before peripheral venous catheter insertion [82]. *Category IB*
2. Prepare clean skin with a >0.5% chlorhexidine preparation with alcohol before central venous catheter and peripheral arterial catheter insertion and during dressing changes. If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as alternatives [82, 83]. *Category IA*
3. No comparison has been made between using chlorhexidine preparations with alcohol and povidone-iodine in alcohol to prepare clean skin. *Unresolved issue*.

6. * Catheter Site Dressing Regimens

1. Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site [84–87]. *Category IA*
2. If the patient is diaphoretic or if the site is bleeding or oozing, use a gauze dressing until this is resolved [84–87]. *Category II*
3. Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled [84, 85]. *Category IB*
4. Do not use topical antibiotic ointment or creams on insertion sites, except for dialysis catheters, because of their potential to promote fungal infections and antimicrobial resistance [88, 89]. *Category IB*
5. Do not submerge the catheter or catheter site in water. Showering should be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter (e.g., if the catheter and connecting device are protected with an impermeable cover during the shower) [90–92]. *Category IB*
6. Replace dressings used on short-term CVC sites every 2 days for gauze dressings. *Category II*
7. Replace dressings used on short-term CVC sites at least every 7 days for transparent dressings, except in those pediatric patients in which the risk for dislodging the catheter may outweigh the benefit of changing the dressing [87, 93]. *Category IB*
8. Replace transparent dressings used on tunneled or implanted CVC sites no more than once per week (unless the dressing is soiled or loose), until the insertion site has healed. *Category II*
9. No recommendation can be made regarding the necessity for any dressing on well-healed exit sites of long-term cuffed and tunneled CVCs. *Unresolved issue*
10. Ensure that catheter site care is compatible with the catheter material [94, 95]. *Category IB*

a. Chlorhexidine-impregnated dressings with an FDA-cleared label that specifies a clinical indication for reducing catheter-related bloodstream infection (CRBSI) or catheter-associated blood stream infection (CABSI) are recommended to protect the insertion site of short-term, non-tunneled central venous catheters. Updated Recommendations References 8-12 *Category IA*

(See Updated Chlorhexidine-Impregnated Dressings, Implementation Considerations for Patients Aged 18 Years and Older [https://www.cdc.gov/infectioncontrol/guidelines/bsi/c-i-dressings/considerations.html]).

[**Superseded 2011 Recommendation**] Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters in patients older than 2 months of age if the CLABSI rate is not decreasing despite adherence to basic prevention measures, including education and training, appropriate use of chlorhexidine for skin antisepsis, and MSB [93, 96–98]. *Category IB*

Recommendations 12 & 13 have been superseded. See the ***Updated Recommendations on Chlorhexidine-Impregnated Dressings*** (https://www.cdc.gov/infectioncontrol/guidelines/bsi/c-i-dressings/index.html) for more information.

13. ⚠ **Recommendation Update [July 2017]** For patients younger than 18 years:

a. Chlorhexidine-impregnated dressings are **NOT** recommended to protect the site of short-term, non-tunneled central venous catheters for premature neonates due to risk of serious adverse skin reactions. Updated Recommendations References 13,14 *Category IC*

b. No recommendation can be made about the use of chlorhexidine-impregnated dressings to protect the site of short-term, non-tunneled central venous catheters for pediatric patients less than 18 years old and non-premature neonates due to the lack of sufficient evidence from published, high-quality studies about efficacy and safety in this age group. Updated Recommendations References

7. * Patient Cleansing

1. * Use a 2% chlorhexidine wash for daily skin cleansing to reduce CRBSI [102–104]. *Category II*

8. * Catheter Securement Devices

1. * Use a sutureless securement device to reduce the risk of infection for intravascular catheters [105]. *Category II*

9. * Antimicrobial/Antiseptic Impregnated Catheters and Cuffs

1. * Use a chlorhexidine/silver sulfadiazine or minocycline/rifampin -impregnated CVC in patients whose catheter is expected to remain in place >5 days if, after successful implementation of a comprehensive strategy to reduce rates of CLABSI, the CLABSI rate is not decreasing. The comprehensive strategy should include at least the following three components: educating persons who insert and maintain catheters, use of maximal sterile barrier precautions, and a >0.5% chlorhexidine preparation with alcohol for skin antisepsis during CVC insertion [106–113]. *Category IA*

10. * Systemic Antibiotic Prophylaxis

1. * Do not administer systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or CRBSI [114]. *Category IB*

11. * Antibiotic/Antiseptic Ointments

1. * Use povidone iodine antiseptic ointment or bacitracin/gramicidin/ polymyxin B ointment at the hemodialysis catheter exit site after catheter insertion and at the end of each dialysis session only if this ointment does not interact with the material of the hemodialysis catheter per manufacturer's recommendation [59, 115–119]. *Category IB*

10. * Systemic Antibiotic Prophylaxis

1. * Do not administer systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or CRBSI [114]. *Category IB*

11. * Antibiotic/Antiseptic Ointments

1. * Use povidone iodine antiseptic ointment or bacitracin/gramicidin/ polymyxin B ointment at the hemodialysis catheter exit site after catheter insertion and at the end of each dialysis session only if this ointment does not interact with the material of the hemodialysis catheter per manufacturer's recommendation [59, 115–119]. *Category IB*

12. * Antibiotic Lock Prophylaxis, Antimicrobial Catheter Flush and Catheter Lock Prophylaxis

1. * Use prophylactic antimicrobial lock solution in patients with long term catheters who have a history of multiple CRBSI despite optimal maximal adherence to aseptic technique [120– 138]. *Category II*

13. * Anticoagulants

1. * Do not routinely use anticoagulant therapy to reduce the risk of catheter-related infection in general patient populations [139]. *Category II*

14. * Replacement of Peripheral and Midline Catheters

1. There is no need to replace peripheral catheters more frequently than every 72-96 hours to reduce risk of infection and phlebitis in adults [36, 140, 141]. *Category IB*
2. No recommendation is made regarding replacement of peripheral catheters in adults only when clinically indicated [142–144]. *Unresolved issue*
3. Replace peripheral catheters in children only when clinically indicated [32, 33]. *Category IB*
4. Replace midline catheters only when there is a specific indication. *Category II*

15. * Replacement of CVCs, Including PICCs and Hemodialysis Catheters

1. Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections. *Category IB*
2. Do not remove CVCs or PICCs on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a noninfectious cause of fever is suspected. *Category II*
3. Do not use guidewire exchanges routinely for non-tunneled catheters to prevent infection. *Category IB*
4. Do not use guidewire exchanges to replace a non-tunneled catheter suspected of infection. *Category IB*
5. Use a guidewire exchange to replace a malfunctioning non-tunneled catheter if no evidence of infection is present. *Category IB*
6. Use new sterile gloves before handling the new catheter when guidewire exchanges are performed. *Category II*

Category II

17. * Peripheral Arterial Catheters and Pressure Monitoring Devices for Adult and Pediatric Patients

1. In adults, use of the radial, brachial or dorsalis pedis sites is preferred over the femoral or axillary sites of insertion to reduce the risk of infection [46, 47, 157, 158]. *Category IB*
2. In children, the brachial site should not be used. The radial, dorsalis pedis, and posterior tibial sites are preferred over the femoral or axillary sites of insertion [46]. *Category II*
3. A minimum of a cap, mask, sterile gloves and a small sterile fenestrated drape should be used during peripheral arterial catheter insertion [47, 158, 159]. *Category IB*
4. During axillary or femoral artery catheter insertion, maximal sterile barriers precautions should be used. *Category II*
5. Replace arterial catheters only when there is a clinical indication. *Category II*
6. Remove the arterial catheter as soon as it is no longer needed. *Category II*
7. Use disposable, rather than reusable, transducer assemblies when possible [160–164]. *Category IB*
8. Do not routinely replace arterial catheters to prevent catheter-related infections [165, 166, 167, 168]. *Category II*
9. Replace disposable or reusable transducers at 96-hour intervals. Replace other components of the system (including the tubing, continuous-flush device, and flush solution) at the time the transducer is replaced [37, 161]. *Category IB*
10. Keep all components of the pressure monitoring system (including calibration devices and flush solution) sterile [160, 169–171]. *Category IA*

11. Minimize the number of manipulations of and entries into the pressure monitoring system. Use a closed flush system (i.e., continuous flush), rather than an open system (i.e., one that requires a syringe and stopcock), to maintain the patency of the pressure monitoring catheters [163, 172]. *Category II*
12. When the pressure monitoring system is accessed through a diaphragm, rather than a stopcock, scrub the diaphragm with an appropriate antiseptic before accessing the system [163]. *Category IA*
13. Do not administer dextrose-containing solutions or parenteral nutrition fluids through the pressure monitoring circuit [163, 173, 174]. *Category IA*

11. Minimize the number of manipulations of and entries into the pressure monitoring system. Use a closed flush system (i.e., continuous flush), rather than an open system (i.e., one that requires a syringe and stopcock), to maintain the patency of the pressure monitoring catheters [163, 172]. *Category II*
12. When the pressure monitoring system is accessed through a diaphragm, rather than a stopcock, scrub the diaphragm with an appropriate antiseptic before accessing the system [163]. *Category IA*
13. Do not administer dextrose-containing solutions or parenteral nutrition fluids through the pressure monitoring circuit [163, 173, 174]. *Category IA*
14. Sterilize reusable transducers according to the manufacturers' instructions if the use of disposable transducers is not feasible [163, 173–176]. *Category IA*

18. * Replacement of Administration Sets

1. In patients not receiving blood, blood products or fat emulsions, replace administration sets that are continuously used, including secondary sets and add-on devices, no more frequently than at 96-hour intervals, [177] but at least every 7 days [178–181]. *Category IA*
2. No recommendation can be made regarding the frequency for replacing intermittently used administration sets. *Unresolved issue*
3. No recommendation can be made regarding the frequency for replacing needles to access implantable ports. *Unresolved issue*
4. Replace tubing used to administer blood, blood products, or fat emulsions (those combined with amino acids and glucose in a 3-in-1 admixture or infused separately) within 24 hours of initiating the infusion [182–185]. *Category IB*
5. Replace tubing used to administer propofol infusions every 6 or 12 hours, when the vial is changed, per the manufacturer's recommendation (FDA website Medwatch) [186]. *Category IA*
6. No recommendation can be made regarding the length of time a needle used to access implanted ports can remain in place. *Unresolved issue*

19. * Needleless Intravascular Catheter Systems

1. Change the needleless components at least as frequently as the administration set. There is no benefit to changing these more frequently than every 72 hours. [39, 187–193]. *Category II*
2. Change needleless connectors no more frequently than every 72 hours or according to manufacturers' Recommendations for the purpose of reducing infection rates [187, 189, 192, 193]. *Category II*
3. Ensure that all components of the system are compatible to minimize leaks and breaks in the system [194]. *Category II*
4. Minimize contamination risk by scrubbing the access port with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol) and accessing the port only with sterile devices [189, 192, 194–196]. *Category IA*
5. Use a needleless system to access IV tubing. *Category IC*
6. When needleless systems are used, a split septum valve may be preferred over some mechanical valves due to increased risk of infection with the mechanical valves [197–200]. *Category II*

20. * Performance Improvement

1. * Use hospital-specific or collaborative-based performance improvement initiatives in which multifaceted strategies are "bundled" together to improve compliance with evidence-based recommended practices [15, 69, 70, 201–205]. *Category IB*

Strategies for Prevention of Catheter-Related Infections in Adult and Pediatric Patients

Education, Training and Staffing

Recommendations

1. Educate healthcare personnel regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections [7–15]. *Category IA*
2. Periodically assess knowledge of and adherence to guidelines for all personnel involved in the insertion and maintenance of intravascular catheters [7–15]. *Category IA*
3. Designate only trained personnel who demonstrate competence for the insertion and maintenance of peripheral and central intravascular catheters. [14–28]. *Category IA*
4. Ensure appropriate nursing staff levels in ICUs. Observational studies suggest that a higher proportion of "pool nurses" or an elevated patient–to-nurse ratio is associated with CRBSI in ICUs where nurses are managing patients with CVCs [29–31]. *Category IB*

Background

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. Reports spanning

the past four decades have consistently demonstrated that risk for infection declines following standardization of aseptic care [7, 12, 14, 15, 239–241] and that insertion and maintenance of intravascular catheters by inexperienced staff might increase the risk for catheter colonization and CRBSI [15, 242]. Specialized "IV teams" have shown unequivocal effectiveness in reducing the incidence of CRBSI, associated complications, and costs [16–26]. Additionally, infection risk increases with nursing staff reductions below a critical level [30].

Hand Hygiene and Aseptic Technique

Recommendations

1. Perform hand hygiene procedures, either by washing hands with conventional soap and water or with alcohol-based hand rubs (ABHR). Hand hygiene should be performed before and after palpating catheter insertion sites as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter. Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained [12, 77–79]. *Category IB*
2. Maintain aseptic technique for the insertion and care of intravascular catheters [37, 73, 74, 76]. *Category IB*
3. Wear clean gloves, rather than sterile gloves, for the insertion of peripheral intravascular catheters, if the access site is not touched after the application of skin antiseptics. *Category IC*
4. Sterile gloves should be worn for the insertion of arterial, central, and midline catheters [37, 73, 74, 76]. *Category IA*
5. Use new sterile gloves before handling the new catheter when guidewire exchanges are performed. *Category II*

6. Wear either clean or sterile gloves when changing the dressing on intravascular catheters. *Category IC*

Background

Hand hygiene before catheter insertion or maintenance, combined with proper aseptic technique during catheter manipulation, provides protection against infection [12]. Proper hand hygiene can be achieved through the use of either an al-cohol-based product [255] or with soap and water with adequate rinsing [77]. Appropriate aseptic technique does not necessarily require sterile gloves for insertion of peripheral catheters; a new pair of disposable nonsterile gloves can be used in conjunction with a "no-touch" technique for the insertion of peripheral venous catheters. Sterile gloves must be worn for placement of central catheters since a "no-touch" technique is not possible.

Maximal Sterile Barrier Precautions

Recommendations

1. Use maximal sterile barrier precautions, including the use of a cap, mask, sterile gown, sterile gloves, and a sterile full body drape, for the insertion of CVCs, PICCs, or guidewire exchange [14, 75, 76, 80]. *Category IB*
2. Use a sterile sleeve to protect pulmonary artery catheters during insertion [81]. *Category IB*

Background

Maximum sterile barrier (MSB) precautions are defined as wearing a sterile gown, sterile gloves, and cap and using a full body drape (similar to the drapes used in the operating room) during the placement of CVC. Maximal sterile barrier precautions during insertion of CVC were compared with sterile gloves and a small drape in a randomized controlled trial. The MSB group had fewer episodes of both catheter colonization (RR = .32, 95% CI, .10–.96, P = .04) and CR-BSI (RR = .16, 95% CI, .02–1.30, P = .06). In addition, the group using MSB precautions had infections that occurred much later and contained gram negative, rather than gram positive, organisms [76]. A study of pulmonary artery catheters also secondarily demonstrated that use of MSB precautions lowered risk of infection [37]. Another study evaluated an educational program directed at improving infection control practices, especially MSB precautions. In this study, MSB precautions use increased and CRBSI decreased [14]. A small trial demonstrated a

Skin Preparation

Recommendations

1. Prepare clean skin with an antiseptic (70% alcohol, tincture of iodine, an iodophor or chlorhexidine gluconate) before peripheral venous catheter insertion [82]. *Category IB*
2. Prepare clean skin with a >0.5% chlorhexidine preparation with alcohol before central venous catheter and peripheral arterial catheter insertion and during dressing changes. If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as alternatives [82, 83]. *Category IA*
3. No comparison has been made between using chlorhexidine preparations with alcohol and povidone-iodine in alcohol to prepare clean skin. *Unresolved issue*.
4. No recommendation can be made for the safety or efficacy of chlorhexidine in infants aged <2 months. *Unresolved issue*
5. Antiseptics should be allowed to dry according to the manufacturer's recommendation prior to placing the catheter [82, 83]. *Category IB*

Catheter Site Dressing Regimens

Recommendations

1. Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site [84–87]. *Category IA*
2. If the patient is diaphoretic or if the site is bleeding or oozing, use gauze dressing until this is resolved [84–87]. *Category II*
3. Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled [84, 85]. *Category IB*
4. Do not use topical antibiotic ointment or creams on insertion sites, except for dialysis catheters, because of their potential to promote fungal infections and antimicrobial resistance [88, 89]. *Category IB*
5. Do not submerge the catheter or catheter site in water. Showering should be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter (e.g., if the catheter and connecting device are protected with an impermeable cover during the shower) [90–92]. *Category IB*
6. Replace dressings used on short-term CVC sites every 2 days for gauze dressings. *Category II*
7. Replace dressings used on short-term CVC sites at least every 7 days for transparent dressings, except in those pediatric patients in which the risk for dislodging the catheter may outweigh the benefit of changing the dressing [87, 93]. *Category IB*
8. Replace transparent dressings used on tunneled or implanted CVC sites no more than once per week (unless the dressing is soiled or loose), until the insertion site has healed. *Category II*
9. No recommendation can be made regarding the necessity for any dressing on well-healed exit sites of long-term cuffed and tunneled CVCs. *Unresolved issue*

10. Ensure that catheter site care is compatible with the catheter material [94, 95]. *Category IB*
11. Use a sterile sleeve for all pulmonary artery catheters [81]. *Category IB*

Superseded Recommendations

Recommendations 12 & 13 have been superseded.

See the ***Updated Recommendations on Chlorhexidine-Impregnated Dressings*** (*https://www.cdc.gov/infectioncontrol/guidelines/bsi/c-i-dressings/index.html*) for more information. For justification for the updates, see:

- Evidence Summary (https://www.cdc.gov/infectioncontrol/guidelines/bsi/c-i-dressings/summary.html)
- Appendix [PDF – 388 KB] (https://www.cdc.gov/infectioncontrol/guidelines/pdf/guidelines/c-i-dressings-appendix.pdf)

12. ⚠ **Recommendation Update [July 2017]** For patients aged 18 years and older:

    a. Chlorhexidine-impregnated dressings with an FDA-cleared label that specifies a clinical indication for reducing catheter-related bloodstream infection (CRBSI) or catheter-associated blood stream infection (CABSI) are recommended to protect the insertion site of short-term, non-tunneled central venous catheters. Updated Recommendations References 8-12 *Category IA*

13. ⚠ **Recommendation Update [July 2017]** For patients younger than 18 years:

    a. Chlorhexidine-impregnated dressings are **NOT** recommended to protect the site of short-term, non-tunneled central venous catheters for premature neonates due to risk of serious adverse skin reactions. Updated Recommendations References 13, 14 *Category IC* [**Superseded 2011 Recommendation**] No recommendation is made for other types of chlorhexidine dressings. *Unresolved issue*

    b. No recommendation can be made about the use of chlorhexidine-impregnated dressings to protect the site of short-term, non-tunneled central venous catheters for pediatric patients less than 18 years old and non-premature neonates due to the lack of sufficient evidence from published, high-quality studies about efficacy and safety in this age group. Updated Recommendations References 14, 15 *Unresolved issue*

14. Monitor the catheter sites visually when changing the dressing or by palpation through an intact dressing on a regular basis, depending on the clinical situation of the individual patient. 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 of the site [99–101]. *Category IB*
15. Encourage patients to report any changes in their catheter site or any new discomfort to their provider. *Category II*

Background

Transparent, semi-permeable polyurethane dressings permit continuous visual inspection of the catheter site and require less frequent changes than do standard gauze and tape dressings. In the largest controlled trial of dressing regimens on peripheral catheters, the infectious morbidity associated with the use of transparent dressings on approximately 2,000 peripheral catheters was examined [254]. Data from this study suggest that the rate of colonization among catheters dressed with transparent dressings (5.7%) is comparable to that of those dressed with gauze (4.6%) and that no clinically substantial differences exist in the incidence of either catheter site colonization or phlebitis. Furthermore, these data suggest that transparent dressings can be safely left on peripheral venous catheters for the duration of catheter insertion without increasing the risk for thrombophlebitis [254].

A meta-analysis has assessed studies that compared the risk for CRBSIs using transparent dressings versus using gauze dressing [260]. The risk for CRBSIs did not differ between the groups. The choice of dressing can be a matter of preference. If blood is oozing from the catheter insertion site, gauze dressing is preferred. Another systemic review of randomized controlled trials comparing gauze and tape to transparent dressings found no significant differences

Antibiotic/Antiseptic Ointments

Recommendation

1. Use povidone iodine antiseptic ointment or bacitracin/ gramicidin/polymyxin B ointment at the hemodialysis catheter exit site after catheter insertion and at the end of each dialysis session only if this ointment does not interact with the material of the hemodialysis catheter per manufacturer's recommendation [59, 115–119]. Category IB

Background

A variety of topical antibiotic or antiseptic ointments have been utilized in attempts to lower the antimicrobial burden at the catheter insertion site and thus prevent infection. A number of older studies, examining primarily peripheral venous catheters, yielded varying conclusions [82, 285, 286]. In addition, the use of antibiotic ointments that have limited antifungal activity may serve to increase colonization and/or infection due to *Candida* species [89].

More recent studies have examined this approach in high-risk patients, particularly those undergoing hemodialysis [116–119]. Three randomized, controlled trials have evaluated the use of 10% povidone iodine [117–119]. A significant decrease in colonization, exit-site infection, or bloodstream infection was observed. The beneficial effect was most prominent in subjects with nasal colonization by *Staphylococcus aureus* [117–119].

Nasal carriers of *S. aureus* are more likely to experience a CRBSI than non-colonized persons [287–289]. This has prompted investigators to assess the utility of topical mupirocin, a potent anti-staphylococcal agent. Several studies have demonstrated a reduced risk of CRBSI when mupirocin ointment was applied at the catheter insertion site [117, 290–292]. Others have shown similar benefits when mupirocin was applied nasally [288, 289, 293]. However,

enthusiasm for this measure has been dampened by the rapid emergence of mupirocin resistance observed at some centers [88, 294, 295], and the potential degrading effect that mupirocin has on polyurethane catheters [94, 95].

Anticoagulants

Recommendation

1. Do not routinely use anticoagulant therapy to reduce the risk of catheter-related infection in general patient populations [139]. *Category II*

Background

Shortly after insertion, intravascular catheters are coated with a conditioning film, consisting of fibrin, plasma proteins, and cellular elements, such as platelets and red blood cells [213, 302]. Microbes interact with the conditioning film, resulting in colonization of the catheter [303]. There is a close association between thrombosis of central venous catheters and infection [221, 304, 305]. Therefore, anticoagulants have been used to prevent catheter thrombosis and presumably reduce the risk of infection.

In a meta-analysis evaluating the benefit of heparin prophylaxis (3 units/mL in parenteral nutrition, 5,000 units every 6 or 12 hours flush or 2,500 units low molecular weight heparin subcutaneously) in patients with short-term CVCs, the risk for catheter-related central venous thrombosis was reduced with the use of prophylactic heparin [139]. However, no substantial difference in the rate of CRBSI was observed. In a more recent prospective, randomized trial, 204 patients with non-tunneled catheters were assigned to receive a continuous infusion of

heparin (100 units/kg/ d) or saline (50 mL/d) [306]. The rate of CRBSI was significantly decreased in the group receiving heparin (2.5 BSI/1,000 CVC days vs. 6.4 BSI/1,000 CVC days). Because the majority of heparin solutions contain preservatives with antimicrobial activity, whether any decrease in the rate of CRBSI is a result of the reduced thrombus formation, the preservative, or both is unclear. The majority of pulmonary artery, umbilical, and central venous catheters are available as heparin-bonded devices. The majority of catheters are heparin bonded with benzalkonium, which provides the catheters with antimicrobial activity [307] and provides an anti-thrombotic effect [308]. However, some catheters have heparin bound directly to the catheter without benzalkonium [309]. Studies have shown that heparin-bonded catheters reduce risk of thrombosis and risk of CRBSI [306, 308– 310], but are less effective at reducing catheter colonization than catheters impregnated with chlorhexidine/silver sulfadiazine [311]. Unfortunately, heparin-induced thrombocytopenia can occur and has prompted many clinicians to avoid heparin [312]. Trisodium citrate has been

Replacement of CVCs, Including PICCs and Hemodialysis Catheters

Recommendations

1. Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections. *Category IB*
2. Do not remove CVCs or PICCs on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a noninfectious cause of fever is suspected. *Category II*
3. Do not use guidewire exchanges routinely for non-tunneled catheters to prevent infection. *Category IB*
4. Do not use guidewire exchanges to replace a non-tunneled catheter suspected of infection. *Category IB*
5. Use a guidewire exchange to replace a malfunctioning non-tunneled catheter if no evidence of infection is present. *Category IB*
6. Use new sterile gloves before handling the new catheter when guidewire exchanges are performed. *Category II*

Background

Replacement of Administration Sets

Recommendations

1. In patients not receiving blood, blood products or fat emulsions, replace administration sets that are continuously used, including secondary sets and add-on devices, no more frequently than at 96-hour intervals, [177] but at least every 7 days [178–181]. *Category IA*

2. No recommendation can be made regarding the frequency for replacing intermittently used administration sets. *Unresolved issue*
3. No recommendation can be made regarding the frequency for replacing needles to access implantable ports. *Unresolved issue*
4. Replace tubing used to administer blood, blood products, or fat emulsions (those combined with amino acids and glucose in a 3-in-1 admixture or infused separately) within 24 hours of initiating the infusion [182–185]. *Category IB*
5. Replace tubing used to administer propofol infusions every 6 or 12 hours, when the vial is changed, per the manufacturer's recommendation (FDA website Medwatch) [186]. *Category IA*
6. No recommendation can be made regarding the length of time a needle used to access implanted ports can remain in place. *Unresolved issue*

Background

The optimal interval for routine replacement of IV administration sets has been examined in a number of well-controlled studies and meta-analyses. Data from these studies reveal that replacing administration sets no more frequently than 72–96 hours after initiation of use is safe and cost-effective [141, 177, 179–181]. More recent studies suggest that administration sets may be used safely for up to 7 days if used in conjunction with antiseptic catheters or if fluids that enhance microbial growth (e.g., parenteral nutrition or blood) have not been used [216, 345]. When a fluid that enhances microbial growth is infused (e.g., fat emulsions and blood products), more frequent changes of administration sets are indicated as these products have been identified as independent risk factors for CRBSI [182, 216, 346–350]. Little data exist regarding the length of time a needle used to access implanted ports can remain in place and the risk of CRBSI. While some centers have left them in place for several weeks without CRBSI, [351], this practice has not been adequately studied.

Needleless Intravascular Catheter Systems

Recommendations

1. Change the needleless components at least as frequently as the administration set. There is no benefit to changing these more frequently than every 72 hours. [39, 187–193]. *Category II*

2. Change needleless connectors no more frequently than every 72 hours or according to manufacturers' Recommendations for the purpose of reducing infection rates [187, 189, 192, 193]. *Category II*
3. Ensure that all components of the system are compatible to minimize leaks and breaks in the system [194]. *Category II*
4. Minimize contamination risk by scrubbing the access port with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol) and accessing the port only with sterile devices [189, 192, 194–196]. *Category IA*
5. Use a needleless system to access IV tubing. *Category IC*
6. When needleless systems are used, a split septum valve may be preferred over some mechanical valves due to increased risk of infection with the mechanical valves [197–200]. *Category II*

Background

Stopcocks used for injection of medications, administration of IV infusions, and collection of blood samples represent a potential portal of entry for microorganisms into vascular access catheters and IV fluids. Whether such contamination is a substantial entry point of microorganisms that cause CRBSI has not been demonstrated. Nonetheless, stopcocks should be capped when not being used. In general, closed catheter access systems are associated with fewer CRBSIs than open systems and should be used preferentially [352].

"Piggyback" systems (secondary intermittent infusions delivered through a port on a primary infusion set) are used as an alternative to stopcocks. However, they also pose a risk for contamination of the intravascular fluid if the device entering the rubber membrane of an injection port is exposed to air or if it comes into direct contact with nonsterile tape used to fix the needle to the port. Modified piggyback systems have the potential to prevent contamination at these sites [353].

Attempts to reduce the incidence of sharps injuries and the resultant risk for transmission of bloodborne infections to healthcare personnel have led to the introduction and mandating of needleless infusion systems. There are several types of needleless connectors on the market.

The first type of needleless system connectors consisted of a split septum connector, which

Performance Improvement

Recommendation

1. Use hospital-specific or collaborative-based performance improvement initiatives in which multifaceted strategies are "bundled" together to improve compliance with evidence-based recommended practices [15, 69, 70, 201–205]. *Category IB*

Background

Clinical decision makers, healthcare payers, and patient safety advocates emphasize the importance of translating research findings into everyday practice. Rigorous evaluations of CRBSI preventive practices using study designs with high internal validity and including study populations that optimize external validity remain necessary. Once practices have been determined to be effective and economically efficient, the next step is to implement these evidence-based practices so they become part of routine clinical care. Unfortunately, implementation of evidence- based CRBSI preventive practices in U.S. hospitals has been suboptimal [361, 362]. In a national survey conducted in March 2005 of over 700 U.S. hospitals, approximately one quarter of U.S. hospitals indicated that either maximal sterile barrier precautions during central line insertion or chlorhexidine gluconate as site disinfectant, two

practices widely recommended in the guidelines published in 2002 [363], were not being used routinely [364]. Approximately 15% of U.S. hospitals reported routinely changing CVCs to prevent infection despite evidence that this practice should no longer be used [362, 364].

Accordingly, investigators have attempted various approaches to better translate research findings and evidence-based Recommendations into clinical practice. Numerous quality improvement studies have been published during the past several years that have used various methods, such as education of healthcare personnel, audit and feedback, organizational change, and clinical reminders [8–11, 69, 70, 202, 365–367]. The educational interventions primarily targeted hand hygiene, use of maximal sterile barriers during insertion, appropriate insertion site selection, proper site care using chlorhexidine gluconate, and prompt removal of unnecessary catheters. While a large number of before-and-after studies with a few using concurrent control groups [15, 70] have been published, no randomized, controlled trial evaluating a quality improvement strategy to prevent CRBSI has been reported [368]. The vast majority of before-and-after studies reported statistically significant decreases in CRBSI rates after a quality improvement strategy was implemented [368]. Additionally, both controlled trials also found statistically significant reductions of CRBSI in the intervention units compared with control units [15, 70].

الملخص

الخلفية: غالبًا ما تعاني وحدة العناية المركزة من عدوى مجرى الدم المرتبطة بالقسطرة الوريدية المركزية، والتي تعتبر واحدة من أكثر أمراض العدوى المرتبطة بالرعاية الصحية. يعد دور الممرض محوريًا في ضمان تنفيذ مكافحة عدوى مجرى الدم المرتبطة بالقسطرة الوريدية المركزية، سواء أثناء بداية أدخال القسطرة، رعايتها وإجراءات متابعتها تحقيق الأداء الأمثل للتمريض في هذ المجال يتم من خلال الالتزام بالبروتوكولات القائمة على الأدلة العلمية وإنجاز موحد للبرامج التعليمية. يحاول هذا البحث تقييم فعالية تنفيذ برنامج تعليمي قائم على الأدلة حول معرفة التمريض وممارسته فيما يتعلق بالوقاية من عدوى مجرى الدم المرتبطة بالقسطرة الوريدية المركزية في وحدة العناية المركزة.

هدف الدراسة: تهدف هذه الدراسة إلى تقييم ومراجعة فعالية تنفيذ برنامج تعليمي قائم على الأدلة العلمية حول معرفة الممرضين وممارساتهم المتعلقة بالوقاية من العدوى المرتبطة بالقسطرة الوريدية المركزية عند المرضى البالغين المصابين بأمراض حرجة.

المنهجية: البحث دراسة كمية شبه تجريبية. تضمنت الدراسة عينة سمى العينة الملائمة مع ما مجموعه 70 من ممرضي العناية المكثفة الذين يعملون في مستشفيات مدينة جنين في فلسطين (مستشفى ابن سينا، مستشفى الرازي ومستشفى جنين الحكومي) تم تخصيص المشاركين في مجموعه واحدة في الدراسة (تصميم دراسي يتضمن القياس ما قبل وما بعد التدخل) حيث تم تبني هذا النوع من الدراسة وتم قياس معرفة وممارسة تمريض العناية المكثفة والمقارنة بينهما قبل وبعد البرنامج التعليمي، أجريت الدراسة على مدى خمسة أشهر في الفترة من فبراير 2024 إلى نهاية يوليو 2024.

النتيجة: أظهرت النتيجة أن هناك اختلافًا ذا دلالة إحصائية هامة في مستوى المعرفة والممارسة بعد البرنامج التعليمي، وارتفع متوسط درجة المعرفة بشكل ملحوظ من 4.25 ± 1.37 قبل التدخل إلى 13.05 ± 1.58 بعد التدخل الذي أشار إليه الاختبار المزدوج($T = 35.35$ ، $P < 0.001$) وأظهرت درجة الممارسة زيادة ملحوظة حيث ارتفع المتوسط 2.45 ± 1.03 قبل التدخل إلى 14.85

± 2.09 بعد التدخل. كما أن نتيجة اختبار t المقترنة45.75 = t) ، (0.001 > p تؤكد أن هذا التحسن كان هام للغاية.

الخلاصة: أكدت الدراسة أن معرفة الممرضين بالوقاية من عدوى مجرى الدم بالقسطرة الوريدية المركزية قد تحسنت بشكل كبير بعد تنفيذ البرنامج التعليمي القائم على الأدلة العلمية كما كشفت النتائج عن اختلافات في الممارسات العملية والتي اشارت أيضا الى تحسن هام في الرعاية التمريضية ما بعد تنفيذ البرنامج ولكن سلطت الضوء على ان الممرضين بحاجة الى المزيد من الالتزام بالممارسة العملية الوقائية الصحيحة بما يخص العدوى المرتبطة بالقسطرة الوريدية المركزية خاصة في المناطق ذات الاستخدام العالي لها.

الكلمات المفتاحية: القســـطرة المركزية، عدوى مجرى الدم بالقســـطرة الوريدية المركزية، البرنامج التعليمي.