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Association Between Central Line Practices and Bloodstream Infections in Palestinian Hospital's Neonatal Intensive Care Units: A Retrospective Study

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Declaration

I declare that, except where explicit reference is made to the contribution of others, this thesis is substantially my own work and has not been submitted for any other degree at the Arab American University or any other institution.

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Abstract

Catheter-related bloodstream infections (CRBSI) and central line-associated bloodstream infections (CLABSI) are the two main classifications of bloodstream infections (BSIs) linked to Central venous catheters CVCs. In hospitalized neonates, healthcare-associated infections (HAIs) in neonatal intensive care units (NICUs) significantly increase morbidity and late mortality. To reduce infections linked to invasive medical equipment, numerous clinical guidelines have been developed. According to the Institute for Healthcare Improvement, "bundles" are groups of best practices related to a disease process that, when used collectively, significantly improve the quality of care.

To examine the association between central line practices and bloodstream infections in Palestinian hospitals' NICUs.
A retrospective, descriptive, quantitative study design was conducted at hospitals that contain NICUs. The target population was Newborns with central lines, who met the inclusion criteria. A convincing sample composed of (110) NICU neonates was included in the study during the data collection period.

The most frequently utilized central lines (61.8%) are umbilical venous catheters (UVCs), which are mostly placed by neonatologists (74.5%), according to the findings. Despite the high rate of adherence to established insertion protocols (98.2%), there is still a lack of infection prevention strategies, such as the use of antiseptics (17.3%) and full barrier precautions (10.9%). Regular site inspections (92.7%) and mostly aseptic (50.9%) or sterile (47.3%) dressing changes are part of the strict central line management regimen. Candida spp. (25.5%) and Staphylococcus aureus (24.5%) are the most prevalent BSI pathogens; infections are cured in 56.4% of cases, but cause complications (12.7%) or death (9.1%) in other cases. CLABSI was significantly reduced (90.9%) as a result of staff education (27.3%) and care bundle implementation (66.4%). To further reduce BSIs, the study emphasizes the necessity of improved infection prevention strategies.
This study emphasizes the connection between bloodstream infections in Palestinian NICUs and the usage of CVC. Stricter infection control methods are required to further minimize CLABSIs, even when procedure adherence is excellent. Strong surveillance, employee training, and ongoing quality improvement are crucial.
Key Words: Central Line, Bloodstream Infections, Neonatal Intensive Care Units.

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List of Definitions of Abbreviations

Abbreviations	Title
AAUP	Arab American University Palestine
BSIs	bloodstream infections
CDC	Centers for Disease Control and Prevention
CLABSI	central line-associated bloodstream infections
CLUR	Central Line Utilization Ratio
CRBSI	Catheter-related bloodstream infections
CRP	C-reactive protein
CVCs	Central venous catheters
FVCs	femoral venous catheters
HAIs	healthcare-associated infections
ICUs	intensive care units
INICC	International Nosocomial Infection Control Consortium
IRB	Institutional Review Board
ISH	Ibn Sina Hospital
IV	intravenous fluids
LOS	length of stay
NHSN	National Health Surveillance System
NICUs	neonatal intensive care units
PICC	peripherally inserted central catheters
SAH	Specialized Arab Hospital
SPSS	Statistical Package for the Social Sciences
UVCs	Umbilical Vein catheter
VLBW	very low birth weight

Chapter One: Introduction

1.1 Background

Catheter-related bloodstream infections (CRBSI) and central line-associated bloodstream infections (CLABSI) are the two main classifications of bloodstream infections (BSIs) linked to Central venous catheters (CVCs). When bacteremia from the intravenous catheter is confirmed by particular laboratory testing, it is referred to be CRBSI. Conversely, CLABSI is characterized as a primary BSI in a patient who has a central line placed within 48 hours of the onset of symptoms and is not associated with another infection site (Cho and Cho, 2019). Since peripheral blood or catheter tips are not cultured, it is more practical for surveillance purposes but may overestimate the actual rate of CVC-related infections (Cho and Cho, 2019).

In hospitalized neonates, healthcare-associated infections (HAIs) in neonatal intensive care units (NICUs) significantly increase morbidity and late mortality. Many nosocomial infection episodes affect about 25% of very low birth weight (VLBW), less than 1,500 grams, which presents serious health hazards. Prematurity, low birth weight, invasive procedures, indwelling vascular catheters, endotracheal tubes, ventricular shunts, parenteral nutrition with lipid emulsions, compromised skin and mucous membrane barriers, broad-spectrum antibiotics, and extended hospital stays are risk factors for HAIs in neonatal intensive care units (Durant et al., 2024).

Between 5% and 35% of deaths are attributed to HAIs, which poses a serious risk to patients safety (Hightower et al., 2022). Significant risk factors for HAIs include the use of invasive medical devices, such as intravenous catheters, and healthcare workers' inadequate adherence to infection control protocols during the insertion and upkeep of these devices. These expensive and harmful diseases largely caused by the continued uses of these technologies and the contempt for aseptic procedure (Hightower et al., 2022).

The most prevalent type of HAI in NICUs, BSIs, impact 20% to 36% of VLBW infants with sepsis with that manifests within three days of birth. CVCs are responsibles for most occurrences of late-onset sepsis. High death rates, inadequate development and

neurological outcomes, and prolonged hospital admissions are common in premature newborns with catheter-related infections, all of which raise medical expenses. Therefore, improving the outcome of NICU infants require lowering the prevalence of CVC-related infections (Muller et al., 2023).

Additionally, infants with at least one BSI may have adjusted hospitalization costs up to $50,000 higher and hospital stays up to 10 days longer than VLBW newborns without a BSI (Zipursky et al., 2019).

The National Healthcare Safety Network in the United States defines CLABSI as a primary blood culture-based shock illness in children younger than one year old that presents with symptoms such as fever (>38°C), hypothermia (<36°C), apnea, or bradycardia. The illness can be caused by a common skin commensal from two different blood cultures or by a recognized pathogen from one blood culture. These classifications might not apply to newborns, though, as their symptoms are different. Although a newborn's body temperature rarely rises above 38.0°C, they are susceptible to temperature instability, hyperthermia, and hypothermia. Temperature instability, tachycardia, metabolic acidosis, and recently established hyperglycemia are possible additional diagnostic criteria. Some have proposed adding antigen testing and clinical as well as laboratory-confirmed BSIs to the criteria (Kim et al., 2021).

The etiological organisms of CLABSI in NICUs are comparable to those in adults; however, because of increased bacterial translocation from the gastrointestinal tract, especially in infants receiving long-term parenteral nutrition, there is a higher proportion of gram-negative organisms in NICUs, such as Klebsiella pneumonia, E. coli, and Enterobacter cloacae. Gram-negative bacteria are more abundant in developing nations, while gram-positive bacteria, such as Staphylococcus aureus and coagulase-negative staphylococci (CoNS), are more common in wealthy nations (Hamza et al., 2021).

Two clinical indicators and two positive laboratory tests were used to diagnose sepsis. Atypical body temperature without peripheral perfusion abnormalities, bradycardia or tachycardia, tachypnea or apnea, gastrointestinal retention, flatulence, hyperbilirubinemia,

loss of muscular tone, and unwillingness to feed were among the clinical symptoms. Leukocytosis, high C-reactive protein (CRP) levels, and raised serum procalcitonin were laboratory markers of sepsis. When the same organisms developed from a culture obtained from the venous catheter tip and culture obtained from percutaneous blood, CRBSI was verified (Kochanowicz et al., 2022).

Blood cultures are required when sepsis is suspected and are the gold standard for diagnosing the condition. A newly positioned venous access point provided 0.5–1 ml of blood, which was then examined utilizing the bacT/ALERT 3D microbiological identification system. As advised by the manufacturer, an automatic incubation system was used to culture the blood. To prevent contamination, blood samples were taken under strict aseptic procedures that included covering the collection site with surgical covers, donning sterile gowns and gloves, and washing hands surgically (Kochanowicz et al., 2022; Helder et al., 2019).

1.2 Introduction

Central venous catheters (CVCs) are often necessary for administering medication, fluids, parenteral nutrition, and central venous monitoring to hospitalized neonates in NICUs. CVCs have a lot to give, but they can also cause infections and other problems. A laboratory-confirmed bloodstream infection that happens 48 hours following the implantation of a central line or within 48 hours following its removal and is unrelated to another infection site is known as CLABSI (Bierlaire et al., 2020). Most premature infants have central line insertion, particularly peripherally inserted central catheters (PICC), to administer medication and provide nutritional support (Cho and Cho, 2019). Infections related to central lines that occur in the bloodstream (i.e., CLABSIs) are among the most common HAIs in the NICU. Various documented effective quality improvement initiatives have been over the last ten years to lower the NICU's CLABSI rates (Cho and Cho, 2019).

A 70% estimated death rate is associated with CRBSI in infants, and growth and neurodevelopmental problems may occur later in life. While early-onset sepsis is usually described as happening within the first 72 hours of life, late-onset sepsis in newborns is

categorized as symptoms appearing between the third and the seventh day of life (Kochanowicz et al., 2022).

Even in the absence of invasive equipment, preterm, compromised skin integrity, and extended hospital stays raise the risk of infection in neonates. The International Nosocomial Infection Control Consortium (INICC) reports NICU CLABSI rates that are three to four times higher than those recorded by the US National Health Surveillance System (NHSN) from resource-constrained countries (Helder et al., 2019).

Although they are widely utilized in intensive care units (ICUs), CVCs and needleless connections are susceptible to microbial infection. Both the intraluminal side from contaminated catheter hub connectors, intravenous fluids (IV), or bacteremia and the extraluminal side from the skin during and after catheter insertion can harbor microorganisms. Before inserting a catheter, prepare the skin with chlorhexidine gluconate to protect the extraluminal cutaneous route. Numerous studies have demonstrated that intraluminal contamination, which accounts for 50%–67% of CLABSIs, is a substantial risk factor for these infections (Worth et al., 2017).

Since intestine overgrowth of bacteria, immune system development, and central venous access length all affect the prevalence of CLABSI in neonates, they challenging to alter. Nonetheless, CLABSI rates have been successfully reduced by measures including bundling and standardized central line care (Hightower et al., 2022).

Many clinical recommendations have been created to minimize infections associated with invasive medical equipment. The Center for Healthcare Improvement defines "bundles" as collections of best practices associated with an illness process that, when used as a whole; greatly raise the standard of care. Using skilled intravenous (IV) teams, implementing the highest sterile barrier precautions possible during insertion, and removing unnecessary catheters as soon as possible, and provide teaching on aseptic techniques, line insertion, hand hygiene, and maintenance (Hamza et al., 2021).

Using "bundles," which are groups of evidence-based therapies that have been shown to improve patient outcomes when used correctly and consistently, is one efficient

ways to reduce CLABSI (Payne et al. 2017). NICU CLABSI rates lowered by 60% by the uses of a care package (Bierlaire et al., 2020).

The Centers for Disease Control and Prevention (CDC) wants to see CLABSIs eradicated because they are expensive but preventable. Neonatal-specific CLABSI bundle have been created and put into use based on the data currently available in order to lower rates of infection to or below NHSN guidelines. In any hospital context, nurses are essential to preventing CLABSIs. They must make certain that best practices are followed and stop operations if they notice any technique faults (Mahmoud, Al-Rafay, and Ismail, 2021).

In high-income countries, NICU rates of CLABSI have significantly decreased due to the widespread adoption of central-line bundles. According to Paplawski (2020), central-line care bundles are methods for inserting and managing central lines that incorporate a number of evidence-based best practices that used simultaneously. These include sterile line access, the use of closed needleless intravascular catheter systems, hygiene of the hands, the most effective the catheters location, the greatest degree of barrier defense during insertion, chlorhexidine skin antisepsis, daily evaluation of the need for a line, and ensuring that the line dressing is clean and intact.

A thorough review and meta-analysis found that CVC implantation and maintenance bundles are an effective strategy for reducing CLABSI rates (Helder et al., 2019). One parts of the maintenance package involves disinfecting needleless connections with 70% alcohol, povidone-iodine, or chlorhexidine prior to administering IV fluids or medication. This cleaning procedure takes at least 40 seconds when done correctly, which could be challenging given nurses' demanding schedules. Furthermore, there is disagreement regarding the ideal time to rub down connector hubs for disinfection, and in reality, nurses frequently follow the protocol incorrectly, resulting in 33%–45% of hubs being contaminated (Helder et al., 2019).

1.3 Problem Statement

Because preterm infants' delicate skin, need for invasive operations, underdeveloped immune systems, and prolonged hospital stays make them vulnerable to hospital-acquired

infections and sepsis. CLABSI is a major cause of morbidity and mortality in NICUs. In preterm neonates, exposure to inflammatory mediators after infections may result in brain damage and bad developmental outcomes. According to other research, preterm infants who survive necrotizing enterocolitis and postnatal sepsis are more likely than those who do not to experience neurological and developmental impairments (Bierlaire et al., 2020). Securing dependable vascular access is essential to these newborns' survival despite these dangers.

Thus, achieving zero catheter-associated infections requires reducing CLABSI rates (Paplawski, 2020). Research on the specific central line protocols used in Palestinian hospitals and their efficacy in reducing bloodstreams infections is lacking, despite the crucial need for infection prevention in NICUs. Physicians find it more challenging to implement targeted therapies that could reduce infection rates and improve neonatal outcomes when there is a lack of comprehensive data on this topic.

1.4 Significance of the Study

The work is significant because it addresses a crucial problem that could significantly affect newborn healthcare in Palestinian hospitals: preventing CLABSIs in NICUs. CLABSIs are a major source of neonatal mortality and morbidity, especially in susceptible groups like premature and critically unwell infants frequently require central lines for necessary medical care. Understanding and enhancing central line techniques is crucial in the context of Palestinian health services, since funding is frequently scarce and the infrastructure of the medical sector faces major obstacles.

The purpose of this study is to assess the connection between central line practices and bloodstream infections in a Palestinian hospital's intensive care unit. The results may aid in the development of evidence-based protocols that are customized to the unique requirements and constraints of healthcare environments in Palestine. Reducing the incidence of CLABSI through the creation of efficient central line management techniques could enhance the general well-being of these units and newborn rates of survival.

The results may potentially implications for national and hospital-level policies and practices. It could be used as the foundation for teaching programs that enhance the skills

and knowledge of NICU medical staff, ensuring that they are knowledgeable of the best practices for infection prevention.

Additionally, the study might assist lawmakers and hospital executives in determining which locations need the greatest attention, which might lead to improved funding distribution as well as backing for infection control initiatives. The significance of this study ultimately extends beyond its immediate findings since its long-term goal is to foster a culture of continuous improvement in neonatal care, which will enhance the standard of life for the youngest and most susceptible patients in Palestinian hospitals.

1.5 Study Objective

1.5.1 General Objective

- To examine the association between central line practices and bloodstream infections in Palestinian hospitals' NICUs.

1.5.2 Specific Objective

1. To assess the current CVC insertion practice in Palestinian NICU
2. To assess the current CVC maintenance practice in Palestinian NICU
3. To assess the relationship between specific CVC insertion practices and the occurrence of bloodstream infection in Palestinian NICUs.
4. To assess the relationship between specific CVC maintenance practices and the occurrence of bloodstream infection in Palestinian NICUs.
5. To assess the relationship between CVC practice and bloodstream infection regarding HCP demographic characteristics
6. To identify barriers to the implementation of guideline practice for CVC management in Palestinian NICUs.

1.6 Study Question

1. What is the CVC insertion practice in Palestinian NICUs?
2. What is the CVC maintenance practice in Palestinian NICUs?
3. Is there a relationship between specific CVC insertion practices and the occurrence of bloodstream infection in Palestinian NICUs?
4. Is there a relationship between specific CVC maintenance practices and the occurrence of bloodstream infection in Palestinian NICUs?

5. What are the barriers to the implementation of guideline practice for CVC management in Palestinian NICUs?

1.7 Study Hypothesis

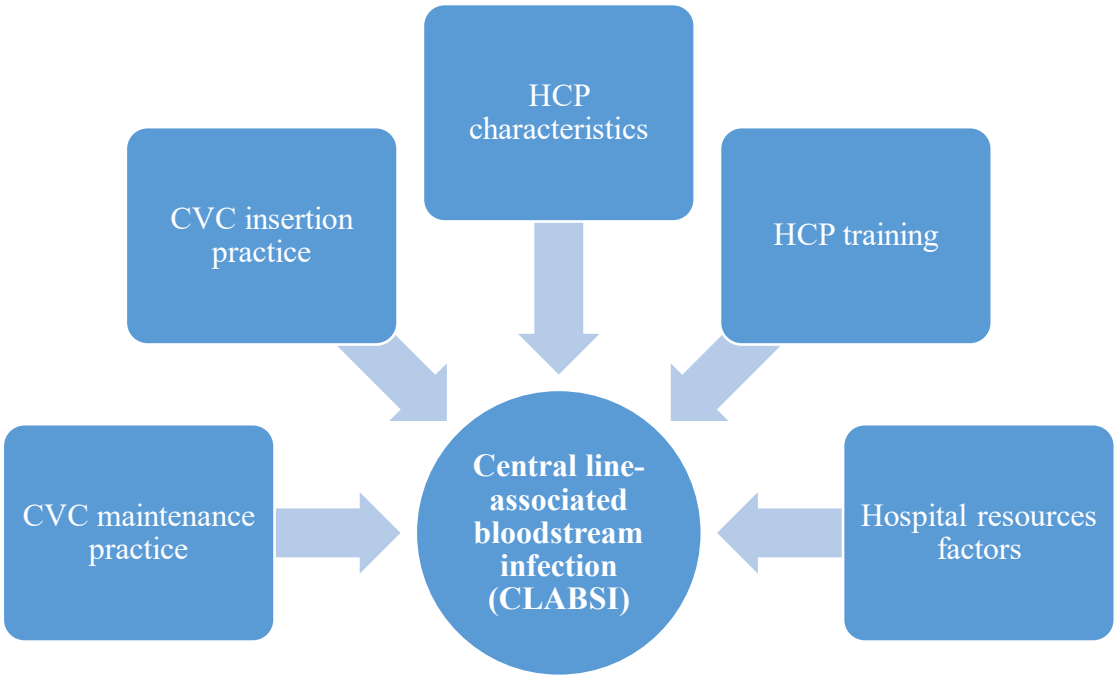
- There is no statistically significance difference at ($\alpha \leq 0.05$) between central line practices and bloodstream infections in Palestinian hospitals' NICUs and CVC insertion practice.
- There is no statistically significance difference at ($\alpha \leq 0.05$) between central line practices and bloodstream infections in Palestinian hospitals' NICUs and CVC maintenance practices.
- There is no statistically significance difference at ($\alpha \leq 0.05$) between central line practices and bloodstream infections in Palestinian hospitals' NICUs and health care professionals (HCP) characteristics.
- There is no statistically significance difference at ($\alpha \leq 0.05$) between central line practices and bloodstream infections in Palestinian hospitals' NICUs and HCP training.
- There is no statistically significance difference at ($\alpha \leq 0.05$) between central line practices and bloodstream infections in Palestinian hospitals' NICUs and Hospital resources factors.

1.8 Study Variables

1.8.1 Dependent Variable: Central line-associated bloodstream infection (CLABSI).

1.8.2 Independent Variables: CVC insertion practice, CVC maintenance practice, HCP characteristics, HCP training, Hospital resources factors, Infant characteristics.

1.9 Variables framework



1.10 Conceptual Definition

1. **Central line-associated bloodstream infection (CLABSI):** CLABSIs are bloodstream infections that happen in people who have a central line inserted either right before the infection starts or 48 hours beforehand. These are a severe consequence that, particularly in susceptible groups like infants, can raise morbidity and mortality (Hamza et al., 2021).
2. **Central line insertion practice**: These are the methods that medical professionals use when inserting CVCs into patients. To reduce the danger of infections, proper insertion techniques are essential (Mahmoud, Al-Rafay, and Ismail, 2021).
3. **Central line maintenance practice**: Routine treatment and care of central lines following insertion are referred to as "maintenance practices" to avoid complications like infections. These procedures include changing dressings, flushing lines, and handling objects carefully while gaining access (Helder et al., 2019).

1.11 Operational Definition

1. **Central line-associated bloodstream infection (CLABSI)** refers to bloodstream infections in neonates that are verified to meet the CDC/NHSN criteria for CLABSI. Central line insertion practice
2. **Central line insertion procedures** 2. Compliance with specific standards, such as choosing the insertion location, applying sterile barriers, and preparing the skin with an antiseptic, will be taken into consideration when evaluating central line insertion procedures. Data will be gathered through an examination of medical records.
3. **3. Central line maintenance practice:** This study will evaluate central line maintenance practices by looking at how often and how dressing changes are performed, if sterile procedures are used during line access, and whether maintenance requirements are followed. Data will be gathered from medical records.

1.12 Summary

CRBSI and CLABSI are serious healthcare issues, particularly in NICUs. Bloodstream infections in central line patients that occur within 48 hours of the start of symptoms are referred to as CLABSI, while bacteremia confirmed by laboratory testing is known as CRBSI. Mortality and morbidity in NICUs are significantly impacted by HAIs, especially for VLBW neonates. Some factors that raise the risk of infections linked to healthcare include prematurity, invasive treatments, and compromised immune systems. Despite being widely used in NICUs, CVCs are associated with a risk for infection, particularly CLABSI, which can result in life-threatening outcomes like death, prolonged hospital stays, and stunted infant growth.

Given the severe risk of CLABSI, proper line placement and maintenance techniques are critical to reducing infection rates. The goal of this study is. To evaluate the relationship between bloodstream infections and central line procedures in the newborn intensive care units of Palestinian hospitals.

Chapter Two: Literature Review

2.1 Introduction

This chapter provides an overview of current research on bloodstream infections and central line operations. Studying this problem requires an understanding of central line procedures, risk factors, clinical presentation, demographic data, and bloodstream infections. Each idea is discussed independently.

The literature was gathered by electronically searching databases. To locate relevant papers and journals, databases like Pub Med were reviewed. The examined studies were published from 2016 to 2024. The following keywords were used in the search: NICU, CLABSI, HCP, and CVC.

2.2 Neonatal CLABSI Risk Factors

Case-control research was conducted in retrospect design by Durant et al. (2023) to investigate CLABSI risk variables in NICU patients, paying special attention to the type and location of central lines. Bivariate and multivariate analysis with matching propensity scores were used to compare central line insertions that caused CLABSI versus cases that did not. Implantable devices, neck site location, device dwell time, and the years 202 and 2022 are examples of multivariate risk variables. This suggests that using an implanted central line increases the risk of developing CLABSI by 14.5 times when compared to the benchmark category (PICC devices). The chance of CLABSI is 7.1% greater in individuals with an implanted device than in comparable patients with other central lines when cases are compared to matched controls.

A study by Kochanowicz et al. (2022), comparing risk factors and patient characteristics based on the kind of catheter used and the classification of birth weight was the goal of this investigation. 51 babies with confirmed CRBSI were included in the research. In our study group, the risk of developing CRBSI was highest for infants with a low birth weight and those who needed continuous parenteral nourishment. The results of the blood culture were not related to the kind of venous catheter. Additionally, the etiology of sepsis did not differ between infants born weighing less than 1500 g and those weighing more than 1500 g. To determine the relative risk of sepsis caused by venous catheters and whether the

result can be specifically linked to catheters type or patient characteristics, more research is needed.

A retrospective cohort study by Zipursky et al. (2019) to ascertain if the reported decline in hospital-acquired infections is attributable to a decrease in CLABSIs or non-CLABSIs. Hospital-acquired illnesses occurred in 3206 (11.7%) of the 28144 eligible newborns from 30 neonatal critical care units in the Canadian Neonatal Network. During the study period, there was a substantial decrease in the length of central line use, which was accompanied by a significant decrease in the rate of hospital-acquired infections and the rate of both CLABSIs and non-CLABSIs. During the study period, meningitis rates also decline. Gram-positive cocci-related infections sharply declined, but gram-negative organism-related infections stayed constant.

A retrospective cohort study that was conducted by Bannatyne et al. (2018), following the installation of the central line bundles in our NICU at Canberra Hospital, rates of CLABSI and central line utilization were investigated in this research. Overall, the findings demonstrated a significant drop in CLABSI rates during the intervention period, going from 8.8 per 1,000 central line days to 4.9 per 1,000 central line days. Additionally, the central line use ratio decreased from 0.177 (4414/25013) to 0.13 (3633/27384) between the pre- and postintervention periode. During the intervention period, there was an increase in adherence to insertion and maintenance forms. For central venous catheters, the use of a central line bundle effectively decreased both CLABSI rates and CLUR (dwell time).

A study conducted by Geldenhuys et al. (2017) to explain CLABSI episodes and pinpoint risk variables for CLABSI development in a NICU with limited resources. Four randomly chosen controls were matched to prospectively collected NICU CLABSI incidents in a retrospective case-control study. Over the course of the trial, 530 neonates had a total of 706 central lines placed. With a CLABSI rate of 5.9/1 000 line days, 19 CLABSI incidents were found. Patients with CLABSI had prolonged catheter dwell periods (>4 days), lower median birth weights, lower gestational ages, and a higher likelihood of undergoing surgery while in the intensive care unit. Central line insertion in an operating room and duration of stay greater than 30 days were significant factors in risk for CLABSI. Gram-negative

bacteria were the most common (12/22; 54%), and the majority of isolates (10/12; 83%) had multidrug resistance.

To examine the prevalence and risk variables for problems associated to central lines in newborns, a retrospective cohort research was conducted by Soares et al. (2017). 240 newborns received 400 CLs in total, with a CL usage ratio of 0.64. The overall rate of CL complications per 1000 catheter days was 29.6. The most common consequence was a bloodstream infection linked to the central line (12.4 per 1000 catheter days). The mechanical issue that was most frequently mentioned was infiltration. Compared to umbilical catheters, non-umbilical catheters had a noticeably greater frequency of problems. A greater probability of indwelling complications was linked to peripherally inserted central catheter implantation, lower gestational age, low birth weight, extended catheter stay, and extended complete parenteral feeding.

2.3 Neonatal Central line maintenance and prevention infection bundles

A study by Hightower et al. (2022), central venous lines are often necessary for critically unwell infants and those with complicated medical disorders. Unfortunately, the healthcare system is burdened by the expense and longer length of stay associated with central line-related bloodstream infections (CLABSIs), which also cause significant morbidity and mortality. In the beginning, job instruction sheets were given to the nursing staff of the NICU at the same time as trainers and bedside nurses had one-on-one teaching sessions. The CLABSI rate per 1000 line days was not improved by retraining for detected deficiencies or conducting intermittent performance audits. Hospital-acquired condition interactor audits and standardized care packages were not enough to lower the CLABSI rate. On the other hand, CLABSI rates were considerably reduced when care bundles and education were combined with simulation-based training.

In Egypt, Hamza et al. (2021), implementing standardized quality improvement initiatives, this study aims to lower the undesirable relative high CLABSI rate. A pre-post-intervention design was used in the investigation. The CLABSI rate dropped by 59.5% from 7.5 to 3.0 per 1000 central line days during the post-intervention phase, and the central line use duration dropped from 21.3 ~ 9.9 to 11.0 ~ 3.2 days ($P < 0.05$). The rate of CLABSI in our pediatric and neonatal intensive care units was effectively decreased by the

implementation of a quality improvement interdisciplinary intervention that included a central line installation and maintenance care package, a dedicated IV crew, education, and feedback.

Assessing the effect of novel central line inserting, dressing, and maintenance "bundles" on the incidence of CLABSI and catheter-related complications was the goal of this quasi-experimental study conducted by Bierlaire et al. (2020). The rate of CLABSI (8.4 to 1.8 infection per 1000 CVC days) and catheter-related problems (47 to 10) was considerably reduced as a result of the introduction of the new "bundles" and the modification of specific materials. Lowering the incidence of CLABSI in the NICU requires analyzing the current "bundles" and implementing updated central line "bundles" based on best practice recommendations. Immediately following the introduction of the new evidence-based central line "bundles," our unit's CLABSI rate significantly decreased.

A literature review by Paplawski (2020), bloodstream infections linked to central lines pose a serious risk to neonates in the neonatal critical care unit. Health organizations around the world prioritize preventing these expensive and destructive infections because it is essential to reducing harm to this susceptible group. This study's objective is to investigate and pinpoint evidence-based preventative measures for bloodstream infections in neonates linked to central lines. Four successful preventative measures were identified by a thematic examination of the literature, specialized vascular access teams, regular surveillance, consistent education, and central line care bundles. The best course of action appears to be a combination of these evidence-based therapies; yet, further study is needed to determine the best skin antiseptic and to keep looking into novel preventative techniques.

A study by Helder et al. (2019) investigated the implementation procedure and the impact of using antiseptic barrier caps on the prevalence of CLABSI in newborns and children. conducted a prospective, mixed-method, observational study before and after. There were 2,248 patients in all. The total incidence decreased by 22% as the rate at which CLABSIs per 1,000 catheter days decreased from 3.15 to 2.35. For the pediatric critical care unit and newborn intensive care unit, nurses followed the antiseptic barrier cap protocol

89.0% and 95.2% of the time, respectively. The study's CLABSI rates were not considerably decreased by the antiseptic barrier cap.

Infants who are premature and other newborns are at significant risk for contracting different microbes. A study by Cho and Cho (2018) that the most prevalent nosocomial infection type in this population is bloodstream infection linked to catheter use. The most effective way to avoid central line-associated bloodstream infections (CLABSIs) is to regularly educate and train medical workers. Effective strategies to lower the frequency of CLABSIs include bundle methods and the use of checklists during central catheter insertion and maintenance. Although chlorhexidine is not recommended for use in newborns less than two months, it is frequently used in neonatal intensive care units because there aren't many other options. Chlorhexidine is frequently used as a skin disinfection prior to catheter insertion and dressing replacement. Newborns cannot be bathed or dressed with chlorhexidine, which is advised for adults.

According to a study by Mobley and Bizarro (2017), one of the most prevalent HAIs in the NICU population is central line-associated bloodstream infection (CLABSI), which is linked to a higher risk of morbidity and mortality as well as higher medical expenses and length of hospital stay. CLABSI rates have significantly decreased during the last ten years as a result of multiple local, state, and federal quality improvement initiatives. Similar tactics have been used by most successful initiatives to carry out and maintain their work, such as training NICU staff in quality improvement principles, developing and implementing bundles for central line inserting and maintenance and techniques for evaluating compliance, assembling specialized teams for central line inserting and maintenance, and using dependable and efficient techniques for data collection, analysis, and display.

2.4 Compliance with neonatal CLABSI guidelines

The evidence supporting the effectiveness of care bundles in lowering CLABSIs in NICU was evaluated through a systematic review conducted by Payne et al. (2017), aftercare bundles were implemented, a meta-analysis showed a statistically significant decrease in CLABSIs (rate ratio=0.40 (CI 0.31 to 0.51), $p<0.00001$), or a 60% decrease in the CLABSI rate. A large body of quasi-experimental data suggests that care bundles may lower CLABSI

rates in the NNU, although it's unclear which bundle components work best in particular contexts. Future studies should concentrate on identifying the procedures that facilitate the successful use of infection prevention guidelines and the components that are crucial to these care bundles.

A study by Worth et al. (2017) in Australian neonatal and pediatric intensive care units (ICUs), the study's goal was to assess the burden of illness, aetiology, and time trends for central and peripheral line-associated bloodstream infections (CLABSI and PLABSI). The quarterly risk for newborn CLABSI episodes decreased significantly with time, and this decline was particularly noticeable for the cohort with birth weights ranging from 751 to 1000g. CLABSI incidents were most commonly caused by coagulase-negative Staphylococcus species (24.2%) and Staphylococcus aureus (16.1%). There was a notable decrease in Gram-negative newborn infections. Neonatal infections have drastically decreased over time, and CLABSI rates in pediatric and neonatal intensive care units in our area are minimal. To ascertain whether particular tactics may be used to further lower infection risk, evaluation of infection prevention programs is necessary.

Prospective study conducted by Venturini et al. (2016), the most prevalent infections linked to healthcare in children are CLABSI. Large, high-quality studies are scarce, despite the availability of global data on infections linked to healthcare in specific patient groups. 3.73/1000 central line-days was the CLABSI rate. Female gender and underlying medical disorders (apart from prematurity, surgical illnesses, and cancer) were associated with a higher frequency of CLABSI. Five of the infections in our study were brought on by organisms that produce extended-spectrum β-lactamases, and one was brought on by Klebsiella pneumoniae that was resistant to carbapenem. Our research validates that children's infections linked to healthcare are caused by the proliferation of multi-resistant microorganisms. In our investigation, underlying medical problems were linked to a higher incidence rate of CLABSI.

A prospective study of a cohort study by Carter et al. (2016) to assess the prevalence of CLABSI over time and identify risk variables for CLABSI in children admitted to hospitals. 385 of the 5,648 patients experienced CLABSI. Within 60 days following insertion, the majority of infections happened. From 4.87 per 1,000 in-hospital line days,

CLABSI rates dropped. There was a correlation found between a hand hygiene awareness effort and a decrease in CLABSI over time. CLABSI was statistically substantially correlated with CVC type, lumen count, dressing type, insertion vein, and critical care unit status. Children at the highest risk for CLABSI were identified through hospital-wide surveillance over an 18-year period, and their risk decreased with time; this decline was linked to a hand cleanliness campaign.

2.5 Neonatal central line type

To provide guidelines for prevention and treatment, a study by Kim et al. (2021) to ascertain the prevalence of CLABSI in the NICU, assess the clinical characteristics of the patients, and identify the causative factors. An analysis of the charts of infants with CLABSI in the past. There were 2.85 CLABSIs for every 1,000 catheter days. Eighty-one percent of catheters were peripherally implanted central catheters. Of the 57 pathogens that were identified, 36.8% were Gram-negative bacteria, 5.3% were Candida spp., and 57.9% were Gram-positive bacteria. Staphylococcus aureus (21%) and coagulase-negative staphylococcus (21%), followed by Klebsiella aerogenes (14%), were the most prevalent pathogens. Nineteen occurrences had bacteremia lasting three days or longer, with a median duration of two days.

In a cohort study by Dubbink-Verheij et al. (2017) in Germany of neonates with femoral venous catheters (FVCs), UVCs, and PICCs and gestational ages ≥34 weeks, aim to assessed the incidence and risk factors for CLABSI. PICCs had an incidence rate of 5.3 per 1,000 catheter days, UVCs had an incidence rate of 10.6 per 1,000 catheter days, and FVCs had an incidence rate of 12.3 per 1,000 catheter days. Higher birth weight, male gender, and parenteral nourishment were all independently linked to an increased risk of CLABSI, while receiving antibiotics at birth was linked to a lower risk. found no distinction in the incidence of CLABSI between UVCs, PICCs, and FVCs. Higher birth weight, male gender, and parenteral nourishment are linked to the occurrence of CLABSI. A lower risk of CLABSI was linked to antibiotic therapy at birth.

To assess the risks for CLABSI in newborns with UVC, PICC, or both in succession, study by Sanderson et al. (2017). 3985 newborns with UVC or PICC were included in the study: 1276 had both UVC and PICC (Group 3), 1392 had UVC exclusively (Group 1), and

1317 had PICC solely (Group 2). Out of 6000 venous catheter insertions, 403 CLABSI occurred, for a total of 43302 catheter days. Compared to Group 1 (3.3/1000 UVC days; 37 weeks) and Group 2 (4.8/1000 PICC days; 30 weeks), CLABSI rates were greater in Group 3 infants, who had the lowest gestation (16.9/1000 UVC days and 12.5/1000 PICC days; median 28 weeks). The rates of PICC CLABSI stayed comparatively constant at 12–20/1000 PICC days. UVC exhibited a greater adjusted CLABSI risk corrected for dwell duration than PICC.

2.6 Roll of multidisciplinary team practice and neonatal CLABSI prevention

A descriptive study by Mahmoud et al. (2021) to evaluate nurses' compliance and understanding of the CLABSI package. 86 nurses who worked in the aforementioned context were part of the study's purposive sample. Revealed that more than half had incompetent practice, whereas less than half had bad knowledge and more than half had mediocre knowledge of the CLABSI package. The study showed that there was little training and no standard procedure for preventing CLABSI in the NICUs under investigation. This suggests that a CLABSI prevention procedure based on the most recent evidence-based standards has to be developed, and an education program about this protocol needs to be created. Establishing a mechanism to carry out prevention protocols, monitor adherence, and administer the CLABSI package is also necessary.

An 18-month cross-sectional study conducted by Kulali et al. (2019) aimed to assess the efficacy of bundle treatments in preventing bloodstream infections linked to umbilical venous catheters (UVCs). 589 patients were taken into the NICU during the prebundle era, and records showed 6,769 hospital days and 485 UVC days. Likewise, 508 patients were taken to the NICU during the bundling period, and records showed 7,789 hospital days and 508 UVC days. During the pre bundle, the rate of UVC-associated bloodstream infections was 12.4 per 1,000 catheter days; during the bundle period, it dropped to 3.9 per 1,000 catheter days. Consequently, the prevalence of infection dropped by 68% following the introduction of bundled apps. This study demonstrated that bundle application successfully decreased bloodstream infections linked to UVC.

Atilla et al. (2016) conducted a study to examine the effectiveness of a care bundle in reducing infectious problems associated with the implantation of a CVC in patients in the

ICU as well as CLABSIs. Patients with CLABSIs experienced longer catheterization times and more femoral access observations. Utilizing the care bundle resulted in a drop in CLABSI rates. 3.88/1,000 catheter days during the intervention period, 1.05/1,000 catheter days during the third period, and 6.20/1,000 catheter days during the previous period were the CLABSI rates in the medical intensive care unit. During these three time periods, the surgical intensive care unit's CLABSI rate was 8.27/1,000, 4.60/1,000, and 3.73/1,000 catheter days, respectively.

2.7 Gaps in the Studies

A more comprehensive examination is necessary to ascertain whether antiseptic barriers are helpful in reducing CLABSI in neonatal populations, even though they are noted in some publications. Another gap highlights the need to optimize care bundles for NICUs around the world: the variety of preventive bundle components, with little information on which ones are most useful in which circumstances.

Additionally, although staff training and simulation-based learning have shown short-term gains in CLABSI rates, little is known about how long-term sustainable these educational interventions will be. Lastly, more study is required to ascertain the efficacy of multidisciplinary team involvement in preventing CLABSI, particularly about collaboration amongst different healthcare practitioners.

2.8 Summary

This review looks at the primary causes of CLABSIs in NICUs as well as ways to avoid them. Research from a number of countries has shown that low birth weight, prolonged parenteral nourishment, abdominal surgeries, double-lumen catheters, gestational age, length of usage, and catheter size and type are all significant risk factors.

The incidence of CLABSI has been successfully decreased by preventative strategies such as central line care bundles, routine monitoring, staff training, audits, and simulation-based education. Other tactics, such as sterile insertion techniques, well-supervised placement teams, and readily available bedside kits, significantly reduce infection rates.

However, inconsistent compliance with infection control guidelines emphasizes the need for uniform practices and continuous education, especially in larger NICUs.

Variations in infection risks among catheter types, particularly with prolonged use of UVCs, suggest the benefits of timely catheter removal or replacement. Despite the importance of nurses and multidisciplinary teams in avoiding CLABSI, knowledge gaps highlight the need for targeted educational initiatives. Reiterating existing protocols and bolstering training programs are necessary to improve adherence and lower infection rates in NICUs.

Chapter Three: Methodology

3.1 Introduction

This chapter introduces the study methodology, including study design, study setting, population and sample, study tool, data collection procedure and pilot Study, statistical analysis, ethical considerations, and summary process with the headlines.

3.2 Study Design

A retrospective, descriptive, quantitative study design was used to explore the association between central line practices and bloodstream infections in Palestinian Hospital's NICU.

One kind of observational study that concentrates on people who share a connection to a disease or risk factor is called a retrospective cohort study. In order to establish relationships and determine the likelihood of a particular outcome linked to a particular exposure, retrospective cohort studies examine health outcomes over time. This method is perfect for researching healthcare outcomes since it enables the identification of trends, connections, and patterns without changing factors. Examining patient records, clinical results, and illness trends is made easier with this design, which offers insightful information for further study and better healthcare.

3.3 Study Setting

The study was conducted at hospitals that contain NICUs. (Specialized Arab Hospital (SAH) in Nablus which contains 25 incubators; Ibn Sina Hospital (ISH) which contain 24 incubators).

3.4 Study Population

A research population is a collection of subjects or departments who have certain traits and meet the inclusion requirements, and from whom data can be collected. (Polit& Beck 2014).

In this study, the target population was Newborns with central lines, who met the inclusion criteria.

The accessible populations are those neonates who were admitted to the NICU at this hospital From January/ 2023 until December/2023.

3.5 Sample and Sampling

Convenience sampling was used, which a type of non-probability is sampling method that is also used in quantitative approaches. This form of sampling was used for the study because it was convenient for respondents. The researcher uses this strategy to choose the appropriate sample while keeping in mind the need to include certain criteria and elements inside the study.

The total number of participants was (110) neonates. A convincing sample composed of (110) NICU neonates was included in the study during the data collection period.

3.6 Inclusion Criteria

1. Newborns admitted to the NICU in West Bank
2. Newborns with central line
3. Completed medical records documentation.

Neonates with positive infection BSIs

3.7 Exclusion Criteria

1. Neonates without central line
2. Incomplete medical records or missing data regarding central line
3. Neonate with central line less than 48 hours

3.8 Sample Size Calculation

The total sample size was 110 neonates. However, a convincing sample was composed of 110 neonates was participated in the study during the data collection period. As mentioned in (Table 3.1) below, the population count is 410 neonates, where the total number of participants in the study is 110 neonates.

Based on alpha 0.05, and power of 0.80, and medium effect size, and the estimated sample size using G power, the total sample size was 110 newborns.

Table 3.1: Hospital distribution

Hospital Name	Admission From 1-2023 to 12-2023	Sample	Sampling
Private Hospital- SAH Nablus	434	221	81
Private Hospital- ISH Jenin	420	189	29
Total	854	410	110

3.9 Study Tool

The data abstraction sheet constructed based on the literature review, contains six parts.

Part one contains demographic and clinical data, which contains date of birth, GA, birth weight, gender, admission date, discharge date, and length of stay in NICU. **Part Two** contains central line details with 5 questions. **Part three** insertion practice with 2 questions. **Part four** maintenance practice with 3 questions. **Part five** bloodstream infections data with 4 questions. **The part six** intervention and outcome with 3 questions.

3.10 Data Collection Procedures

After obtaining the ethical approval from the IRB/AAUP committee (R-2024/ A /121/ N) and permission from the administrative department and medical director of selected settings to conduct the study, the investigator first introduced and explained the need and the purpose of the study to the unit managers at West Bank hospitals.

After contacting the IT departments of each department to request access to the hospital's system, a list of the names and numbers of infants from each department was acquired. Following the entry of each name, it was verified that the infant had received an CVC, and data were collected from hospital medical files and the HIS system database focusing on study variables that were mentioned on instruments.

3.11 Study Validity and Reliability

The study's methodology, internal validity, and data-collecting techniques properly assessed the variables' relationships. To prove a causal relationship, all possible sources of bias and confounding variables were properly managed. The results of this study can be applied to the larger group of newborns who have CVC. The sample's representativeness and the significance of the CVC under study should be taken into account.

A statistician assessed the questionnaire's reliability by computing the Cronbach's Alpha coefficient. It was verified for pediatricians who worked in hospitals, nursing faculty, staff, and experts.

3.12 Pilot Study

The researcher conducted a pilot study with 20 neonates who met the inclusion criteria prior to applying the study. The researcher received feedback on the questionnaire, confirmed its validity and reliability, pointed out areas of confusion, calculated the actual time required to complete it, pointed out phrasing errors, and obtained a clear opinion about the questionnaire. The neonates were included in the actual study because the researcher thought the questionnaire was straightforward and contained no remarks on information from files or a jury group of experts who assessed the questionnaire's content, no changes were made to any of the data collection tool domains, the questionnaire's internal consistency was excellent, and no additional data collection tool adjustments were made.

3.13 Ethical Considering

Ethical approval was obtained from the Arab American University Ethical Committee Institutional Review Board (IRB) before data collection, and then permission for conducting the study in hospitals was taken from their administrative department. Upon approval, all data will kept confidential and only for the use of research purposes, no names of any neonates will be mentioned or used, and no other information will be used in any context other than this research.

3.14 Analysis Plan

The Statistical Package for the Social Sciences (SPSS) version 23 was used to analyze the acquired data in this study. SPSS is a software package used for statistical analysis, data manipulation, and the generation of tables and graphs utilizing descriptive and inferential statistics. The chi-square, correlation, averages and standard deviations are used to summarize the data.

Consequently, data cleaning was done and the questionnaire results were immediately entered into the database. This made it possible to find correlations between the pertinent variables that might be statistically significant.

Chapter Four: Results

4.1 Introduction

This chapter summarizes the data analysis done for the study "Association between Central Line Practices and Bloodstream Infections in Palestinian Hospitals' Neonatal Intensive Care Units: A Retrospective Study." The study examines the relationship between bloodstream infections (BSIs) and CVC insertion and maintenance procedures in NICUs (n across Palestinian hospitals. Data was retrieved retrospectively from 110 patients in order to evaluate compliance with CVC recommendations and determine potential risk factors that may contribute to infections.

By assessing CVC insertion and maintenance procedures, investigating their correlation with blood rates of infection, and identifying obstacles to the use of evidence-based recommendations, the analysis seeks to answer the study's research questions. While inferential analysis will ascertain correlations between certain procedures and infection outcomes, descriptive statistics will offer a summary of existing CVC practices.

4.2 Demographics

4.2.1 Infant Demographics

Key neonatal characteristics, such as the length of stay (LOS) in the NICU, birth weight, and gestational age at birth, are summarized in (Table 4.2). The mean gestational age at birth is 34.5 weeks, with a standard deviation of 3.4 weeks, ranging from 26 to 40 weeks, indicating a mix of preterm and full-term infants. The mean birth weight is 1927.15 grams, with a wide range from 700 to 3551 grams, reflecting variability in neonatal conditions. The average NICU stay is 61.81 days, but the high standard deviation (84.13 days) and the range from 3 to 335 days, the gender distribution of the study participants. Out of the total sample, 60 participants (54.5%) are male, while 50 participants (45.5%) are female

4.2.2 Central Line

The following (Table 4.3) provides details on the types of central lines used and the healthcare professionals performing the insertions. The most commonly used central line is

the Umbilical Venous Catheter (UVC) (68 cases, 61.8%), followed by the CVC (32 cases, 29.1%), while the PICC is the least used (10 cases, 9.1%). No other types were reported. Regarding the personnel inserting the central lines, neonatologists performed the majority of procedures (82 cases, 74.5%), followed by pediatricians (25 cases, 22.7%), and a small percentage were placed by nurse practitioners (3 cases, 2.7%), with no insertions by other healthcare providers.

The following (Table 4.4) shows the duration of central line usage in the study participants. The average duration is 30.6 days, with a wide standard deviation of 50.18 days, indicating considerable variation in how long the central lines were in place across different patients. The duration ranged from a minimum of 3 days to a maximum of 305 days.

Table 1.4 duration of central line

	Mean	St.d	Minimum	Maximum
Duration of Central Line (days)	30.60	50.18	3.00	305.00

4.2.3 Insertion Practices

The following (Table 4.5) provides insights into the practices followed during the central line insertions. A vast majority (98.2%) of insertions followed standardized protocols, with only 1.8% not adhering to these guidelines. Regarding infection prevention measures, the most common practice was hand hygiene, performed during 70% of insertions. The use of antiseptic solution was employed in 17.3% of cases, while full barrier precautions were taken in 10.9% of insertions. The least followed measures were the use of sterile gloves and gown, which was recorded in just 1.8% of the insertions.

4.2.4 Maintenance Practices

The following (Table 4.6) details the maintenance practices for central lines. Most central line site assessments for signs of infection were performed every shift (92.7%), with only a small number conducted daily (4.5%) or every other day (2.7%). Regarding dressing change protocols, the aseptic technique was used (50.9%), followed closely by the sterile

technique (47.3%), while only 1.8% of changes were done using the non-sterile technique. For documentation of central line site care, the majority (70%) used electronic medical records, with 29.1% using both electronic and paper records. Only 0.9% relied on paper records alone, and no cases were found with undocumented care.

4.2.5 Bloodstream Infections Data

The following (Table 4.7) presents data on BSIs in the study. The most common diagnostic method was blood cultures (64.5%), followed by laboratory tests (29.1%) and clinical signs and symptoms (6.4%). No infections were diagnosed using other methods. In terms of pathogens, Staphylococcus aureus was the most frequently identified (24.5%), followed by Candida spp. (25.5%), Gram-negative bacilli (20%), and coagulase-negative staphylococci and Enterococcus spp. (both 11.8%). The outcome of these infections showed that the majority were resolved (56.4%), with ongoing infections in 21.8%, and a significant proportion resulting in complications (12.7%) or being fatal (9.1%).

4.2.6 Interventions and Outcomes

The following (Table 4.8) provides data on the interventions implemented to reduce central line-associated bloodstream infections (CLABSIs) and their outcomes. A large majority (97.3%) of participants reported that interventions were put in place, with the most common being the implementation of care bundles (66.4%), followed by staff education and training programs (27.3%). Fewer interventions included use of antimicrobial-impregnated catheters and enhanced infection surveillance (both 0.9%), while 4.5% mentioned other unspecified interventions. The impact of these interventions was largely positive, with 90.9% of participants reporting a significant reduction in CLABSI rates, 6.4% noting a moderate reduction, and 2.7% seeing an increase.

4.3 Answering research questions

4.3.1 What is the CVC insertion practice in Palestinian NICUs?

From the data in (Table 4.3), it can be inferred that the majority of central venous catheters (CVCs) are inserted by neonatologists (74.5%), with a smaller percentage

performed by pediatricians (22.7%) and nurse practitioners (2.7%). The most common type of CVC used is the Umbilical Venous Catheter (UVC) (61.8%), followed by the Central Venous Catheter (CVC) (29.1%) and the Peripheral Inserted Central Catheter (PICC) (9.1%). The data shows a strong adherence to standardized protocols for insertion (98.2%) and infection prevention measures like hand hygiene (70%) and use of antiseptic solution (17.3%). This suggests that Palestinian NICUs generally follow established guidelines for CVC insertion.

4.3.2 What is the CVC maintenance practice in Palestinian NICUs?

From (Table 4.6), it is clear that most CVC site assessments are performed every shift (92.7%) to check for signs of infection, which indicates a high frequency of monitoring. The dressing change protocol is mainly done with aseptic technique (50.9%) and sterile technique (47.3%). For documentation, electronic medical records (70%) are primarily used. These practices suggest that maintenance of CVCs in Palestinian NICUs generally adheres to recommended guidelines, with an emphasis on frequent assessments and proper dressing techniques.

4.3.3 What is the relationship between specific CVC insertion practices and the occurrence of bloodstream infection in Palestinian NICUs?

Since all participants already have BSIs, the focus is on analyzing how different CVC insertion practices (independent variables) vary within this group and potentially affect the outcome severity or complication rates (dependent variables), we will be using Chi-square for testing between the two categorical variables

The p-value of the Chi-square test in (Table 4.9) below is 0.696, which is greater than the significance level of 0.05. This suggests that there is no statistically significant relationship between the adherence to standardized protocols and the outcomes of bloodstream infections in this dataset.

While the data shows that most cases followed standardized protocols (108 out of 110), the chi-square result indicates that the outcome of the infection (whether resolved, ongoing, resulted in complications, or fatal) is not significantly influenced by whether these

protocols were followed during insertion. This could imply that factors other than adherence to protocols during insertion may be more influential in determining the outcome of the infection

Table 4.2: Outcome of Bloodstream Infection * Standardized Protocols During Insertion Cross tabulation

					Chi-square P-value
Count					
		Were Standardized Protocols Followed During Insertion		Total	
		No	Yes		
Outcome of Bloodstream Infection	Resolved	1	61	62	0.696
	Ongoing	1	23	24	
	Resulted in Complications	0	14	14	
	Fatal	0	10	10	
Total		2	108	110	

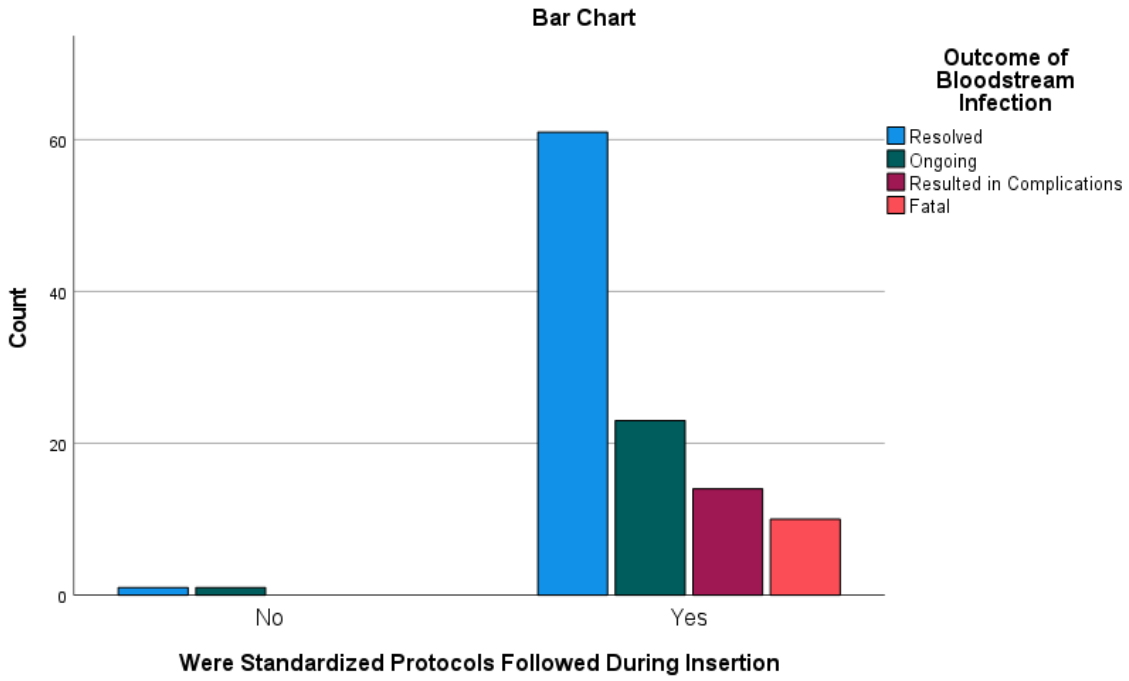


Figure 4.1 Outcome of Bloodstream Infection with Standardized Protocols during Insertion

4.3.4 What is the relationship between specific CVC maintenance practices and the occurrence of bloodstream infection in Palestinian NICUs?

The following (Table 4.10) below shows the relationship between the frequency of central line site assessments for signs of infection and the outcome of bloodstream infections (BSIs). The frequency of site assessments is categorized as every shift, daily, and every other day. The outcome of BSIs is divided into resolved, ongoing, resulted in complications, and fatal. Most infants had their central line sites assessed every shift (102 cases). The majority of resolved infections occurred among those with daily assessments (2 cases) or every shift (58 cases). Similarly, most ongoing infections (23 cases) and complications (13 cases) also had every shift assessment.

The p-value of 0.304 from the Chi-square test indicates that there is no statistically significant relationship between the frequency of central line site assessments and the outcome of BSIs, suggesting that the frequency of site assessments did not have a meaningful

impact on whether the infection was resolved, ongoing, or resulted in complications or fatalities.

Table 4.3: Outcome of Bloodstream Infection * Frequency of Central Line Site Assessment for Signs of Infection Cross tabulation

						Chi-square P-value
Count						
		Frequency of Central Line Site Assessment for Signs of Infection			Total	0.304
		Every shift	Daily	Every other day		
Outcome of Bloodstream Infection	Resolved	58	2	2	62	
	Ongoing	23	1	0	24	
	Resulted in Complications	13	0	1	14	
	Fatal	8	2	0	10	
Total		102	5	3	110	

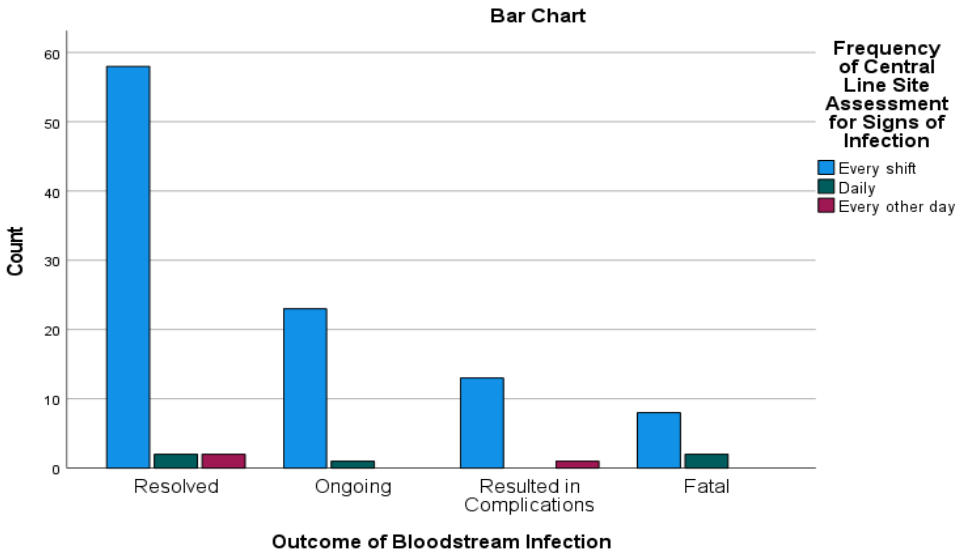


Figure 4.2: Outcome of Bloodstream Infection with Frequency of Central Line Site Assessment for Signs of Infection

4.3.5 What are the barriers to the implementation of guideline practice for CVC management in Palestinian NICUs?

Despite a high adherence to standardized protocols, infection prevention measures like use of full barrier precautions (10.9%) and sterile gloves and gowns (1.8%) were less commonly followed, indicating potential barriers such as resource limitations (e.g., access to sterile equipment) or insufficient training. Additionally, the use of antimicrobial-impregnated catheters was very low (0.9%),

Chapter Five: Discussion

5.1 Introduction

This chapter examines the study's findings and assesses them about earlier research, theoretical perspectives, and real-world applications. It examines the findings' applicability, possible reasons, and contrast with previous studies.

5.2 Demographics Data Characteristics

The study population's demographics are representative of the NICU preterm and full-term infants. The average birth weight of 1927.15 grams is consistent with the research done by Bierlaire et al. (2021) and García et al. (2019), but not consistent with the study done by Kim et al. (2021). Durant et al. (2024) and Helder et al. (2019) found that the average GA was 34.9 weeks. However, the mean LOS of 61.81 days is longer. This finding is consistent with the findings of the studies conducted by Hamza et al. (2021) and Kochanowicz et al. (2022).

5.3 CVC Practices

According to the our results, the UVC is the most commonly used types of central line (61.8%), with the PICC and CVC coming in second and third, respectively. This result is not similar to the study by Durant et al. (2024), which shows that most catheters are PICC (61.2%). As is common given their expertise in neonatal care, neonatologists (74.5%) are the primary healthcare providers in charge of doing CVC insertions, following worldwide norms, which is not similar to the study by García et al. (2019) that shows the pediatric resident doing insertion of CVC in NICU.

5.4 Insertion and Maintenance of CVC Practices

Strong protocol-driven practice is demonstrated by the 98.2% adherence to established protocols during CVC insertion and the 70% adherence to infection prevention measures, such as hand hygiene. International guidelines, such as those provided by the WHO and the CDC, stress rigorous adherence to insertion protocols to lower the risk of infections, this result consistent with the study by Muller et al. (2023). However, it is disturbing that the relatively low usage of antiseptic solution (17.3%) and full barrier precautions (10.9%) is in contrast to findings from other research, such as those conducted in NICUs in North America and Europe, where these procedures are more frequently used,

this similar to Bannatyne et al. (2018) and Bierlaire et al. (2020). This identifies a need for improvement because comprehensive barrier precautions are known to lower the incidence of infections connected to catheter use.

The majority of neonates (92.7%) had their central line sites evaluated during each shift, which complies with international guidelines for regular monitoring. However, a strong commitment to upholding infection control protocols is shown by the frequency of dressing changes and the 98.2% of instances that used aseptic and sterile techniques. However, the very low number of non-sterile dressing changes (1.8%) may increase the risk of infection, which is consistent with earlier research by Kulali et al. (2019) that has demonstrated a positive relationship between poor dressing practices and higher infection rates.

5.5 Bloodstream Infections & Pathogen Distribution

The results offer a detailed examination of the prevalence and consequences of BSIs. Blood cultures were the diagnostic technique most often used (64.5%), which aligns with recommended NICU infection diagnosis procedures. In constant with findings from other studies like Muller et al. (2023), García et al. (2019), and Helder et al. (2019), which highlight fungal and Gram-positive bacterial infections as the primary causes of BSIs in newborns, the study's pathogen distribution shows a greater prevalenc of Staphylococcus aureus (24.5%) and Candida spp. (25.5%). Since these organisms are often difficult to cure and are often assoceated with the use of central lines, strong infection control measures are required.

Interestingly, even though the majority of infections (56.4%) were treated, a significant portion (12.7%) resulted in complications, and 9.1% were fatal. This result rate is consistent with a study by Bierlaire et al. (2020) and Zipursky et al. (2019), which show lower mortality rates from CLABSIs

5.6 Management and Outcomes

According to the findings, 97.3% of participants implemented treatments to reduce the rates of CLABSI; the most common ones were care package implementation (66.4%) and staff education and training (27.3%). This is consistent with successful strategies employed in other NICUs across the world, where it has been shown that care bundles significantly reduce infection rates (Hightower et al., 2022; Bierlaire et al., 2019). The great majority of

respondents (90.9%) reported a considerable drop in CLABSI rates following the implementation of these interventions, demonstrating their effectiveness.

5.7 Connection Between BSI Results and CVC Insertion Procedures

The results of the study showed that the progression of bloodstream infections was not significantly affected by following established insertion protocols ($p = 0.696$). Despite the fact that 98.2% (108/110) of patients followed the recommended protocols, there was no appreciable variation in the outcomes of infections (solved, ongoing, complications, or fatal) based on adherence.

These findings are in line with recent studies that suggest rigorous regimen adherence may not be sufficient to prevent severe bloodstream infection outcomes. According to Helder et al. (2019), infection rates varied according on the kind of catheter, the patient's condition, and infection control protocols specific to each hospital, despite the fact that several facilities had outstanding compliance rates with CVC insertion bundles. According to a research by Kim et al. (2021), adherence to insertion techniques also significantly reduced overall CLABSI rates, even though it had no direct impact on infection levels or infection control when they did occur.

However, other studies have found a more reliable link between following the procedure and a reduction in the severity of the sickness. According to Sanderson et al. (2017), rigorous adherence to insertion bundles significantly reduced the incidence and severity of CLABSI in a number of intensive care units. The results of BSI may be more significantly influenced by other relevant factors (such as post-insertion care, nurse-to-patient ratios, trends of antibiotic resistance, and protocols for infection control after insertion).

5.8 The connection between BSI outcomes and CVC maintenance practices

The rate of central line placement examination for infection symptoms did not significantly correlate with the result of BSI ($p = 0.304$). Even though the majority of cases (102/110) had assessments every shift, the result of infections (solved, ongoing,

complications, or fatal) did not differ significantly from patients with regular or every-other-day assessments.

These findings run counter to a research by Paplawski (2020), Hamza et al. (2021), and Hightower et al. (2022) that found regular and consistent central line surveillance was associated with less severe infections and better patient outcomes in NICUs. One factor contributing to the absence of relationships in the Palestinian NICUs may be variations in the way site assessments are conducted, including as assessments that are conducted inconsistently or that lack consistent documentation.

Additionally, a study by Bierlaire et al. (2020) found that while routine assessments are beneficial, they must be used in conjunction with evidence-based interventions such early line removal, chlorhexidine-based skin antisepsis, and strict hand hygiene.

5.9 Barriers to the Application of CVC Management Guidelines

Despite strong adherence to established protocols, the study observed inadequate compliance with critical infection prevention measures, including the use of sterile gloves and gowns (1.8%), full barrier precautions (10.9%), and antimicrobial-impregnated catheters (0.9%). These findings align with Mahmoud et al.'s research from 2021. However, research in high-income countries such as the US and Europe reveals a higher level of adherence to these preventative interventions, which contributes to the notably lower prevalence of CLABSI (Atilla et al., 2016). An international investigation by Mobley and Bizarro (2017) found that hospitals in developing countries with inadequate access to infection control technologies had a greater incidence of CLABSI even when protocol adherence was documented.

5.10 Conclusion

The results demonstrate a generally high level of adherence to established procedures for the insertion and upkeep of central lines. To reduce the incidence of CLABSIs, some infection control practices such as rigorous adherence to hand hygiene, careful hub cleaning, and ideal dwell time management need to be strengthened even more.

The prevalence of bloodstream infections highlights the necessity for ongoing quality improvement programs, focused staff training, and methodical monitoring of CVC-related behaviors, even in the face of advancements in CLABSI prevention efforts. To further lower CLABSI rates, it is crucial to strengthen adherence to evidence-based recommendations, put in place reliable surveillance mechanisms, and encourage an accountable culture among healthcare professionals.

Palestinian hospitals may greatly improve the outcomes for neonatal patients by strengthening infection prevention procedures and encouraging adherence to standard practices. Future studies should concentrate on analyzing the long-term efficacy of quality improvement initiatives, investigating novel approaches to catheter care, and determining how antimicrobial-impregnated catheters contribute to lower infection risks.

5.11 Recommendations

1. Strengthen adherence to standardized CVC insertion and maintenance protocols, including maximal sterile barriers, appropriate catheter site selection, and proper dressing techniques.
2. Improve disinfection procedures to reduce microbiological contamination, especially for catheter hubs and access points.
3. Develop and carry out frequent training sessions that emphasize infection control, CVC insertion, and maintenance best practices.
4. To standardize CVC administration across NICUs, and implement evidence-based interventions including care checklists and central line bundles.

5.12 Limitations

1. Limited access to the medical file
2. Incomplete medical file data
3. Limited approval to participate in the study from the governmental hospital
4. Limited transfer between cities in the West Bank

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Appendices

Appendix One: List of Tables

Table 4.4: Variables

		Mean	SD	Minimum	Maximum
Gestational Age at Birth (weeks)		34.50	3.40	26.00	40.00
Birth Weight (grams)		1927.15	581.17	700.00	3551.00
Length of Stay in NICU (days)		61.81	84.13	3.00	335.00
		Count	N %		
Gender	Male	60	54.5%		
	Female	50	45.5%		

Table 4.5: central line details

		Count	N %
Type of Central Line Used	Peripheral Inserted Central Catheter (PICC)	10	9.1%
	Central Venous Catheter (CVC)	32	29.1%
	Umbilical Venous Catheter (UVC)	68	61.8%
	Other (please specify)	0	0.0%
Person Performing Insertion	Neonatologist	82	74.5%
	Pediatrician	25	22.7%
	Nurse Practitioner	3	2.7%
	Others	0	0.0%

Table 6.4: duration of central line

	Mean	St.d	Minimum	Maximum
Duration of Central Line (days)	30.60	50.18	3.00	305.00

Table 4.7: insertion practices

		Count	N %
Were Standardized Protocols Followed During Insertion	No	2	1.8%
	Yes	108	98.2%
Infection Prevention Measures Taken During Insertion	Hand hygiene	77	70.0%
	Use of sterile gloves and gown	2	1.8%
	Use of antiseptic solution	19	17.3%
	Use of full barrier precautions	12	10.9%

Table 4.8: Maintenance Practices

		Count	N %
Frequency of Central Line Site Assessment for Signs of Infection	Every shift	102	92.7%
	Daily	5	4.5%
	Every other day	3	2.7%
	Weekly	0	0.0%
	Others	0	0.0%
Dressing Change Protocol Followed	Sterile technique	52	47.3%
	Aseptic technique	56	50.9%
	Non-sterile technique	2	1.8%
	Others	0	0.0%
Documentation Method for Central Line Site Care	Electronic medical records	77	70.0%
	Paper records	1	0.9%
	Both	32	29.1%
	Not documented	0	0.0%

Table 4.9: Bloodstream Infections Data

		Count	N %
Diagnostic Method for Bloodstream Infection	Blood cultures	71	64.5%
	Clinical signs and symptoms	7	6.4%
	Laboratory tests	32	29.1%
	Others	0	0.0%
Pathogens Identified	Staphylococcus aureus	27	24.5%
	Coagulase-negative staphylococci	13	11.8%
	Enterococcus spp.	13	11.8%
	Gram-negative bacilli	22	20.0%
	Candida spp.	28	25.5%
	Others	7	6.4%
Outcome of Bloodstream Infection	Resolved	62	56.4%
	Ongoing	24	21.8%
	Resulted in Complications	14	12.7%
	Fatal	10	9.1%

Table 4.10: Interventions and Outcomes

		Count	N %
Were Any Interventions Implemented During the Study Period to Reduce CLABSIs	No	3	2.7%
	Yes	107	97.3%
If Yes, Describe the Interventions	Staff education and training programs	30	27.3%
	Implementation of care bundles	73	66.4%
	Use of antimicrobial-impregnated catheters	1	0.9%
	Enhanced infection surveillance	1	0.9%
	Others	5	4.5%
Impact of Interventions on CLABSI Rates	Significant reduction	100	90.9%
	Moderate reduction	7	6.4%
	No change	0	0.0%
	Increase	3	2.7%

Appendix Two: Study Tools

Demographic and Clinical Data

1. Date of Birth:
2. Gestational Age at Birth (weeks):
3. Birth Weight (grams):
4. Gender:
    A. Male
    B. Female
5. Admission Date:
6. Discharge Date:
7. Length of Stay in NICU (days):

Central Line Details

10. Type of Central Line Used:
    A. Peripheral Inserted Central Catheter (PICC)
    B. Central Venous Catheter (CVC)
    C. Umbilical Venous Catheter (UVC)
    D. Other (please specify)
11. Date of Central Line Insertion:
12. Date of Central Line Removal:
13. Duration of Central Line (days):
14. Person Performing Insertion:
    A. Neonatologist
    B. Pediatrician
    C. Nurse Practitioner
    D. Other (please specify)

Insertion Practices

15. Were Standardized Protocols Followed During Insertion?

A. Yes

B. No

16. Infection Prevention Measures Taken During Insertion:

A. Hand hygiene

B. Use of sterile gloves and gown

C. Use of antiseptic solution

D. Use of full barrier precautions

E. Other (please specify)

Maintenance Practices

17. Frequency of Central Line Site Assessment for Signs of Infection:

A. Every shift

B. Daily

C. Every other day

D. Weekly

E. Other (please specify)

18. Dressing Change Protocol Followed:

A. Sterile technique

B. Aseptic technique

C. Non-sterile technique

D. Other (please specify)

19. Documentation Method for Central Line Site Care:

A. Electronic medical records

B. Paper records

C. Both

D. Not documented

Bloodstream Infections Data

20. Date of Bloodstream Infection Diagnosis:

21. Diagnostic Method for Bloodstream Infection:
    A. Blood cultures
    B. Clinical signs and symptoms
    C. Laboratory tests
    D. Other (please specify)
22. Pathogens Identified:
    A. Staphylococcus aureus
    B. Coagulase-negative staphylococci
    C. Enterococcus spp.
    D. Gram-negative bacilli
    E. Candida spp.
    F. Other (please specify)
23. Outcome of Bloodstream Infection:
    A. Resolved
    B. Ongoing
    C. Resulted in Complications
    D. Fatal

Interventions and Outcomes

24. Were Any Interventions Implemented During the Study Period to Reduce CLABSIs?
    A. Yes
    B. No
25. If Yes, Describe the Interventions:
    A. Staff education and training programs
    B. Implementation of care bundles
    C. Use of antimicrobial-impregnated catheters
    D. Enhanced infection surveillance

E. Other (please specify)

26. Impact of Interventions on CLABSI Rates:

A. Significant reduction

B. Moderate reduction

C. No change

D. Increase

Appendix Three: IRB Approval

Arab American University
Institutional Review Board - Ramallah

الجامعة العربية الأمريكية
مجلس اخلاقيات البحث العلمي – رام الله

IRB Approval Letter

Study Title: "Association of Central Line Practices with Bloodstream Infections in Palestinian Hospital's Neonatal Intensive Care Unit; A Retrospective Study".

Submitted by: Muna Mohmmad Abed

Date received: 22th July 2024

Date reviewed: 29th July 2024

Date approved: 29th July 2024

Your Study titled **"Association of Central Line Practices with Bloodstream Infections in Palestinian Hospital's Neonatal Intensive Care Unit; A Retrospective Study"** with the code number **"R-2024/A/121/N"** was reviewed by the Arab American University Institutional Review Board - Ramallah and it was approved on the 29th of July 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 6 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 Four: تسهيل المهمة

Arab American University

Faculty of Graduate Studies

الجامعـــة العربيـــة الأمريكيـــة

كلية الدراسات العليا

2024/8/5

إلى من يهمه الأمر

تسهيل مهمة بحثية

تحية طيبة وبعد،

تُهديكم كلية الدراسات العليا في الجامعة العربية الأمريكية أطيب التحيات، وبالإشارة الى الموضوع أعلاه، تشهد كلية الدراسات العليا في الجامعة أن الطالبة **منى محمد عبد الرحمن عابد** والتي تحمل الرقم الجامعي 202216667هي طالبة ماجستير في برنامج تمريض حديثي الولادة وتعمل على رسالة الماجستير الخاصة بها بعنوان:

" العلاقة بين ممارسات القسطرة المركزية والتهابات مجرى الدم في وحدات العناية المركزية لحديثي الولادة في المستشفيات الفلسطينية: دراسة استرجاعية"، تحت إشراف الدكتور معتز دريدي . نأمل من حضرتكم الإيعاز لمن يلزم لمساعدتها للحصول على المعلومات اللازمة للدراسة، علماً أن المعلومات ستستخدم لغاية البحث فقط وسيتم التعامل معها بغاية السرية، وقد أعطيت هذه الرسالة بناءً على طلبها.

وتفضلوا بقبول فائق الاحترام

عميد كلية الدراسات العليا

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العلاقة بين ممارسات القسطرة المركزية والتهابات مجرى الدم في وحدات العناية المركزة لحديثي الولادة في المستشفيات الفلسطينية: دراسة استعادية

منى محمد عابد

د. معتز دريدي

د. عمر المحمود

د. داليا طوقان

ملخص

العدوى المرتبطة بالقسطرة (CRBSI) والعدوى المرتبطة بالخط المركزي في مجرى الدم (CLABSI) هما التصنيفان الرئيسيان للعدوى المرتبطة بالقسطرة الوريدية المركزية. في الأطفال حديثي الولادة في المستشفيات، تزيد العدوى المرتبطة بالرعاية الصحية (HAIs) في وحدات العناية المركزة لحديثي الولادة (NICUs)بشكل كبير من معدلات الإصابة والوفيات المتأخرة. للحد من العدوى المرتبطة بالمعدات الطبية الغازية، تم تطوير العديد من المبادئ التوجيهية السريرية. وفقًا لمعهد تحسين الرعاية الصحية، فإن "الحزم" هي مجموعات من أفضل الممارسات المتعلقة بعملية المرض والتي، عند استخدامها بشكل جماعي، تعمل على تحسين جودة الرعاية بشكل كبير.

لدراسة العلاقة بين ممارسات الخط المركزي والعدوى في مجرى الدم في وحدات العناية المركزة لحديثي الولادة في المستشفيات الفلسطينية.

تم إجراء تصميم دراسة كمية وصفية بأثر رجعي في المستشفيات التي تحتوي على وحدات العناية المركزة لحديثي الولادة. كان السكان المستهدفون هم الأطفال حديثي الولادة الذين لديهم خطوط مركزية، والذين استوفوا معايير الإدراج. تم تضمين عينة مقنعة مكونة من (110) من حديثي الولادة في وحدة العناية المركزة لحديثي الولادة في الدراسة خلال فترة جمع البيانات.

وفقًا للنتائج، فإن الخطوط المركزية الأكثر استخدامًا (61.8٪) هي قسطرة الوريد السري(UVCs) ، والتي يتم وضعها في الغالب من قبل أطباء حديثي الولادة (74.5٪). وعلى الرغم من ارتفاع معدل

الالتزام ببروتوكولات الإدخال المعمول بها (98.2٪)، لا يزال هناك نقص في استراتيجيات الوقاية من العدوى، مثل استخدام المطهرات (17.3٪) واحتياطات الحاجز الكامل (10.9٪). تعد عمليات التفتيش المنتظمة للموقع (92.7٪) وتغيير الضمادات المعقمة (50.9٪) أو المعقمة (47.3٪) جزءًا من نظام إدارة الخط المركزي الصارم. تعد المبيضات (25.5٪) والمكورات العنقودية الذهبية (24.5٪) أكثر مسببات الأمراض انتشارًا لالتهابات المسالك البولية. يتم علاج العدوى في 56.4% من الحالات، ولكنها تسبب مضاعفات (12.7%) أو الوفاة (9.1%) في حالات أخرى. تم تقليل CLABSI بشكل كبير (90.9%) نتيجة لتثقيف الموظفين (27.3%) وتنفيذ حزمة الرعاية (66.4%). لمزيد من تقليلBSIs ، تؤكد الدراسة على ضرورة تحسين استراتيجيات الوقاية من العدوى.

تؤكد هذه الدراسة على العلاقة بين عدوى مجرى الدم في وحدات العناية المركزة لحديثي الولادة الفلسطينية واستخدام القسطرة الوريدية المركزية. هناك حاجة إلى طرق أكثر صرامة لمكافحة العدوى لتقليل CLABSIsبشكل أكبر، حتى عندما يكون الالتزام بالإجراءات ممتازًا. المراقبة القوية وتدريب الموظفين وتحسين الجودة المستمر أمر بالغ الأهمية.

الكلمات الافتتاحية: الخط المركزي، التهابات مجرى الدم، وحدات العناية المركزة لحديثي الولادة