

SHifa Bsharat

**Improving The Compliance With The Updated
Guidelines To Prevent Health Care Associated Infection
Caused By Central Venous Catheter And Peripheral
Intravenous Cannula In Neonatal Intensive Care Unit
At Rafedia Hospital**



Al-Quads University Thesis Title
Al Quads – Palestine

February 2015

Deanship of graduate studies
Child health master program



Thesis Submitted in Partial Fulfillment of the Requirements for the Degree
of Master of child health at Al-Quads University

By:

SHIFA S. BSHARAT

Supervisor

Mrs. Dina Nasser and Dr Tom Hutchison

Supported by the Royal College of Pediatrics
And Child Health, UK



Definitions

Catheter related blood stream infection (CRBSI): a primary Laboratory confirmed blood stream infection during the presence of vascular access device, 48-hour period after initial insertion, with the presence of clinical evidence of infection and no other source for infection except the catheter [1].

Central line-associated blood stream infection (CLABSI) is A laboratory-confirmed bloodstream infection (LCBI) where central line or umbilical catheter was in place for >2 calendar days on the date of event, with day of device placement being Day 1, the onset of symptoms and the infection is not related to an infection from another site[2]

Care bundles: Are groups of evidence-based interventions for patient with central line that when implemented together, result in improvement in [3] patient outcome.

The CABSI rate per 1000 central line days counted by:
$$= \frac{\text{Number of CABSI} \times 1000}{\text{Number of catheter day}}$$

Abstract

Background: the health care associated infections caused by intravascular catheters in the NICU increase the patient morbidity and mortality rate, length of hospital stay and medical cost. The newborn babies are at high risk of health care associated infection because of reduced barrier function of their skin, impaired host defenses mechanisms, limited amount of protective endogenous flora on skin and mucosal surface at birth and use of invasive procedure and devices. Using an evidence based educational intervention can enhance the nurses and doctor's commitment with the best practice to decrease these infections.

Objective: The overall objective of this study is to improve the health care workers compliance with the CDC guidelines for prevention of intravascular catheter related infection²⁰¹¹to prevent the infections caused by vascular access devices, those devices are umbilical catheters and intravenous cannula.)

Method: this observational cross-sectional study done in the NICU at Rafedia Hospital in Nablus city; was conducted in the period between June 1. 2014 and November 25. 2014, over three phases; the pre intervention phase, intervention and post intervention phase, each phase lasted for two months. All nurses N=28 and doctors N=11 working in the NICU were enrolled in this study. Data was collected using a questionnaire to assess the staff knowledge regarding the strategies for health care associated infection prevention and checklists, which consisted of observing the health care workers who insert and manage the vascular access device against evidence-based standards

During the intervention phase, a multi component educational intervention was applied

for the purpose of changing the health care workers behavior, these consisted of introducing the standardized practice checklist, lectures, printed materials(posters, self teaching module), group discussion and supervision.

Outcome monitoring including proportion of staff compliance, central line related infection/1000 patient day, %). The CLABSI rate per 1000 central line days counted by: = Number of CABSI x 1000.

Number of central line day

the catheter utilizing rate (**the catheter days divided by the total patient days**), and the intravenous cannula related complications and local infections.

For comparison purposes, the data was collected in two phases, pre and post intervention phase using the same tools monitoring the same population in the same setting and over the same length of period. Frequencies, Percentages, One Sample and Two Samples T-Test and chi square used to analyze the collected data.

Result: The pre intervention study included of 1272 in-patient days, and 261 umbilical catheter days, period of umbilical catheterization ranged from 2-12days, with a mean day(5). The overall catheter-using rates were 20.51%.The IV cannula days during this period were 382 IV cannula days, the overall IV cannula-utilizing rate were (30.03%).

The post intervention study included of 1125 in-patient days, and 291 catheter days, period of umbilical catheterization ranged from 2-14days, with a mean day(6). The overall catheter-using rates were 25.86%. The IV cannula days during the two months period for the post intervention sample were 370 IV cannula days, the overall IV cannula utilizing rate during this period were 32.8

The health care workers compliance with the CVC insertion bundle were increased from 59%-82.8% after educational intervention; the central line maintenance and care bundle from 34.8%-63.05%; peripheral intravenous cannula insertion bundle from 52.1%-73.2%; peripheral intravenous cannula care from 34.7%-68.2%

The central line associated blood stream infection rate (that confirmed by positive blood cultures and presence of infection signs, with no other source of infection except the umbilical venous catheter, after 2 calendar days of UVC insertion) decreased from 3.12/1000catheter days during the pre intervention study to 1.7/1000 catheter days during the post intervention P=.000.

The presence phlebitis signs (redness, swelling and presence of exudates around the intra venous cannula insertion site decreased from 42.2% during the pre intervention period to 17.8% during the post intervention period P=0.002.

Conclusion

An evidence based intervention consisted of application of standards and education resulted in improving in the health care workers practice and decrease the infections caused by vascular access devices among newborn babies in the neonatal intensive care unit.

تحسين الامتثال للمبادئ التوجيهية المحدثة لمنع العدوى المرتبطة بالرعاية الصحية والناجمة عن القسرة الوريدية المركزية وقسرة الوريد الطرفي للاطفال حديثي الولادة في وحدة العناية المركزة في مستشفى رفديا

ملخص: ان العدوى اللتي تحدث للاطفال اثناء تلقيهم القسرة داخل الاوعية الدموية تزيد من معدل الوفيات والامراض بين الاطفال حديثي الولادة بالاضافة لزيادة فترة الاقامة في المستشفى والتكاليف الطبية.

ان الاطفال حديثي الولادة هم اكثر عرضة لاكتساب العدوى داخل المستشفيات, بسبب انخفاض وظيفة حاجز البشرة لديهم, ضعف اليات الدفاع (المناعة) عند الولادة. التدخل التعليمي عن طريق الادلة المستتة على دراسات يلعب دور هاما في تعزيز التزام الممرضات والاطباء هي من افضل الممارسات للمساعدة في تقليلي انتقال العدوى من خلالهم الى الاطفال حديثي الولادة.

الهدف: سعت هذه الدراسة الى تحسين امتثال العاملين في الرعاية الصحية للمبادئ التوجيهية لمنع الالتهابات اللتي تسببها وسائل الوصول الى الاوعية الدموية عن طريق الابرة الوريدية وقسرة الوريد السري.

طرق واساليب البحث: اعتمدت الدراسة اسلوب بحث المراقبة المقطعي للعاملين في وحدة العناية المركزة في مستشفى رفديا, في الفترة ما بين حزيران وتشرين الثاني لعام الفين واربعة عشر, تمت هذه المراقبة على ثلاث مراحل: المرحلة الاولى ما قبل التدخل التعليمي واستمرت لمدة شهرين متتاليين, المرحلة الثانية واستمرت لمدة شهرين متتاليين ايضا حيث اشتملت على تعليم وتدريب العاملين في الرعاية الصحية بالاضافة الى اعطائهم خلفية عن ادائهم اثناء التدريب, المرحلة الثالثة وتمت فيها مراقبة العاملين بعد التعليم والتدريب واستمرت لمدة شهرين متتاليين ايضا. تمت مراقبة جميع الممرضين والممرضات وعددهم 28 وجميع الاطباء وعددهم 16.

احتوت الدراسة على استبانة لتقدير رؤية ومعرفة العاملين في المبادئ التوجيهية المحدثة لمنع العدوى بالاضافة الى قائمة تدقيق لتقييم العاملين اثناء العمل قبل وبعد المرحلة التعليمية.

تضمنت المرحلة التعليمية عدة مواضيع نظرية متعددة المضمون والاسلوب من محاضرات تعليمية وتطبيقية, مواد مطبوعة وملصقات, وحدة تعليم ذاتي لتغيير سلوك العاملين من خلال ادخال ممارسة قائمة على مرجعية موحدة تم العمل بها عن طريق مركز الوقاية من الامراض ومكافحة العدوى اللتي

تم تطويرها عام الفين واحد عشر.

في المرحلة ما بعد التدخل التعليمي, تم مراقبة نفس الشخصا بنفس ادوات الرصد وفي نفس المكان ولمدة شهرين على غرار المراقبة ما قبل التدخل التعليمي.

بعد الانتهاء من تعبئة الاستبانات وقوائم التدقيق والرصد, تم جدولتها وتحليلها عن طريق ايجاد النسب المئوية والتكرار, واستخدام اخبار (تي) للمقارنة بين السلوكين قبل وبع التدخل التعليمي. **النتيجة:** بلغت ايام مكوث جميع الاطفال اللذين تم ادخالهم لوحدة العناية المركزة 1272 يوما. كان من بينهم 261 يوما تشمل على وجود اطفال لديهم كاثيتر في الوريد السري, 382 يوما تشمل على وجود اطفال لديهم ابرة وريدية , وبهذا كان معدل استخدام الكاثيتر في الوريد السري 20,5% ومتوسط عدد ايام استخدامها من 2-12 يوما, ومعدل استخدام الابرة الوريدي 30,5% ومتوسط عدد ايام استخدامها من 3-5 ايام.

ارتفعت نسبة امتثال الاطباء بعد المرحلة التعليمية لمبادئ منع العدوى خلال ادخال الكاثيتر السري من 59% الى 82% كما ارتفعت نسبة امتثال للمرضين والممرضات خلال رعاية وصيانة الكاثيتر السري من 34.8% الى 63.2%. كما ارتفعت نسبة امتثال الممرضين والممرضات خلال ادخالهم الابرة الوريدية من 52.1% الى 73.2% بالاضافة الى ارتفاع نسبة امتثالهم ايضا خلال العناية اليوميو واستخدام الابرة الوريدية من 34.7% الى 68.2%.

انخفض معدل وجود علامات التهاب موضعي (احمرار, تورم, وجود افرازات أو صديد في وحول مكان ادخال الابرة الوريدية من 42.2% الى 17.8% ما بعد التدخل التعليمي, كما وانخفض معدل وجود علامات التهاب حول مكان ادخال الكاثيتر السري مع عدوى مجرى الدم اللتي اثبتت بفحص زراعة دم ايجابي من 3.12 لكل 1000 كاثيتر سري الى 1.7 لكل 1000 كاثيتر.

الاستنتاجات: ادى دليلا تالف التدخل على اساس تطبيق المعايير والتدخل التعليمي الى تحسين ممارسة وامتثال العاملين في الرعاية الصحية للمبادئ التوجيهية لمنع العدوى, وانعكس ذلك على تقليل نسبة حدوث التهابات موضعية وتسمم في الدم اللتي تسببها عملية وصول هؤلاء العاملين الى الوعية الدموية وذلك بين الاطفال حديثي الولادة في وحدة العناية المركزة في مستشفى رفيديا.

Declaration

"I declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree of the university or other institute, except those been made in the text".

Acknowledgment

I would like to express my gratitude to all people who have contributed to this work. In particular, I would like to thank:

- ❖ The first persons in my life (my parents)
- ❖ Special thanks and apologies to my **family**: beloved husband, for his support and efforts dear brother and sisters, and my sweet daughter to her patience until finishing my thesis.
- ❖ My supervisor Dina Nasser, for her professionalism and encouragement.
- ❖ Special thanks to **Dr Samir Khaleel**, for his support and help to make this program succeed .
- ❖ **DR Khaldoon Zaid** who was the coordinator of this program.
- ❖ All tutors for their kind appreciable help
- ❖ To **my colleagues** in the Masters of Child Health program.
- ❖ To the workers of NICU, microbiology laboratory and the health information system at Rafedia hospital.
- ❖ Finally, I would like to thanks all the people who supported, guided and encouraged me in this scientific journey.

ABBREVIATIONS

CDC: centers of disease prevention and control.

HICPAC: health care infection control practice advisory committee .

VAD : vascular access devices

HAI : health care associated acquire infection

CLAPSI: central line associated blood stream infection.

CRIBSI : catheter related blood stream infection.

HCW : health care workers.

NICU : neonatal intensive care unit.

WHO : world health organization.

MOH : ministry of health.

USAID : united states agency for international development.

IVC : intra venous cannula .

CVC : central venous catheter .

IVC : intravenous cannula

US : united state .

CINAHL: Indexed Citations, Cumulative Index to Nursing and Allied Health Literature

Chapter 1

Introduction

1.1 Overview

Intra vascular catheter related infections can be caused by health care professionals during peripheral venous cannulation or central venous catheter insertion if they do not practice the proper way before, during, after the procedure.

The catheter related infection is the most common hospital acquired infection in neonatal intensive care units; the central line related infections constitute the large part of catheter related infections.[4]

The peripheral intravenous cannula (PIC) and umbilical catheter are the main vascular access devices that are used for intravenous treatment at Rafedia hospital.

The peripheral intravenous cannula PIC has many complications but less than central line catheters, it may be local e.g. phlebitis or systemic e.g. catheter related blood stream infection (CRBSI).

Phlebitis is the most common local complication of PIC, it is classified into mechanical, chemical and infected phlebitis that occurs when the microorganisms entering the vein through the puncture site from the infants skin flora or because of poor hygiene practice of health care workers.

CRBSI another complication of PIC, is caused when the microorganisms are introduced within contaminated infusion fluids [5]

The central venous catheter is defined as a vascular access device that the tip of its end terminates at, or close to the heart, or in one of these great vessels: aorta. Pulmonary artery, superior vena cava, inferior vena cava, brachial cephalic vein, internal jugular vein, subclavian vein, femoral vein and the umbilical artery/vein.[6]

The Central line infection can be also local e.g., phlebitis or systemic e.g. central line associated blood stream infections (CLABSI)[7].

The most common type of central line used in the neonatal intensive care unit is the umbilical venous catheter that the tip of its end is positioned at the junction of the inferior vena cava and right atrium via the umbilical vein, on chest x-ray it appears above the diaphragm at the 8th and 9th thoracic vertebrae level. [8]

the umbilical catheters represent a potential portal of entry for microorganisms into the vascular system, leading to blood stream infections [9], these infections happen when the organisms adhere to the catheter surfaces and produce substances that lead to adhesions and forming the

biofilms, which periodically can cause microbial cells, these cells enter the blood stream causing an infection, the biofilms are resistant to the body defense mechanisms and antibiotics [10].

In Rafedia Hospital, the umbilical catheter is the only central line that is used for newborn babies for rapid vascular access in case of poor peripheral cannulation. Recently in Rafedia hospital, the umbilical catheter became routinely inserted for all premature babies whose weights are less than 1250 gm to decrease the local and systemic infections caused by multiple peripheral intra venous cannula attempts. Several scientific articles

considered that umbilical catheterization has become a standard of care in the NICUs, and provides reliable and painless access for intravenous therapy [11].

It used for fluid, medication, parenteral nutrition and blood product administration. It is used also for accurate laboratory determination and blood exchange in case of severe hyperbilirubinemia.

The use of these devices (central line and peripheral cannula) play an essential role in neonatal care, however the device related infections are within the leading cause of health care associated blood stream infections, particularly in premature infants. In addition, are associated with mortality and morbidity rate, hospital stay length and economic burden beside the physical, social and psychological effect on the infant and his relatives [12]

The neonates are at high risk of health care associated infections because they have loss of defense mechanisms, deficiency of endogenous flora on their skin at birth, reduction of barrier function on their skin.

The invasive procedures and vascular access devices, prematurity, low birth weight and a critically ill neonate also increase the susceptibility to health care associated infection

HAI in neonatal intensive care unit NICU. [13]

Safe Standards for minimizing risk of HAIs: hospital environmental hygiene, hand hygiene, the use of personal protective equipment, the safe use and disposal of sharps, preventing infections associated with the use of short-term indwelling urethral catheters, Preventing infections associated with central venous catheters, Isolation.[14]

The health care associated infections risk in the NICU can be minimized through the health care workers' compliance to performing invasive procedures only when needed and in the safest manner possible. [15]

Hand hygiene is a simple procedure but it remains the most effective method for reducing health care associated infections.

The World Health Organization (WHO) published new recommendations for hand hygiene in May 2009; the guidelines provide a comprehensive overview of hand hygiene and successful implementation in health care [16] The WHO recommendations for hand hygiene adopted at Rafedia hospital wards with low-level compliance.

We can also prevent the neonatal infection that is acquired during hospitalization by simple interventions like encouraging exclusive breast-feeding, effective and correct hand washing for staff and the contact persons, Avoiding the use of water in the incubator humidifier to prevent colonizing of pseudomonas , strict sterility for invasive procedures and removing IV drip if they are not necessary [17]

The Center for Disease and infection Control (CDC) and Health Care Infection Control Practice Advisory Committee (HICPAC) developed new Guidelines in 2011 for the prevention of intra vascular catheter related infections;[annex1] these guidelines make specific recommendations for the use of umbilical catheters.

They focused on implementing a group of bundle together and presented as the central line care bundle to reduce the incidence of health care associated infections caused by central line insertion and daily care. [18].

The recommendations are divided into five **categories** ranging from strongly recommended practice that is supported by high-level evidence and based on well-designed experimental and clinical studies to the categories that lack evidence and depend on policy standards and suggestions.[annex 2]

I built my checklists and data collection on standard within these recommendations, I chose the **category IA**, which strongly recommended and supported by will designed experimental and clinical studies and **category IB** that is strongly recommended and supported by some experimental, clinical and epidemiologic studies. In addition, strong theoretical rational.

2.1 Significance

- 1- It has been reported that the health care associated infections caused by vascular access devices VAD are an important cause of mortality and morbidity for neonates. It increases the economic burden of the ministry of health by hospital stay length especially that we are a country under occupation and lack resources. Another risk factor is the poor practice of the health care workers during insertion and maintenance of these devices and can be a major cause of infection.[19]

According to the US CDC between 12-25% of patient who acquire catheter related blood stream infection die, the others stay in the hospital for long time

and this can be increase the cost both financially and socially. Each year in US, the central venous catheter can cause 80000 CRBSI out of 250000 case of BSI [20]. According to some studies the single accident of CRBSI can cost 56000 CS\$ for the treatment, the lab tests, catheter change and others [21] The prevalence of out breaks in the NICU in the last decade had an effect on my study selection , many neonatal infections were reported through blood culture and other sections like umbilical , nasal , skin, ear and rectal swab cultures. There were 1389 new patients' admissions, 2514 different cultures for bacterial isolates were done for 912 newborns, and some cultures were done 2-4 times for one newborn baby during the days of hospitalization.

Out of 2514, cultures, there were 900(35.8% n=240) positive results. The large proportion of these positive results was the blood culture, (26.6% n=240). a total of 240 positive blood cultures . The types of isolates cultured are described in figure ---
- below Figure....

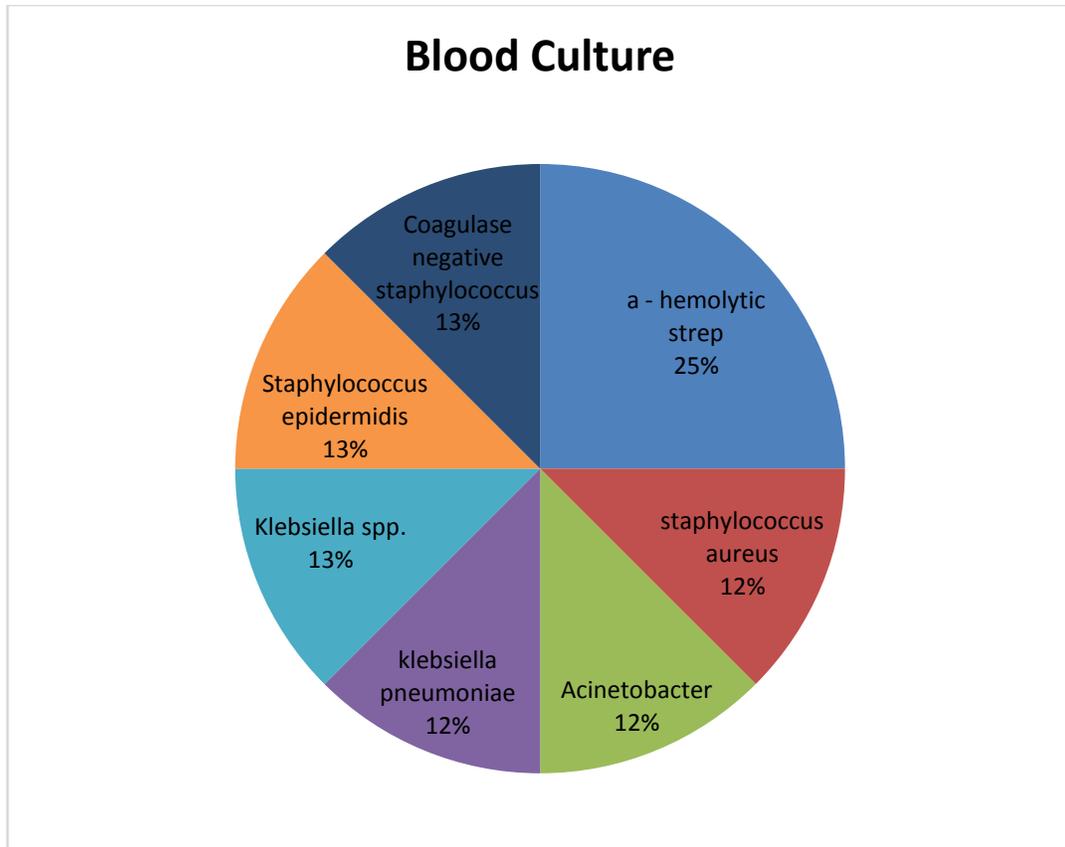


Figure 1.1: Types of isolates among positive blood cultures

2- Rafedia Hospital is a main one in the north of Palestine , it Received the premature and full term babies from one day to 28 days form Nablus city, its villages and camps whether new admissions or referred from other Hospitals. It contains 35 incubators; all are usually occupied most of the time.

In this busy area it is Important to measure the adherence of professionals and compliance regarding the infection control measures and guidelines.

3- Most BSI in neonate are associated with the presence of umbilical catheter at the time or before the onset of infection [NHSN CLABSI training / surveillance of central line associated blood stream infection. [22].

3.1 The aims

- **The main aim is to ensure safe use of vascular access device for the babies who are under intravenous therapy** through adherence to evidence based standards.
- Standardize the care of the vascular access devices using evidence-based guidelines to provide the babies with the best practice through continuous care
- Assess the knowledge of the professionals who insert and manage the vascular access devices regarding the guidelines through a questionnaire.
- Observe the staff compliance with the CVC bundles during insertion and maintenance through a checklist.
- Monitor the cannula and venous umbilical catheter insertion site by observing and palpating through the dressing on daily regular time. Educate staff regarding the proper procedures; appropriate infection control measures during vascular access devices insertion and maintenance to prevent the intravascular related infections.

4.1 Objective:

The overall objective is to improve the health care workers compliance with the evidence-based guidelines to prevent the infections caused by intravascular device.

5.1 Research hypothesis: application of standards and education will improve the health care workers practice that affects health care associated infections among newborns aged 1-28 days in the neonatal intensive care unit

6.1 Research questions:

1- Can staff training and education programs improve the staff?

2- Can the staff compliance to the application of standards affect the incidence of infection among the newborn babies?

7.1 Limitations and barriers.

1- To demonstrate a more significant improvement in the health care workers practices and decline in HAIs, a long monitoring period would have been preferred.

2- Seeing this was a quality improvement intervention, the essential part of its success was based on the people who were involved in the practice in the NICU. There was a bit of dissatisfaction and cooperation among some nurses and doctors during the intervention period because of work tension as they said.

3- Not all staff can be observed on different shifts because they always have a fixed pattern of work. Meaning that some nurses and doctors work on morning shift only, the others divided on the different shifts.

4- Although the time between the intervention and filling the questionnaire during the post intervention was not so long (one week) and the information that given are still fresh in their mind, I have a bit concern of their reliability in their answers.

Chapter 2

Literature review

1.2 Health care associated infection

“The very first requirement in hospital is that it should do the sick no harm” Florence Nightingale.

1.1.2 Back ground

In the past centuries, the hospitals have been known as dangerous places, in 1847 Ignas Semmelwis presented evidence that child bed fever was spread from person to person on the unclean hands of health care workers, but these findings didn't improve the sanitary condition at that time, it just directed the doctors to think about the septic and antiseptic technique [23] .

In India , Egypt , Palestine , and Greece , the concept of hospital with hygienic practice was presented 500BC , the transmission of the infection was known since the sick persons were collected together for treatment , but there was no epidemiological data or surveillance system at that time .

The nature of the problem of HAI was understood through the writing of John Bell in 1801[23].

The infection that happened after the admission of the child to the hospital for other reason and not documented by lab tests on admission is a health care associated infection.

The CDC defined the HAI as the systemic or localized infection resulting from an adverse reaction of an infectious agent that wasn't present on admission to the acute care

facilities [24] there must be no evidence that infection was present at the time of the patient admission [25].

2.1.2 Epidemiology for HAI

Surveys found that 10-20% of all neonates in hospital in any day may have HAI and this percentage increases during the sepsis out breaks [26]

each year hundred millions of patients are affected by HAI worldwide , out of 100 hospitalized patients at least 7 patients in the developed country and 10 in a developing country acquire HAI .

The endemic burden of health acquired infection in the ICU and NICU in the lower and middle-income countries is higher than the high-income countries [27]. The newborn babies are at higher risk of acquiring HAI 2-20 times in developing countries than developed countries and HAIs are responsible for 4-56%of all cases of deaths in the neonatal period , and 75% in south east Asia and sub-Saharan Africa .

At any given time, the prevalence of HAIs in developed countries varies between 3.5-12% on the other hand it reaches 7,5-19% in the lower income countries 7.5-19% (WHO health care associated infection fact sheet2010).

3.1.2 The infections that Infants acquires during hospitalization may be:

- Endogenous or self-infection in which the causative agents are on in the infant's body on the admission without signs of infection, during hospitalization, the infection developed because of alteration in the child immunity.
- exogenous or cross infection: that is acquired from the surrounding environment during hospitalization by contact with new infective agent [28]

- Iatrogenic infection: that is caused by the modern medicine, catheters, and invasive procedures.
- Super infection: that results from the abuse of antibiotics [29].

4.1.2 Surveillance of Health care associated infections in Palestine

Palestine lacks a surveillance system for HAIs and there is complexity and lack of criteria in diagnosing the infection, hospitals can diagnose an infant as having neonatal sepsis by doing blood culture sample to detect the causative organism without determination for the source of these agents, also there is difficulty in gathering reliable data about this topic

2.2 Local study

The studies related to this topic are limited. A cross sectional study done in Gaza in (2011) concentrated on the epidemiology of neonatal septicemia by defining the main etiological bacterial agents in the neonatal intensive care units in two local hospitals in Gaza; AL-Nasser and AL-SHifa Hospitals.

The study result showed the incidence rate of septicemia was 10.4% (24.2/1000 patient day) at Al-Nasser unit, At Al-Shifa's Hospital 9.1% (14.4/1000 patient day), It classified the causative organisms by blood culture sampling, a total 534 were positive and 57 wares negative result.

The causative bacteria were Coagulase-negative Staphylococcus aureus (39%,n=24),Staphylococcus aureus (39%, n=24). (23%,n=14),streptococcus spp.(12%, n=7),Enterobactercloacae and Pseudomonad spp. (8%, n=5), and Escherichia coli and Klebsiella Pneumonia (5%, n=3 each)[30].

The findings of this study do not identify the original source of the microorganism. Blood cultures done for patients, sampling the environment and the workers for potential pathogens and testing isolated microorganisms for antibiotic susceptibility was also done. The recommendations concentrated on hand washing, continuous surveillance program for infections in Gaza hospitals, and the need for HCW monitoring and enforcing to commit with infection control measures.

3.2 diagnosis of sepsis at Rafedi Hospital

The diagnosis of neonatal sepsis in the NICU at Rafedia hospital begins with clinical suspicion; Nurses and doctors usually observe the common signs and symptoms of neonatal sepsis in the very low birth weight babies like hypothermia, hypotonic or lethargy, apnea, increased need for O2 ventilation, pallor, mottling skin or fever.

When the doctors suspects epticemia, they start antibiotic doses after blood culture is withdrawn and complete septic work up is done.

4.2 use and misuse of antibiotics

Usually the infants are kept under IV antibiotics for a long period. Sometimes there is no review for the necessity of the antibiotic, even though the blood culture result is negative the antibiotics continue until the infant is discharged.

There is another protocol in the NICU at Rafedia Hospital that each infant admitted to the ward must received IV antibiotic as prophylactic especially in the presence of umbilical catheter. Sometimes the antibiotic is changed more than once in a short period.

The CDC recommended not administering systemic anti biotic routinely before insertion of intravascular catheter to prevent colonizing or blood stream infection (A recent Cochrane review of prophylactic antibiotics in neonates with umbilical venous catheters concluded that there is insufficient evidence from randomized trials to support the use of prophylactic antibiotics) (CDC guidelines for prevention of intravascular related infection2011). In addition; the use and misuse of antibiotics lead to alteration in the newborns micro flora and antibiotic resistant, e.g. the resistant of gram negative organism to vancomycin, methecicillin resistant staphylococcus aureus.[31]

The infectious disease society of American and the society for health care Epidemiology of American have developed a guidelines for antimicrobial stewardship to reduce antimicrobial resistant these guidelines recommended for auditing the antimicrobial use, restriction and authorized requirement for selected of antimicrobial agent, antimicrobial order form, education, plans for narrowing or reduction to the un necessary antimicrobial agents[32]. These guidelines are effective to applied in our NICU; they gave me an idea to do auditing for using antimicrobial agent in my sitting in the future.

5.2 The Procedures and protocols references used in the NICU for infant care

- The neonatal care procedural manual for hospital (produced by the united states agency for international development(USAID)2010 was adopted in the NICUs in the Palestinians Hospitals , it contains wide information about general and specific guidelines for infection control , special isolation precaution and infection out breaks . It has adopted the CDC guidelines as reference for the work .
- Hand book of neonatal intensive care(seventh edition)2011[33]

6.2 Catheters used for venous and arterial access at Rafedia hospital NICU

There is confusion in the terminology to identify different types of catheters. A catheter can be named by the type of vessel it is inserted in e.g. peripheral venous, central venous or arterial. Others are named according to their life span such as temporary or permanent. Or according to its site of insertion e.g. subclavian, femoral, internal jugular, peripheral, or peripherally inserted central catheter [34].

The most common catheters used in the NICU are the peripheral short-term cannula and the umbilical catheter

1.6.2 Umbilical catheter

The umbilical catheter cannulation was first described in 1947 for blood exchange to treat the infants with severe hyper bilirubinemia. Since 1959 the, umbilical catheter was used for arterial blood gasses. [35]

The umbilical catheter can be inserted in the umbilical vein or the umbilical artery, the most common one used in the NICU is the umbilical venous catheter UVC. It is applied for rapid vascular access, accurate laboratory determination, administration of fluids, medications, blood products and parenteral nutrition. The umbilical catheter should not be exceed more than 5 days, however the umbilical venous catheter is allowed for no more than 14 days. [36]

The umbilical catheter not only has benefits for newborn babies, but also has significant complications e.g. sepsis, bleeding, clot formation, embolism and other complications related to mal positioning like arrhythmias, hepatic necrosis or portal hypertension.

Most blood Stream infections (BSI) in neonates are associated with the presence of an umbilical catheter at the time or before the onset of infection [NHSN CLABSI training / surveillance of central line associated blood stream infection. [37]

The umbilical venous is the site of choice for the low birth weight infants and blood exchange because, it can be cannulated easily although its stump becomes heavily colonized soon after birth, the associated blood stream infection caused by the UVC was not always related to the stump colonization. In several studies, an estimated 22%-59% of umbilical vein catheters colonized and 3%-8% of colonized catheters result in CRBSI (CDC guidelines for prevention of intravascular catheter related infection 2011).

2.6.2 Peripheral venous cannula

The injection of medication into the veins was used in the 16 century, by using metal tips, animal veins as tubing, and various species of bladder as container bags. by the 19 century Dr Richard Lower used the feather quills and animal bladders to reach the area of IV infusion ,by the twentieth century equipment began to be made of plastics, first polyvinylchloride, then Teflon and finally, polyurethane. [38]

The IV cannula is a device inserted inside the vein to provide venous access for the purpose of fluid, medications, chemotherapy and blood administration, it is also used for nutritional support and in the case of repetitive blood sampling. It has various gauges, 16-24G and 25-44mm length. (Intravenous canulation, Med Escape 2013) .

The Gauge of IV cannula used in the NNICU is 24(yellow color) It used because it is the smallest gauge.

The complications of the IV cannula are less dangerous than the central line; thrombi phlebitis, local infection, hematoma, infiltration and extravagation are the most

complications for IV cannula, good monitoring, compliance with infection control measures and close observation for the insertion site play an important role in minimizing these complications.[39]

An intravenous cannula should not remain in place if the child does not receive IV treatment, daily review should be done by the doctors and nurses for the necessity of it. [40]

7.2 Intravascular catheter related infection.

The intravascular catheters used for the administration of fluids, medications, blood products, parenteral nutrition and patient monitoring. play an important role in the occurrence of blood stream infection. The blood stream infections BSI are caused after external and internal bacterial colonization or direct infusion of the pathogen into the bloodstream.

The most common type of intravascular catheter that may cause blood stream infection is the central line, which is defined as an intra vascular device that the tip of its end terminates in one of the great vessels. [41]

The first central line was applied by Hermosura in 1950 in the internal jugular vein , at that time mechanical complications after central venous catheter insertion like embolism and leak occurred, then BSIs became a serious complication associated with the use of central line catheters [42].

The CDCs National Health Care Safety Network (NHSN) used a term Central line acquired Blood Stream Infection (CLABSI) that is a primary blood stream infection in

the patient that had a central line within the 48-hour period before the development of the blood stream infection and that is not related to an infection at another site [43]

Catheter Related Blood Stream Infection (CRBSI) is known to be the most common hospital acquired infection [44]. Various definitions and terms are used when defining the CRBSI. Definition is the infection that is caused as a result of an intravascular catheter and is confirmed with either a positive catheter tip culture or positive blood culture from the catheter referred to as a catheter related blood stream infection.[45] The central line related infections are in large part of CRBSI.

Most BSI in neonate are associated with the presence of a central line at the time or before the onset of infection (NHSN CLABSI training / surveillance of central line associated blood stream infection). [46]

A survey in England (2011) showed that 64% of all patients with blood stream infection had a vascular access device in the 48 hours prior to the onset of infection 59% of them received central venous catheter CVC[47].

8.2 Educational intervention

1.8.2 Overview

Educational interventions for preventing intravascular catheter related infection have been done in the NICU at Rafedia hospital; they were vary in their content and complexity, and range from the provision of simple checklists and posters to complex interventions including multimedia lectures and self teaching module that has already been prepared for the staff to encourage self discovery of information.

It has been proposed that the majority of Intravascular catheter associated infection could be prevented using evidence-based educational interventions to ensure that doctors and nurses are committed to a culture of safety and follow best practice to achieve this(48)

The US CDC emphasizes the need for staff education and training in evidence-based practice for preventing of intravascular associated infections.

Those evidence-based practices that been recommended include of care bundles for CVCs and peripheral intravenous cannula.

2.8.2 International studies

a study including education and introducing of central venous catheter insertion bundle done by Hung-Jen, His-lan Lin in the Chi Mei medical center department of intensive care unit between march and decemcer2012, to measure the impact of central line insertion bundle on central line associated infection, during the ten months period, there were a total of 687 CVC insertions, the rate of central line associated blood infection CLABSI significantly decrease from 1.56/1000 catheter day during the pre intervention period to 0.65/1000 catheter day post intervention, this result showed the effectiveness of intervention and introducing of CVC bundle in reducing the rate of CLABSI.[49]

A systematic literature review done by Frampton et al. in February 2014 To assess the effectiveness and cost-effectiveness of educational interventions for preventing catheter-blood stream infection (BSI) in critical care units in England, Two reviewer reviewed ((Sixteen electronic bibliographic databases – including, MEDLINE, and, Other Non-Indexed Citations, Cumulative Index to Nursing and Allied Health Literature (CINAHL), NHS, and The Cochrane Library databases were searched)) Geoff K Frampton 2014.

The result of this review suggested that it would be cost effective and cost saving for the NHS to implements educational intervention for catheter related blood stream infection in critical care unit [50]

In addition; since 2004, WHO patient safety developed a training materials and tools to improve the health care professionals knowledge about patient safety (WHO Patient Safety Curriculum Guide October 2011)[51]

Chapter 3

Methodology

1.3 the pre intervention period

1.1.3 Study design, sitting, population and period

An observational cross sectional study for medical staff in NICU at Rafedia Hospital was done, this governmental hospital is directed and owned by the Palestinian ministry of health MOH, the study period was from June1 2014 to July 26/ 2014 for the pre intervention performance, and from October 1/2014 to November 25/2014 for the post intervention performance.

An intervention period was done between August 1 2014 to September 30 2014

2.1.3 Sampling method

All nurses and doctors working in the neonatal ICU were enrolled in this study, the total participant (N=44); doctors (n=16), nurses (n=28)

3.1.3 Data collection methods

Two tools used to collect data included:

- 1- An observational checklist based on evidence-based care elements for the prevention of infection during insertion and maintenance of central line and peripheral cannula.
- 2- A Questionnaire to assess the staff knowledge and perspectives towards the infection prevention strategies to prevent the health care associated infection (HAI).

2.1.3 Sample characteristics

1.2.1.3 The doctors

The pre intervention sample size was 16 Doctor's.

Doctors professional qualification / Table 1.3

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Pediatrician	5	31.3	31.3	31.3
General Doctor	11	68.8	68.8	100.0
Total	16	100.0	100.0	

Table 2.3 shows the frequencies and percentages for the different age groups in the pre intervention sample.

Doctors age groups frequencies and percentages / Table2.3

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 21 to 30 years	3	18.8	18.8	18.8
30 to 40 years	9	56.3	56.3	75.0
40 to 45 years	3	18.8	18.8	93.8
Above 45 years	1	6.3	6.3	100.0
Total	16	100.0	100.0	

Table 3.3 shows the frequencies and percentages for the number of years of experience in the neonatal world.

Years of experience in neonatal world / Table 3.3

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less than 5 years	3	18.8	18.8	18.8
5 to less than 10 years	9	56.3	56.3	75.0
10 to less than 15 years	2	12.5	12.5	87.5
Above 15 years	2	12.5	12.5	100.0
Total	16	100.0	100.0	

Gender for the doctors' pre intervention sample (16) shown in frequencies and percentages in table .4.3

Gender / Table .4.3

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Male	12	75.0	75.0	75.0
Female	4	25.0	25.0	100.0
Total	16	100.0	100.0	

Their age group ranged between 21 to above 45 years old, their experience in the neonatal ward was less than five years to above 15. The pre intervention sample was 28 nurses, 23 were females and five were male.

2.2.1.3 Nurses

Nurses qualification also differed between practical nurse (2 years nursing) and staff nurse, the staff classified into Bachelor's degree and Bachelor's degree and high diploma in neonates.

Their age group also ranged between 21 to above 45 years old, their experience in the NICU was ranged from one to above 45 years. The pre intervention sample size was 28; table 5.3 illustrates the different Frequencies and percentages of the nurses' professional qualification.

Nurses' professional qualification / Table 5.3.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Basic B.Sc. Nursing	13	46.4	46.4	46.4
Bachelors degree				
Post Basic B.Sc. (2 years)	8	28.6	28.6	75.0
High Diploma	7	25.0	25.0	100.0
Total	28	100.0	100.0	

Table 6.3 shows the frequencies and percentages for the different age groups in the pre intervention sample.

Nurses age groups frequencies and percentages / Table 6.3

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 21 to 30 years	15	53.6	53.6	53.6
30 to 40 years	9	32.1	32.1	85.7
40 to 45 years	3	10.7	10.7	96.4
Above 45 years	1	3.6	3.6	100.0
Total	28	100.0	100.0	

Table 7.3 shows the frequencies and percentages for the number of years of experience in the neonatal world.

Years of experience in neonatal world / Table 7.3

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less than 5 years	9	32.1	32.1	32.1
5 to less than 10 years	8	28.6	28.6	60.7
10 to less than 15 years	7	25	25	85.7
Above 15 years	4	14.3	14.4	100.0
Total	28	100.0	100.0	

Gender for the nurses pre intervention sample (28) shown in frequencies and percentages in table 8.3

Gender / Table 8.3

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Male	5	17.9	17.9	14.8
Female	23	82.1	82.1	100.0
Total	28	100.0	100.0	

3.2.1.3 Characteristics of Target group

(1)The children who received umbilical catheters were divided into two groups; Full term (above 37 weeks)n=12(25%) and Premature (37 weeks and below)n=36(75%) The weights for premature children (36 cases) divided into three groups, from 500 gm. To 1500 gm 8 (22.2%) children, from 1501 gm. To 2500 gm. 25(69.44%) children, from 2501gm to 3500 gm 3(8.33%), Child weights for full term GA children (12 cases) are 2100-3900

The insertion site for the pre intervention sample was 100% Umbilical for all of the 48 cases, 30 (62.5%) insertions done as new indication (first time), and 18 (37.5%) insertion were done after malfunctioning of previous catheters.

(2)The children who received IV cannula are divided into two groups; Full term (above 37 weeks) n=61(72.6%), and Premature (37 weeks and below) n=23(27.4), The children weights' for full term babies ranged between 2200gm to 4200gm. Child weight for premature children ranged between500gm-to 3500gm.

3.1.3 Data collection methods

1.3.1.3 Prior pilot criteria:

Piloting for the data collection tools was done before starting the data collection. I observed the CVC insertion procedure three times; I noted that some elements of the CVC insertion bundle are not applied in the NICU at Rafedia hospital such as:

(1) the avoidance of femoral vein because the CVC catheter used in NICU is only the umbilical catheter), for this reason, I did not use this element because it is not valid in our NICU.

(2)The use of chlorohexadine 0.5percent in alcohol for skin antisepsis that is not available, and is replaced with Povidone Iodine solution.

- Observed ten nurses who managed the umbilical catheter, I found that some elements of the CVC maintenance checklist were not applied such as the daily review of catheter necessity, the use of a transparent dressing, the use of a special set containing sterile drape, gown and all the necessary equipment. For this reason, these elements were not used in my assessment.

2.3.1.3 Questionnaire

The questionnaire consisted of two sections, the first section covered the professional information (demographic data), and the second consisted of 18 questions, the questions adapted from a predefined survey ((a toll to assess barriers to adherence to hand hygiene guidelines)) by. Larson, 2004, American journal of infection control. The staffs (nurses and doctors) answered the questionnaire using a liker scale of 0-5. Zero being strongly disagree and five strongly agree. [See Annex3] for the questionnaire

3.3.1.3 Checklists

Four checklist forms were filled during the pre intervention period

- 1- CVC insertion checklist (doctor task)
- 2- CVC maintenance and care checklist (nurses task)
- 3- Peripheral intravenous cannula insertion checklist (nurses task)
- 4- Daily peripheral intravenous cannula maintenance and care checklist (nurses task).

4.1.3. Central venous catheter CVC insertion bundle checklist

CVC insertion checklist filled during the pre intervention phase, consisted of the following evidence based practices[Annex 4]

- 1- Hand hygiene,
- 2- Maximal barrier precautions.
- 3- skin antisepsis,
- 4- optimal catheter site and selection, [26].

The checklist was filled by me, by monitoring of doctors (N=16) compliance with the central venous bundles insertion while performing the task . Three observations for each doctor; All 48 procedures for inserting central catheters were umbilical. The time of monitoring was performed over the three shifts; Shift A (7 AM to 2 PM), Shift B (2 PM to 9PM) and Shift C (9 PM to 7 AM).

5.1.3. Central venous catheter (CVC) maintenance and care bundle checklist

The CVC care and maintenance filled in the pre intervention phase consisted of the following evidence based practices: [Annex 5]

1. Hand Hygiene
2. Proper Dressing Change
3. Aseptic technique for accessing and changing needleless connector
4. Standardize tubing change
5. Daily review of catheter necessity.

The checklist was filled by me, by monitoring to the nurses (N=28) compliance with the central venous catheter maintenance and care bundle, the central line catheter that was managed by the nurses was 100% umbilical catheter, three observations for each nurse,

84 observations were done during the pre intervention study, the data collected between 03.06.2014 to 29.07.2014.

The children who received care by nurses are the same group (48) who received umbilical catheter, I chose to observe the same children to follow these cases for the presence of signs of infections or any complication caused by those catheters.

6.1.3 Peripheral venous cannula insertion checklist

The peripheral venous cannula insertion checklist filled during the pre intervention phase consisted of an evidence-based practice: [Anex7]

- 1- Hand hygiene
- 2- Wearing clean gloves,
- 3- preparing equipment before procedure
- 4- optimal site selection
- 5- skin antisepsis.
- 6- Using no touch technique after scrubbing
- 7- proper dressing.

Insertion site and the IV cannula Gauge, Antiseptic technique, Dressing technique, Flushing after insertion, Documentation.

The checklist was filled by me, monitoring to the nurses (N=28) compliance with evidence based international practice during IV cannula insertion, 3 observations for each nurse, 84 observations was done over different shifts. The data collected between the dates 01.06.2014 to 26.07.2014.

7.1.3 Peripheral venous cannula care and maintenance

The peripheral venous cannula care and maintenance checklist filled during the pre intervention phase consisted of the following evidence-based practices:[Anex8]

- 1- Hand hygiene
- 2- Replacement of the caps and stopcocks
- 3- daily dressing regimen
- 4- changing IV tubing.
- 5- Daily observation for the presence of infections signs
- 6- Daily review to the necessity of the IV cannula .
- 7- Flushing after and before administrating medication.
- 8- Documentation.

The checklist was filled by me, monitoring the nurses (N=28) compliance with for IV cannula care and maintenance, 3 observations for each nurse, 84 observations was done over different shifts.

During filling the peripheral IV care and maintenance checklist, I continue observing the same children who received IV cannula to see the infections signs that may be caused because of poor compliance during insertion.

84 observations were done during this

The observation checklists were completed, as I worked with the health care workers HCWs I was familiar with most of them, thus they behaved normally in the presence of

me, they were unaware of being under observation, this allowed me to observe their level of compliance with the guidelines.

2.3 Intervention

1.2.3 Implementation phase

Permission for giving lectures and training programs was taken from the director of the hospital and director of nursing.

The intervention period was made between the dates 01.08.2014 to 30.9.2014.

1- An educational session was prepared in PowerPoint manner, done in a different sessions, they differ in duration and component, ranging from half to one hour, the attendance was mandatory for all NICU staff.

2- Individual and group training programs were done in the ward, the staff mostly in need of training were those who have been recruited recently, they were trained by me with the help of other expert colleague in the ward to insert the IV cannula in a safe manner following the standard precautions and guidelines for infection control and prevention.

First, the nurses trained on the hand washing technique: procedure, time for hand washing and the necessity according to the WHO five moments for hand washing.

Then training on IV cannula insertion started according to a schedule applied by the NICU head nurse and me, the place was in the NICU, on a real newborn babies because the doll were not available.

The training programs done after theoretical lectures and showing some videos about the way for IV cannula insertion.

Each time I started with one case in front of the nurse or the nurses in need, talking and discussion during insertion were done by me during insertion, question from the nurses was allowed during my application.

The training was done on the new admissions or on the newborns that had accidentally IV cannula removal or whom in need for changing the IV cannula.

Performance feedback has been given after each procedure.

IV cannula and umbilical catheter dressing and managing were discussed during the educational lectures at first then the application done in the ward by me first and then by nurses.

The doctors were trained by their seniors according to some observations, which offered to the head of the department.

A formal letters sent to the head of the pharmacy to provide the ward with the need resources for hand hygiene, dressing cannula and umbilical catheter transparent dressing.

2.2.3 The topics that were covered during the educational program

The topics were taken from the CDC guidelines which emphasized on the care bundles for CVC and IV cannula insertion and maintenance and included :

- .1- hand hygiene
- 2- IV cannula insertion, management and daily care.
- 3- Umbilical catheter insertion, management and daily care.
- 4- Guidelines for prevention of health care associated infection
- 5- CDC guidelines for intravascular catheter related infection.

Methodology

3.3. During the Post intervention phase

1.3.3 Study design, setting, population and period

Re auditing observational study for medical staff in NICU at Rafedia Hospital was done. The study period was from October 1/2014 to November 25/2014 for the post intervention performance.

2.3.3 Sampling method

All the nurses and doctors working in the NICU were enrolled in this study, the total participants (N=44), all doctors (n=16), nurses (n=28).

1.2.3.3 Sample characteristics

The doctors and nurses in the post intervention sample were the same as those in the pre intervention sample ; they had the same size, professional qualification, age group, year of experience and gender.

2.2.3.3 Characteristics of Target group.

(1)The children who received umbilical catheters post intervention were divided into two groups; Full term (above 37 weeks) n=12(29.2%) and Premature (37 weeks and below)n=34(70.8%).

The weights for premature children (34 cases) divided into three groups, from 500 gm to 1500 gm 13 (38.2%) children, from 1501 gm. To 2500 gm 13(28.2%) children, from 2501gm to 3500 gm 8(23.53%)

Child weights for full term GA children (14 cases) ranged from 1200gm to 3970 gm.

The insertion site for the post intervention sample was 100% Umbilical for all of the 48 cases, 38 (79.2%) insertions done as new indication (first time), and 10 (20.8%) insertion were done after malfunctioning of previous catheters.

(2)The children who received IV cannula are divided into two groups; Full term (above 37 weeks) n=57(67.9), and Premature (37 weeks and below) n=27(32.1).

The children weights' for full term babies (75 cases) ranged between 1700gm to 4100gm.

Child weight for premature GA children (23 cases) are divided into three groups as followed: from 500 gm. To 1500 gm. were 5 (18.5%), from 1501 gm. To 2500 gm. 19(70.4 %). And from 2501 gm. To 3500 gm. Were 3(11.1%).

3.3.3 Data collection methods

I used the same tools that used during the pre intervention period, the same number distributed to the same sample and in the same sitting.

Same checklist elements filled by me with the same were during pre intervention, same people were observed for three times.

Chapter 4

1.4 analysis and result of CVC insertion checklist

The calculated value of Cronbach's Alpha ranged from 60% to 75%, which means that the study is reliable.

The sample data collected using the questionnaire (appendix) was analyzed using SPSS version 18.0, through the following statistical results: Frequencies, Percentages, One Sample and Two Samples T-Test.

1.1.4 analysis of CVC insertion checklist during the pre intervention period

During this two months period in the NICU, there were a total of 1272 in-patient days, and 261 catheter days, the overall catheter-using rate were 20.51% for the pre intervention sample.

Out of 48 insertions, 33 (68.7%) were done by resident doctors, while 15 (31.3) insertions were done by specialist doctors. The optimal site selection was 100% the umbilical vein

Staff compliance with CVC insertion standard during the pre intervention period.

The overall compliance with the 4 elements of central line insertion bundle was (59.1%), as was (59.1%), the compliance of each elements was follows : hand hygiene (39.5), maximal barrier precaution(48.5), prepared skin with povidone iodine solution(48.5), optimal catheter site selection(100%).

Table 1.4 shows Percentage of doctor's complying with the four elements of CVC insertion bundle.

CVC insertion bundle checklist frequencies and percentages (Pre intervention) / Table 1.4						
	Yes		No		Not Available	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<u>Hands hygiene</u>						
Is hand hygiene done before umbilical catheter insertion	19	39.5	29	60.5		
<u>Maximal barrier precaution</u>						
Wearing cap	17	35.4	31	64.6		
Wearing mask	17	35.4	31	64.6		
Wearing sterile gown	21	43	27	57		
Wearing sterile gloves for the person who insert the catheter	36	75	12	25		
Covering the patient with sterile drape with an opening for the CVC insertion	26	54.1	21	45.9		
<u>skin antiseptic:</u>						
Prepares skin with anti-septic povidone iodine10% solution.	33	68.7	15	31.3		
Press the sponge of povidone iodine10% against the skin , using back and forth friction scrub for at least 30 second	26	54.1	22	45.9		
Allow the antiseptic to dry completely before puncturing for at least 2 minutes	11	22.9	37	77.1		
<u>Optimal catheter site selection :</u>						
Umbilical vein	51	100				

2.1.4 Analysis of CVC insertion checklist during the post intervention period

During this two months period in the NICU, there were a total of 1125 in-patient days, and 299 catheter days, the overall catheter-using rate were 26.5% for the post intervention sample.

Out of 48 insertions, 33 (68.8%) were done by resident doctors, while 15 (31.3) insertions were done by specialist doctors.

Staff compliance with the CVC insertion standard during post intervention period

The overall compliance with the 4 elements of central line insertion bundles were 82.8% , as Shown in table B9 the compliance of each elements was follows : hand hygiene 79.9, maximal barrier precaution87.5,prepared skin with povidone iodine solution63.9, optimal catheter site selection(100%). Table 2.4: Percentage of doctor’s complying with the four elements of the CVC insertion bundle.

CVC insertion bundle checklist frequencies and percentages (Post intervention) / Table 2.4						
	Yes		No		Not Available	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<u>Hands hygiene</u>						
Is hand hygiene done before umbilical catheter insertion	35	72.9	13	27.1		
<u>Maximal barrier precaution</u>						
Wearing cap	25	52.1	23	47.9		
Wearing mask	26	54.2	22	45.8		
Wearing sterile gown	28	58.3	20	41.7		
Wearing sterile gloves for the person who insert the catheter	48	100				
Covering the patient with sterile drape with an opening for the CVC insertion	48	100				
<u>Povidone iodine 10% skin antiseptic:</u>						
Prepares skin with povidone iodine solution	42	87.5	6	12.5		
Press the sponge of antiseptic solution against the skin , using back and forth friction scrub for at least 30 second	29	60.4	19	39.6		
Allow the antiseptic to dry completely before puncturing for at least 2 minute	21	43.8	27	56.3		
<u>Optimal catheter site selection:</u>						
Umbilical vein	48	100				

3.1.4 Using Independent Two Samples T-Tests for comparison purposes:

Because the study has two data collecting periods, Independent Two Samples T-Test is calculated for each part of the questionnaire and checklist using the Pre intervention and Post intervention factor.

1.3.1.4 Hand Hygiene

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention shows a significant difference $P=.002$. This indicates that the variability in the two means with an increase in compliance in the post intervention statistically significant

2.3.1.4 Maximal Barrier Precaution:

1- wearing sterile gloves

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention shows a significant difference $P=.001$. This indicates that the variability in the two means with an increase in compliance in the post intervention statistically significant

2- Wearing mask

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention shows no significant difference $P=.139$

3- Wearing cap

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention shows no significant difference $P=.203$

4- Wearing sterile gown

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention shows no significant difference .P=0.063

5- Covering patient with sterile drab

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention shows a significant difference .P=.038 This indicates that the variability in the two means with an increase in compliance in the post intervention statistically significant.

3.3.1.4 povidone iodine 10% skin antiseptic:

1- Scrubbing the skin for at least 30 seconds

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention shows a significant difference .P=.040 this indicates that the variability in the two means with an increase in compliance in the post intervention statistically significant

2- Allow the disinfectant solution to dry for at least 30 seconds

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention shows a significant difference .P=. 003 This indicates that the variability in the two means with an increase in compliance in the post intervention statistically significant

4.1.4 Result

The result of this study show varying degree of compliance with the different elements of CVC insertion bundles, the overall compliance with the four bundles improved from 59% during the pre intervention period to 82.8% in the post intervention period.

After analyzing the data that was collected, I found that there were positive findings reflecting the staff adherence to standards post intervention. With a 95% confidence that the differences were statistically significant between their pre and post intervention practice indicates the successful intervention that been done regarding main areas in the bundle as hand washing, use antiseptic povidone iodine 10% solution and maximal barrier precautions. There was however no change noted in wearing cap and wearing mask so there was a need for further education and monitoring.

The successful intervention in this area was the lectures that consisted of the indications and rationales for each bundle, and the self teaching module which printed to all staff in the ward, also the provision of facilities for hand washing as soap, paper towels, and Alco gel help in the staff compliance.

Training on hand hygiene procedure and postures consisted of the WHO five moments for hand hygiene help in this successful result.

2.4 Analysis and results of CVC maintenance and care checklists during the pre intervention period

During the two months period in the NICU, there were a total of 1272 in-patient days, and 261 catheter days, period of umbilical catheterization ranged from 2-12days, with a mean day(5). The overall catheter-using rates were 20.51% for the pre intervention sample.

among total of 84 observations done for nurses during catheter care and maintenance on 48 children during the post intervention period, 24 observations (28.5%) done by practical nurse, 39(46.5%) done by staff nurse who has bachelor degree, 21(25%) done by staff nurse who has bachelor degree in addition to high diploma in neonates.

1.2.4 The staff compliance with CVC maintenance and care during the pre intervention period

The overall compliance with the four elements of central line care and maintenance bundle was (34.8%), the compliance of each element was as follows: the nurse's commitment with WHO five moments for hand hygiene (34.7%), accessing the central line catheter (26.5%), and replacement of administration set (43.3. %), dressing change (34.9%). Details of the compliance with the standards of maintenance and care are detailed in table 3.4.

CVC maintenance and care bundle checklist frequencies and percentages (Pre intervention) / Table 3.4						
	Yes		No		Not Applicable	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<u>Hands hygiene: Did the health care workers committed with the WHO five moments for hand hygiene</u>						
Before touching the patient	15	17.8	69	82.1		
Before clean/aseptic procedure	26	31	58	69		
After body fluid exposure during CVC care	48	57.1	32	38	4	4.7
After touching the patient	31	36.9	53	63.1		
After touching the patient surrounding	26	31	58	69		
<u>Accessing the central line catheter: When accessing the central line is:</u>						
Scrubbing the needless access device and hub done for 10- 15 seconds with 70% alcohol every time they make or break the connection	15	17.9	69	82.1		
Complete aseptic technique before blood sample withdrawn	15	17.9	50	59.6	19	22.6
Complete aseptic technique before blood culture withdrawn from the central line done	29	34.6	21	25	37	44.4
Flushing after blood withdrawal	30	35.7	26	31	28	33.3
<u>Replacement of administration sets:</u>						
Is extension tubes and lines changed today	32	38	44	52.4	8	9.5
Is the heparin lock, stopcock changed every 96 hours	16	19.	27	32.1	41	48.5
If present, is TPN and intra lipid set changed every 24 hours	12	14.3	9	10.7	63	75
Is new covering device attached to the end of the set after each intermittent use	37	44	39	46.4	8	9.5
Is blood remains in the IV set after maintenance	30	25.7	49	58.3	5	5.9
If blood remains in the IV set, does it changed	20	23.8	40	47.6	24	28.6
Are gloves worn before accessing the IV set	33	39.2	44	52.3	7	8.5
Does the child received blood or blood products	18	21.5	64	76.2	2	2.3
Are blood transfusion and blood products sets changed within 24 hour	28	33.3	16	19	40	47.6
Is any thrombolytic agent as heparin done after difficulty Flushing or no blood returned to prevent obstruction	20	23.8	32	38.1	32	38.1

1.1.2.4 Changing dressing

I observed that all umbilical catheters dressing was done by applying gauze then a bridge done with adhesive plaster, other layer of adhesive plaster applied over the bridge.

As in the below figure 1.4 .



Figure 1.4 umbilical catheter dressing

This dressing did not allow for the insertion site inspection, and if applied, it must be change daily (CDC guidelines 2011). Unfortunately changing dressing wasn't performed daily in the NICU, although it was 100% gauze dressing, the days of changing dressing ranged from 2-10 days with mean of 4.8 days.

The overall dressing compliance during the pre intervention period was 34.9%.

During the pre intervention period, out of 84 children, there were 23 (27.3%) cases had redness around the umbilical area, 17 of them had both redness and swelling, 6 children had redness, swelling and exudates.

2.1.2.4 Daily observation for catheter safety

Daily observation done at 1:00 pm for all umbilical catheters that were maintained by nurses. Out of 261 catheter day during the pre intervention period, 84(32.1) catheter days were observed.

3.1.2.4 Presence of infection signs and other complications

Out of 48 observations, 28(27.7%) observations showed umbilical catheters complications, 23 of them divided into two parts, 17 of them had both redness and swelling recorded in 4 babies, 6 were redness, swelling and exudates recorded in 6 babies and 5 observations show changing in abdominal color and abdominal distention recorded for 5 babies.

The total number of babies who have UVC complications were 15 (31.2%) out of 48 babies.

The babies who had abdominal distention and changing in abdominal color were mostly the low birth weight N= 4, and post blood exchange N=1.

4.1.2.4 Is the umbilical venous catheter changed when the previous complications occurred?

1- For babies with local signs of infection (redness, swelling and exudates) n=6, the umbilical catheter was removed immediately when the infection was observed and not replaced.

2- For babies with redness and swelling only n=17, the umbilical catheter was changed after 3-4 days. The catheter that was not clinically indicated was removed.

3- For babies with changing in abdominal color and presence of abdominal distention (n=5) three died because and had low birth weight and prematurity, two were removed and IV cannula applied.

5.1.2.4 Catheter security.

As the dressing was secured with gauze and adhesive plaster, it made it easy for displacement or being accidentally removed, unless it is secured by stitches, in the NICU the umbilical catheter was secured by bridge done with adhesive plaster to keep it secured and fixed. Out of 48 catheters 25(29.8%) were fixed by stitches in addition to the plaster bridge.

Figure 2.4 shows the bridge and stitches together, the insertion site was visible.



Figure 2.4 stitches and bridge for UVC security

This picture shows the NGT size 6 which was inserted instead of the umbilical catheter. 54 catheters observation (64.2%) recorded no leakage from the connections and catheters dressing were dry. The lack of daily dressing besides the oozing around the insertion site was within the causes of other 48.8% wet dressing. It was observed that the children who didn't received proper care especially those without changing dressing were the mostly

susceptible for presence of local infection, besides the poor compliance with maximal barrier precautions during insertion especially for low birth weight babies.

6.1.2.4 Catheter removal

When removing the UVC, sterile technique should be used (CDC guidelines 2011).

During the pre intervention period the staff compliance using sterile technique was 23.9% and documentation after removal was 27%. Table 4.4 and 5.4 shows the frequencies and percentage of dressing changing process and daily observation results.

CVC maintenance and care bundle checklist frequencies and percentages (Pre intervention) / Table 4.4								
	Yes		No		Not applicable		Not Done	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<u>Dressing changing:</u>								
<u>After removing the old dressing is redness, swelling or exudates seen at the site of catheter:</u>								
Redness	23	27.3	61	72.7				
Swelling	17	20.2	67	79.8				
Exudates	6	7.1	78	92.9				
Is oozing around the umbilical catheter was seen	20	23.8	64	76.2				
Is aseptic technique used when changing dressing	30	35.7	54	64.3				
Is the site been cleaning with chlorohexadine or iodine for 30 seconds and allow drying completely	30	35.7	54	64.3				
Is sponge dressing done every 24 hours	31	46.9	53	63.1				
Is documentation on the line done by date and time	30	35.7	54	64.3				
Is dressing change any time it has become loose	27	32.1	57	67.9				

Table 5.4 showed daily observation results for UVC site

Daily observation for the umbilical catheter safety and complications frequencies and percentages (Pre intervention) / Table 5.4								
	Yes		No		Not applicable		Not Done	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<u>1:00 pm daily observation</u>								
Is the catheter secure	64	76.1	20	23.9				
Is dressing dry	41	48.8	43	51.2				
Are all connections hasn't leaking	54	64.2	30	35.8				
<i>Are there any signs of local infection on the umbilical area:</i>								
Redness	23	27.4	61	72.6				
Pus	6	7.1	78	92.9				
Swelling	17	20.2	67	79.8				
Is there any changing in abdominal color , or presence of abdominal distention and discomfort.	5	5.9	79	95.1				
Is the umbilical venous catheter changed if the above complications occurs	11	13	17	16.8	56	37.3		
Is the catheter still clinically indicated	58	69	26	25.7				
If the catheter removed: Is sterile technique used when removing the umbilical catheter	20	23.9	16	50.9	36 catheters removed			
Is documentation done after removing	10	27	26	73				

2.2.4 Analysis of CVC care and maintenance checklist during the post intervention period

During the two months period in the NICU, there were a total of 1125 in-patient days, and 291 catheter days, period of umbilical catheterization ranged from 2-14days, with a mean day(6). The overall catheter-using rates were 25.86% for the post intervention sample. among total of 84 observations done for nurses during catheter care and maintenance on 48 children during the post intervention period, 24 observations (28.5%) done by practical nurse, 39(46.5%) done by staff nurse who has bachelor degree, 21(1%) done by staff nurse who has bachelor degree in addition to high diploma in neonates.

1.2.2.4 The staff compliance with CVC care and maintenance standard during the post intervention period

The overall compliance with the four elements of central line care and maintenance bundle was (63.05%), the compliance of each elements was follows: the nurses commitment with WHO five moments for hand hygiene (69.4%), accessing the central line catheter (56.8%), replacement of administration set (43.9.4%), dressing change (82.1%).

Table 6.4 show the CVC maintenance and care bundle frequencies and percentage during the post intervention period.

CVC maintenance and care bundle checklist frequencies and percentages (Post intervention) / Table 6.4						
	Yes		No		Not Abdicable	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<u>Hands hygiene: Did the health care workers committed with the WHO five moments for hand hygiene</u>						
Before touching the patient	59	70.2	24	28.6		
Before clean/aseptic procedure	56	66.7	17	20.2	10	11.9
After body fluid exposure during CVC care	68	81.0	13	15.5	2	2.4
After touching the patient	70	83.3	13	15.5		
After touching the patient surrounding	46	54.8	37	44.0		
<u>Accessing the central line catheter: When accessing the central line is:</u>						
Scrubbing the needless access device and hub done for 10- 15 seconds with chlorohexadine or 70% alcohol every time they make or break the connection	54	64.3	29	34.5		
Complete aseptic technique before blood sample withdrawn	44	52.4	24	28.6	15	17.9
Complete aseptic technique before blood culture withdrawn from the central line done	41	48.8	5	6.0	37	44.0
Flushing after blood withdrawal	52	61.9	16	19.0	15	17.9
<u>Replacement of administration sets:</u>						
Is extension tubes and lines changed today	60	71.4	22	26.2	1	1.2
Is the heparin lock, stopcock changed every 96 hours	31	36.9	19	22.6	33	39.3
If present, is TPN and intra lipid set changed every 24 hours	12	14.3	4	4.8	67	79.8
Is new covering device attached to the end of the set after each intermittent use	58	69.0	22	26.2	2	2.4
Is blood remains in the IV set after maintenance	29	34.5	54	64.3		
If blood remains in the IV set, does it changed	14	16.7	14	16.7	55	65.5
Are gloves worn before accessing the IV set	55	65.5	20	23.8	8	9.5
Does the child received blood or blood products	41	48.8	42	50.6		
Are blood transfusion and blood products sets changed within 24 hour	29	34.5	12	14.3	42	50.0
Is any thrombolytic agent as heparin done after difficulty Flushing or no blood returned to prevent obstruction	33	39.3	26	31.0	24	28.6

2.2.2.4 Dressing changing

The nurse compliance with changing dressing increase to 82.1% after intervention.

During the post intervention period, dressing on the umbilical catheter became differ from the pre operative period after introducing the CVC care bundle to the daily care, in addition to the transparent dressing provision.

The gauze dressing during the post intervention period done only in case of blood exchange, because the UVC applied for short period, 1-2 days.

Table E13 shows the significant change in the staff compliance with daily dressing to the gauze dressing, the non-applicable choice mean that the dressing was transparent which can be keep for seven days. The transparent dressing was available in the pharmacy for other types of CV lines, it is provided to the adult ICU. Now it used for umbilical catheter as routine, the head nurse through the HIS (health information system) requested it daily through item ordering page. During the post intervention period, out of 84 children, there were 18 (21.4%) cases had redness around the umbilical area, 4 of them had both redness and swelling, 2 children had redness, swelling and exudates. **Figure3.4** shows the transparent dressing after intervention.



Figure 3.4 dressing after intervention

CVC maintenance and care bundle checklist frequencies and percentages (Post intervention) / Table 7.4.A

	Yes		No		Not Applicable		Not Done	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<u>Dressing changing:</u>								
<i>After removing the old dressing is redness, swelling or exudates seen at the site of catheter:</i>								
Redness	4	4.8	71	84.2	1	1.2	8	9.5
Swelling	4	4.8	71	84.2	1	1.2	8	9.5
Exudates	1	1.1	74	88	1	1.2	8	9.5
Is oozing around the umbilical catheter was seen	19	22.8	64	76.2				
Is aseptic technique used when changing dressing	37	44.5	9	10.7	37	44.6		
Is the site been cleaning with chlorohexadine or iodine for 30 seconds and allow drying completely	36	43.3	10	11.9	37	44.6		
Is sponge dressing done every 24 hours	42	50.6	3	3.6	28	33.8		
Is documentation on the line done by date and time	38	45.8	8	9.6	37	44.6		
Is dressing change any time it has become loose	23	27.4	5	6.0	66.1	59.5		

Daily observation for the umbilical catheter safety and complications frequencies and percentages (Post intervention) / Table 7.4 ,B

	Yes		No		Not Abdicable		Not Done	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<u>1:00 pm daily observation</u>								
Is the catheter secure	74	88.1	10	11.9				
Is dressing dry	69	82.1	15	17.8				
Are all connections hasn't leaking	58	69.0	25	29.8				
<i>Are there any signs of local infection on the umbilical area:</i>								
Redness	4	4.8	80	95.2				
Pus	1	1.1	83	98.8				

Swelling	4	4.8	80	95.8				
Is there any changing in abdominal color , or presence of abdominal distention and discomfort	2	2.2	82	97.8				
Is the umbilical venous catheter changed if signs of infection seen	9	10.7	0	0	75	89.3		
Is the catheter still clinically indicated	56	66.7	28	33.3				
If the catheter removed: Is sterile technique used when removing the umbilical catheter	37	77.1	11	22.9	48 catheters			
Is documentation done after removing	28	75.6	9	24.4	37 removed			

3.2.2.4 Daily observation for catheter safety

Daily observation done at 1:00 pm for all umbilical catheters that been maintained by nurses. Out of 291 catheter day during the post intervention period, 84(28.9) catheter day were observed.

4.2.2.4 Presence of infection signs and other complications

Out of 84 observations, there were 11(13.%) observations shows umbilical catheters complications, 9 of them divided into two parts, 8 of them had both redness and swelling recorded to 6 babies, 1 were redness, swelling and exudates recorded to 1 baby, and 2 observations show changing in abdominal color and abdominal distention recorded for 2 babies.

The total number of babies who have UVC complications were 9(10.7) out of 48 babies.

The babies who had abdominal distention and changing in abdominal color were mostly the low birth weight N= 2 .

5.2.2.4 Is the umbilical venous catheter changed when the previous complications occurred?

1- The baby with local signs of infection (redness, swelling and exudates) n=1, the umbilical catheter removed immediately when the infection observed and not replace. IV cannula applied.

2- Babies with redness and swelling only n=6, the umbilical catheter changed after 1-2 days and replaced with IV cannula.

3- Babies with changing in abdominal color and presence of abdominal distention (n=2) the UVC removed. After all, the two babies died because of prematurity, low birth weight (less than 750gm) and sepsis.

6.2.2.4 Catheter security.

During the post intervention period, The UVCs secured by using stitches and transparent dressing. Out of 48 catheters 10(20.8%) were fixed by stitches in addition to the plaster bridge, 38(79.2%) secured by stitches and transparent dressing.

58(69%) of catheters has no leakage from the connections, 69 (82.1%) of catheters were dry.

When transparent dressing applied on the UVC, it has three advantages: (1) it fix and secure the catheter more than the gauze dressing, (2) it decrease handling by the length of its changing period(7 days), it allow the insertion site inspection.

7.2.2.4 Catheter removal

During the post intervention period the staff compliance with using sterile technique during catheter removal was 77.1% and the compliance with Documentation after removal was 75.6% .

3.2.4 Independent Two Samples T-Tests:

Independent Two Samples T-Test is calculated for each part of the questionnaire using the Pre intervention and Post intervention factors. Pattern of colors applied to all results in the study as followed:

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention highlighted in yellow and gray color shows a significant difference and This indicates that the variability in the two means with an increase in compliance in the post intervention statistically significant.

An independent Two Sample T-Test comparing the means compliance between the Pre intervention and Post intervention highlighted in blue and green colors shows no a significant difference . This indicates that the variability in the two means with an decrease or stable in compliance in the post intervention statistically significant

4.2.4 Result of data analysis for CVC maintenance chicklists

Positive findings

1.4.2.4 Hands Hygiene

As you seen in table F2, two variables changed regarding WHO five moment for hand hygiene after intervention, with statistically significant change, that are hand washing after touching the patient $P=(.000)$, and after exposure to body fluid $P=(.022)$, This change is appositive point towered compliance improvement; my experience in the NICU is the first one in its quality and effect on the HCW practice. Therefore, we need more intervention in this direction to optimize the patients care outcome and acheive100percentage staff compliance.

In addition, the ward provision with resources for hand hygiene as soap, alcohol gel and paper towel were within the main causes for this compliance.

Although the resources were provided, I observed that the role of the administrator and continuous monitoring was within the main causes towered compliance achievement.

The staff compliance with hand hygiene before clean aseptic technique has no statistically significant change $P= (.56)$ and after touching the patient surrounding was not significantly changed $P= (.59)$, as they said (we cannot wash our hand any time we move, and all the time we are between the patients) work overload and emergency condition prevent us from perfect commitment. Also this need more strict observation and follow-up after this study.

Table 8.4 shows the different colors that indicates presence of statistically significant change between the two variables pre and post intervention or not.

Independent Two Samples T-Test / Table 8.4 (WHO five moments for hand hygiene)

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
Before touching the patient	Equal variances assumed	.661	.417	5.751	182	.000
	Equal variances not assumed			5.765	176.711	.000
Before clean/aseptic procedure	Equal variances assumed	3.688	.056	.921	169	.359
	Equal variances not assumed			.914	154.623	.362
After body fluid exposure during CVC care	Equal variances assumed	15.455	.000	2.313	181	.022
	Equal variances not assumed			2.349	180.928	.020
After touching the patient	Equal variances assumed	87.206	.000	5.575	182	.000
	Equal variances not assumed			5.746	179.551	.000
After touching the patient surrounding	Equal variances assumed	.280	.597	1.740	182	.084
	Equal variances not assumed			1.739	174.729	.084

2.4.2.4 Accessing the central line catheter:

Positive findings

1- As you seen in table F4, there is a significant change in the nurses compliance with scrubbing the needleless device pre and post intervention $P=(.024)$, those devices were not scrubbed before intervention, because the HCWs were not aware with this issues as they said. The percentage of nurses who done this practice before intervention were 14.8%, those that been fallen down or contaminated during practice.

2- The nurses compliance with Complete aseptic technique before and during blood withdrawal for sampling and blood culture has a significant different after intervention $P= (.014)$ for the two variables.

To achieve this change, a special tray was prepared for this procedure consisted of sterile gauze, antiseptic solutions and sterile gloves.

Comments on the non-significant results

Flushing after blood withdrawal is not significantly changed $P=(1.000)$ because most of infants are under continuous IVF. The nurses were connecting the IVF after sampling, the number of babies without IVF was small, the reason that gave me no significant change value.

Table 9.4 shows the differences in color that indicated presence of significant changes pre and post intervention, using independent two samples T-Test.

Independent Two Samples T-Test / Table 9.4 (accessing the central line)

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
Scrubbing the needless access device and hub done for 10- 15 seconds with 70% alcohol every time they make or break the connection	Equal variances assumed	.408	.024	4.601	182	.000
	Equal variances not assumed			4.593	173.953	.000
Complete aseptic technique before blood sample withdrawn	Equal variances assumed	6.164	.014	1.825	180	.0414
	Equal variances not assumed			1.807	166.296	.073
Complete aseptic technique before blood culture withdrawn from the central line done	Equal variances assumed	6.146	.014	-.372	181	.710
	Equal variances not assumed			-.370	169.474	.712
Flushing after blood withdrawal	Equal variances assumed	1.659	.199	.000	164	1.000
	Equal variances not assumed			.000	162.044	1.000

3.4.2.4 Replacement of administration sets.

Positive findings

As you seen in table F6 the variables that been highlighted in yellow color had significant changed when comparing with pre intervention values.

(1)The extension tubes and lines became changed daily after intervention, unless they continuously used according to the (CDC guidelines2011). And there was a statistically significant change between pre and post intervention practice $P= (.001)$

(2)When the blood remain in the IV set, it wasn't changed during the pre intervention period because the IV set was changed daily, and there were shortage of IV to meet this element in addition to the work overload and the continuously admissions after education and diving the rational for the importance of changing the set after filling with blood , there was a statistically significant change in the staff practice regarding this point $P=(.012)$.

(3)The blood transfusion set changing has no statistically significant changed($P=.355$) when comparing with the pre intervention period because it was been observed that the blood transfusion set was changed immediately after blood transfusion finished pre and post intervention, and it was a positive point.

(4)Using anticoagulant agents as heparin has a statistically significant change $P= (.002)$. The staff became used the heparin for flushing when the umbilical catheter has difficulty flushing or no blood return. The CDC guidelines recommended adding low-dose of heparin (0.25-1.0) to the fluid flushing through the umbilical catheter (CDC guidelines 2011, P.17).

(5) changing the heparin lock and stopcock became changed every 96 hours according to the CDC guidelines, there were statistically significant change in the nurses practice regarding this factor $P=(.018)$.

(6) Pre intervention period, I observed that the nurses were attached the covering device with a covered needle and applied it near the patient incubator to re use when the IVF detached from the patient. After intervention and explaining the rational of changing this device every time it become detached from the patient , there were a statistically significant change regarding this factor $P=(.045)$.

(7) there is an important point which was wearing gloves before accessing the IV set, which was not done before intervention and has statistically significant change in its value $P=(.009)$. the cause of un compliance before intervention was personal and attitude reasons discussed in other section.

(8)TPN wasn't given frequently in the NICU, the percentage of children who received TPN are not differ vary much comparing with the pre intervention period $p=(.621)$, The mostly important positive point was the nurse's good compliance pre and post, the reason for no significant grange when comparing with the pre intervention period $P=(.518)$.

Independent Two Samples T-Test / Table 10.4(replacement the administration set)

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
Is extension tubes and lines changed today	Equal variances assumed	15.607	.000	3.283	180	.001
	Equal variances not assumed			3.343	179.846	.001
Is the heparin lock, stopcock changed every 96 hours	Equal variances assumed	.000	.481	2.387	165	.018
	Equal variances not assumed			2.391	151.646	.018
If present, is TPN and intra lipid set changed every 24 hours	Equal variances assumed	.419	.518	-.495	165	.621
	Equal variances not assumed			-.495	165.000	.621
Is new covering device attached to the end of the set after each intermittent use	Equal variances assumed	7.029	.009	2.021	177	.045
	Equal variances not assumed			2.040	176.418	.043
Is any thrombolytic agent as heparin done after difficulty Flushing or no blood returned to prevent obstruction	Equal variances assumed	9.808	.002	-1.019	181	.310
	Equal variances not assumed			-1.036	180.984	.302
If blood remains in the IV set, does it changed	Equal variances assumed	.240	.625	-2.537	182	.012
	Equal variances not assumed			-2.531	173.469	.012
Are gloves worn before accessing the IV set	Equal variances assumed	6.707	.010	-2.637	178	.009
	Equal variances not assumed			-2.606	162.849	.010
Are blood transfusion and blood products sets changed within 24 hour	Equal variances assumed	.929	.336	.928	181	.355
	Equal variances not assumed			.924	171.769	.357

4.4.2.4 Dressing Changing:

1- Positive findings

(1) The infection signs were decreased post intervention, there is a statistically significant change pre and post intervention regarding each signs of infection: redness $p= (.000)$, swelling $P= (.000)$, exudates $P= (.028)$. These values indicate that the staff compliance with the standards during daily care can decrease the infection signs around the umbilical catheter insertion site.

(2)As I observed during the pre intervention period, most of dressings were gauze dressing and not changed daily, and if they changed, sterile technique not used, and there were no special set for changing dressing. After education and presence of sterile dressing, the sponge (gauze) dressing became done daily under sterile technique, and there were a statistically significant change $P= (.020)$, and it become changed any time it become loose $P= (.009)$.

I noted that most of the time the nurses was not comply with documentation after dressing, documentation was done on the nursing note only, not on the dressing itself, even after intervention; the nurses were not comply with documentation, and no statistically significant change was seen $P=(.070)$.

The oozing around the umbilical catheter seen pre and post intervention, and there was no significant change between pre and post intervention $P= (.600)$. The oozing was usually seen in the children with exchange transfusion.

Independent Two Samples T-Test / Table 11.4 (dressing change)

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
Redness	Equal variances assumed	79.883	.000	3.705	177	.000
	Equal variances not assumed			3.823	162.717	.000
Swelling	Equal variances assumed	81.265	.000	3.885	177	.000
	Equal variances not assumed			4.010	162.402	.000
Exudates	Equal variances assumed	6.226	.014	2.210	176	.028
	Equal variances not assumed			2.357	99.498	.020
Is oozing around the umbilical catheter was seen	Equal variances assumed	.532	.467	.525	178	.600
	Equal variances not assumed			.556	131.074	.579
Is sponge dressing under sterile technique done every 24 hours	Equal variances assumed	74.374	.000	-2.341	174	.020
	Equal variances not assumed			-2.282	133.538	.024
Is documentation on the line done by date and time	Equal variances assumed	8.969	.003	-1.821	176	.070
	Equal variances not assumed			-1.809	166.985	.072
Is dressing change any time it has become loose	Equal variances assumed	6.707	.010	-2.637	178	.009
	Equal variances not assumed			-2.606	162.849	.010

5.4.2.4 The daily nursing observation for the central line safety and complications:

Table F10 shows the statistical analysis for the condition of the umbilical catheters during daily observation. Significant different was seen in the majority of observations:

(1) The catheter security and dryness has significant different between the observation s pre and post intervention $P=.042$ for both factors.

(2) The presence of connections leakages has no statistically significant change between the two f actors $P= (.986)$, it was a positive point because the leakages was not seen pre or post intervention.

(3) changing the umbilical catheter incase of the presence of infection signs seen has no statistically significant change $P=(.087)$ because the sample was very small in addition to the changing that were positively done in the two factors.

(4) The presence of changing in abdominal color or distention has significant different $P= (.007)$, but no statistically significant change $P= (.358)$, this because the small sample .

(5) During my observation, I look for the need of the catheter necessity, I founded that the catheters sometimes keep even IV cannula applied. No one review the catheter necessity as daily rotten, this indicate the importance of daily review for catheter necessity. There were a significant different pre and post intervention in the clinically indicated of the catheter $P=(.007)$.

(6) Sterile technique and documentation were used when removing the umbilical catheter pre and post intervention, so there were no statistically significant change pre and post intervention $P=(.150)$ and $P=(.300)$ for documentation.

Independent Two Samples T-Test / Table 12.4 (daily observation for UVC site)

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
Is the catheter secure	Equal variances assumed	4.191	0.042	1.035	182	.302
	Equal variances not assumed			1.038	177.543	.301
Is dressing dry	Equal variances assumed	4.191	.042	1.035	182	.302
	Equal variances not assumed			1.038	178.543	.301
Are all connections hasn't leaking	Equal variances assumed	.027	.869	-.017	181	.986
	Equal variances not assumed			-.017	177.304	.986
Is the umbilical venous catheter changed if signs of infection seen	Equal variances assumed	2.880	.091	-1.720	182	.087
	Equal variances not assumed			-1.729	179.540	.086
Is there any changing in abdominal color , or presence of abdominal distention and discomfort	Equal variances assumed	7.596	.007	.921	166	.358
	Equal variances not assumed			.921	156.556	.359
Is the catheter still clinically indicated	Equal variances assumed	5.926	.016	-1.242	182	.216
	Equal variances not assumed			-1.233	170.451	.219
If the catheter removed: Is sterile technique used when removing the umbilical catheter	Equal variances assumed	5.606	.019	-1.445	182	.150
	Equal variances not assumed			-1.458	181.053	.147
Is documentation done after removing	Equal variances assumed	4.182	0.044	-1.036	182	.301
	Equal variances not assumed			1.039	177.542	.300

3.4 Analysis and results of intravenous cannula insertion checklists during the pre intervention period

During the two months period in the NICU, there were 1272 in-patient days, The IV cannula days during this period were 382 IV cannula days, the overall IV cannula-using

rate were (30.03%). Among 84 IV cannula insertions on 59 children, 38 (54.2%) children had multiple insertions).

1.3.4 Insertion sites

The insertion sites were varies between upper and lower peripherals. The most using site was the cephalic and basilica veins in the upper peripherals 39.4% followed by dorsal venous network 36.9% and saphenous vein 11.9%.

The other sites as posterior auricular vein, median vein were using in case of poor access to the previous sites. See figures 1.4.4 and 2.4.4 they shows the multiple insertion attempts in several sites in the lower and upper peripherals.

During this period, I founded that the nurses were using the same IV cannula several times without changing between each attempts, in additions to the continuously repeating until the cannula applied without asking for help. The percentage of nurses who repeat more than one attempts during the pre intervention period were 66.6%.



Figure 4.4: 1.multiple attempts 2. Multiple IVC insertion attempts

2.3.4 types of intravenous cannula

The color of the cannula used for children during the pre intervention period (84); yellow (88%), blue (12%). The yellow color Gauge is 24, which is the smallest type of IV cannula followed by the blue color Gauge 22. The blue one is always available but the yellow is sometimes become not available because of the large number of admissions in addition to the multiple IV cannula insertion attempts in case of poor vascular perfusion.



Figure 5.4: 1. Gauge 24, 2. Gauge 22

The dressing that mostly used over the IV cannula was adhesive plaster, which applied direct over the skin. 71.4% of IV cannula dressing during the pre intervention period was adhesive plaster, gauze dressing which used in some special cases as skin disease or allergy was 28.6%.

This dressing is gauze dressing covered with elastic bandage see figures (6.4)



1. Posterior auricular vein



2. dorsal venous network

Adhesive plaster dressing



3. Axillary vein



4. saphenous vein



5. Frontal vein

3.3.4 Staff compliance with intravenous cannula insertion standard during the pre intervention period

The overall staff compliance with 13 evidence based practice for IV cannula insertion during the pre intervention period was 52.1%.

1.1.3.4 Hand hygiene

I noted that the commitment with hand hygiene before cannula insertion was not applied 100% in the NICU, although it is a simple procedure, and does not need long time. 40.5% of nurses committed with this important procedure, 70.5% of them wash their hands with water, 29.5% used Alco gel.

The Alco gel founded in the NICU in very small quantities, 1-2 bottles. Just Used during doctors round between the patients.

2.1.3.4 Wearing gloves

Commitment with wearing gloves was very poor, 31% of nurses committed during the pre intervention period although clean (latex) gloves are available in large quantities, most of nurses justified their behaviors with work over load, lack of time and the difficulty of cannula insertion with by wearing gloves in addition to powder allergy.

3.1.3.4 Preparing equipment

50% of nurses prepared the equipment before starting, there was no special set for cannula insertion, if the nurse wants to applied cannula, she collect the equipment in a tray or use the trolley which contain all needed tools. Most of nurses who forget to collect all equipment were during emergencies or mistake. I noted that Loss of daily preparing and chinking on these trolleys allows this mistake.

3.1.3.4 The transference of the baby to a special clean table

The nurse's opinion about transferring the child to a clean special table varied. 52.4% of nurses preferred to applied IV cannula in the child incubator for many reasons (1) it is cleaner than the special one, which used for all babies in the ward. (2) There is one special table, which is not enough for the large number of in patients, this lead the nurses to keep the child in his incubator (3) other nurses said that they prefer to keep the child in his incubator when he is premature to prevent infection caused by surrounded area.

4.1.3.4 Prepare skin with antiseptic

83,3% of nurses scrubbing the skin before applying the IV cannula, the antiseptic solution which used in the NICU is alcohol 70%, most of nurses use the circular motion during scrubbing but they didn't weight for drying , 100% of nurses applied the IV cannula immediately after scrubbing, this was in emergencies and non emergencies cases. The 16.7 of nurses who didn't comply with scrubbing were those who practice more than one attempt, they scrub before the first insertion, then they didn't comply even the insertion site changed.

60% Of nurses, who scrub the skin, palpate the site after scrubbing.

5.1.3.4 Attempts for insertion

I noted that the nurses who had long experience in the NICU were more qualified for IV cannula insertion even they have diploma in nursing. In addition, 28% of insertions were done one time, 68% of insertions were repeated more than one. I noted that some nurses try IV cannula insertion seven to ten times for one patient, when I asked them about this practice, about five nurses answered(during insertion I use all the IV cannula box). 46.4 of nurses were not changing the cannula between each attempt.

78.5 of nurses committed with doing flushing with N/S after insertion to check if the cannula applied in the vein and not in the intracellular space, this to prevent extravasations and fluid infiltration.

6.1.3.4 Documentation

After IV cannula insertion and applying, documentation was done on the dressing by date, time and the nurse name. 59.5 Of nurses were committed with documentation.

2.3.4 Analysis of intravenous cannula insertion checklist during the post intervention period

During this two months period in the NICU, there were a total of 1125 in-patient days, The IV cannula days during the two months period for the post intervention sample were 370 IV cannula days, the overall IV cannula using rate during this period were (32.8%). Among 84 IV cannula insertion on 68 children, 16 (19. %) Children had multiple insertions). Among 84 insertions 24(28.6%) were done by practical nurse, 39(46.4%) by bachelor degree (staff nurse), 21(25%) by bachelor degree in addition to high diploma in neonates (staff nurse). The insertion sites were varies between upper and lower peripherals. The most using site was the cephalic and basilica veins in the upper peripherals (42.9%) followed by dorsal venous network 32.1% and saphenous vein 17.9%. The other sites as posterior auricular and median veins were using in case of poor access to the previous sites. The color of the cannula used for children during the post intervention period N=(84); yellow (54, 64.3%), blue (20, 35.7%). The dressing that mostly used over the IV cannula during the post intervention period was gauze dressing 47.6% followed by transparent dressing 25%. this type of dressing was been provided to

the ward during the intervention period after several written official letters sent to the MOH director and the medical stores administrators, these letters written by the infection control department personnel according to my request and based on the requirement of the children interest.

Other types of dressing were adhesive plaster 19%, which used only if other types of dressing are not available and the semi permeable dressing 8.3%.

1.2.3.4 Staff compliance with intravenous cannula insertion standard during the post intervention period

The overall staff compliance with 13 evidence based practice for IV cannula insertion during the post intervention period was 73.2%.

Table 13.4 shows the percentages and Independent Two Samples T-Tests:

Peripheral venous cannula insertion checklist) frequencies, percentages and Independent Two Samples T-Tests:						
/ Table 13.4						
	Pre intervention		Post intervention		Independent Two Samples T-Tests:	
	Frequency	Percentage	Frequency	Percentage	Sig.	Sig. (2-tailed)
Is hand hygiene done before cannula insertion	34	40.5	53	63.1	.010	.019
Hand rub with Alco gel (50)	10	29.5	24	28.6	.010	.050
Soap and water (50)	24	70.5	29	34.5	.010	.050
Are gloves worn for child and personal protection	26	31	55	65.5	.119	.001
Are all equipment prepared before starting	42	50.	58	69	.023	.251
Is the baby transfer to a clean special insertion table	40	47.6	63	75	.000	.021
Is the site for cannula cleaned by alcohol 70% with circular motion for 30 seconds	70	83.3	63	75	.000	.880

Is the skin allowed to dry for 30-60 seconds	20	23.8	71	84.5	.000	.880
Does the nurse palpate the skin after disinfection to the site	24	28.5	60	17.4	.008	.029
Are more than two attempts done	28	33.3	53	63.1	.148	.005
Was the cannula changed between each attempt	40	47.6	66	76.1	.000	.011
Is flushing done after cannula insertion	40	47.6	77	91.6	.168	.040
Is documentation done after insertion by date , time , nurse name	50	59.5	64	76.1	.712	.854

2.2.3.4 Positive findings

(1) Staff compliance with hand hygiene before IV cannula insertion has statistically significant change after intervention $P= (.019)$ they start using the Alco gel after education and applying the WHO postures for hand wash and hand rub. A statistically significant change $P= (.050)$ seen for the use of hand rub.

(2) There were a statistically significant change $P= (.001)$, for wearing gloves before cannula insertion.

(3) The nurses compliance with transferring the baby to a clean table was improved after education, there were a statistically significant change in their adherence post intervention $P= (.021)$.

(4) pre intervention , I observed that the nurse always palpate the skin after disinfection, post intervention there were a statistically significant change in their behavior regarded the palpation $P=(.029)$.

(5) After education and frequent training, the attempts of cannula insertion limited to two, and if the nurse failed, other one can help her. Post intervention I observed an improvement for some nurses who was week in cannula insertion and there were statistically significant decrease in number of attempts $P= (.005)$.

(6) The staff adherence to flushing cannula after insertion improved after intervention as I noted, there was statistically significant change in the staff adherence $P= (.040)$.

(7) the staff compliance with cleaning the skin before IV cannula insertion with Alcohol 70% was done perfectly pre and post intervention , so there was no statistically significant change between the two factors $P=(.888)$

(8) Changing the IV cannula between each attempt became apply in the NICU after intervention and there was a statistically significant change $P= (.0110)$

(9) Documentation by date, time and nurses name was done pre and after intervention, so I don't found a significant change $P=(.854)$, and this was positive point.

3.2.3.4 Comments on the no significant change results

(1) The staff compliance with preparing all equipment before starting insertion has a significant different $P= (.023)$ but no statistically significant change $P= (.251)$, this indicate the need for more intervention to improve this element.

(2) although there was good staff compliance with insertion site cleaning, there didn't allow the antiseptic solution to dry for at least 30 second even after intervention with no spastically significant change between the two factors pre and post intervention $P=(.888)$.

This indicates further intervention and strict observation to improve the staff compliance.

4.4 Analysis and results of intravenous cannula care and maintenance checklist during the pre intervention period

During the two months period in the NICU, there were 1272 in-patient days, The IV cannula days during this period were 382 IV cannula days for 84 patient, the overall IV cannula-using rate were (30.03%).

1.4.4 Staff compliance

The overall staff compliance with 9 evidence based practice during the pre intervention period were (34.7%).

1.1.4.4 Changing IV cannula caps

Each shift, IV cannula caps removed many times for different purposes as when changing the IV set, giving medication and starting intermittent drip.

32, 2% of nurses were changing the cannula caps when they removing it, 55.9% were not committed with this standard, some of them applied the same cap after falling on unclean field.

2.1.4.4 Flushing after medicine administration

The nurse's compliance with doing flushing after drug administration were 31% , this percentage doesn't apply to the children under IVF that attached to the child after drug administration.

It noted that this policy is not applied in the NICU, each one acting according to his/her knowledge.

3.1.4.4 Changing IV tubing

According to the CDC guidelines, the IV set should be changed no more frequently than 96 hours if it continuously used, if it disconnecting during daily care it should be changed daily or as manufacture recommendations.

The manufacture recommendations in Rafedia hospital disposable store were to use the IV set just for 24 hours.

60.8% of nurses were committed with these recommendations. Some nurses were changing the label date without changing the IV set.

4.1.4.4 The dressing condition

During my daily observation at 1:00 pm, I observed that many dressings has an old documentation date, some of them had documentation before 3 days,

This reflects the lack of daily dressing.

37% of IV cannula dressing were intact, mean that the dressing was tight and secure.

33.3% of dressings were soaked either with blood or with fluid from the IV connections and infiltration.

29% of dressings were dirty with blood.

5.1.4.4 Presence of complication in the insertion site area

Out of 84 observations, there were 50(59.2%) observations shows complications recorded for 36 patients, 17 of observations divided into two parts, 3 of them had redness and recorded to 3 babies, 14 were redness and swelling and recorded to 17 babies, and 19 had extravasations.

Out of 84children, 36(42.2%) had complications.

It was been noted that the complications happened around the insertion area resulted from lack of observation and daily dressing to the IV cannula.

Out of 36 children who had complication, 16 were changed and 20 were not changed. It was been noted that if the cannula were patent, they did not change it even it has redness

or swelling. I saw that the nurses who done dressing to the IV cannula were not use an aseptic technique 25% of nurses used this technique.

6.1.4.4 The clinically indication of the IV cannula

if the cannula still clinically indicated, this mean that the child still received IV medications or IVF. It been observed that all growers babies whom under bottle or NGT feeding and been in the ward for increasing weight were kept with IV cannula until discharge. 45.2% of babies had IV cannula that was clinically not indicated.

7.1.4.4 IV cannula removal

The IV cannula removed only on the day of discharge. When the IV cannula removed, dry cotton and adhesive plaster applied on the exit site. 20% of nurses were committed with applying sterile swab and dressing.

Table J2 shows the frequencies and percentages of the nurse's compliance during pre intervention period.

2.4.4 Analysis of intravenous cannula care and maintenance checklist during the post intervention period

During this two months period in the NICU, there were a total of 1125 in-patient days, The IV cannula days during the two months period for the post intervention sample were 214 divided on 84 patients, meant of days3.5, the overall IV cannula using rate during this period were (19.2%).

The overall compliance with the nine evidence based practice during the post intervention period increased from 34.7% to 68.2% post intervention.

1.2.4.4 Hand hygiene

The nurse's compliance with hand hygiene was 76.1% which as I mentioned before, this change happened after education and training.

2.2.4.4 Wearing gloves before accessing the cannula

Although the nurses were not preferred to apply gloves, their compliance was increase 56% post intervention.

3.2.4.4 Changing IV cannula caps

The nurses compliance with replaced the previous cap with new one was improved from 60% post intervention.

4.2.4.4 Flushing after drug administration

After education and notification about the rational of flushing post drug medication, the percentage of compliance was 66.6%.

5.2.4.4 Changing IV tubing

As all IV set using in the NICU are volume control infusion that should be used just for 24 hours according to the manufacture recommendation, the compliance with this policy was 89.2% post intervention.

6.2.4.4 Presence of complications

Out of 84 observations, there were 15(17.8%) observations shows complications recorded for 12 patients, 8 of observations divided into two parts, 5 of them had redness and recorded to 5 babies, 3 were redness and swelling and recorded to 3 babies, and 7 had extravasations. Out of 84 children, 15(17.8%) had complications. These complications seen mostly early morning after the night shift. Out of 12 children who had complication, 12 (100%) were changed.

7.2.4.4 The dressing condition

During my daily observation at 1:00 pm, I founded that most of dressing were gauze dressing which has documentation for the same day of observation, this reflect daily dressing. Transparent dressing applied for some patients with special skin condition and premature babies.

80.9% of IV cannula dressing were intact, mean that the dressing was tight and secure.

9.5% of dressings were soaked either with blood or with fluid from the IV connections and infiltration. 9.5of dressings were dirty with blood.

8.2.4.4 The IV cannula clinically indication

41% of babies kept with IV cannula although it was not clinically indicated.

9.2.4.4 Cannula removal

83.3% of nurse committed with applying sterile swab and dressing on the exit area after removing cannula.

3.4.4. Data analysis using Independent Two Samples T-Tests:

Independent Two Samples T-Test is calculated for each part of the questionnaire using the Pre intervention and Post intervention factor.

1.3.4.4 Positive findings

1- the nurse compliance with wearing gloves before accessing the IV cannula improved and has statistically significant change between pre and post intervention ($P=.023$).

2- The staff adherence to the IV caps replacement when they removed become improved, a pre packaged sterile caps were available in the Hospital pharmacy started to be used by the nurses, there was a statistically significant change in the staff adherence to this standard $P=(.039)$.

3- also during IV cannula dressing, the nurses compliance with using non touch a septic technique statistically show significant change $P=(.002)$.

4- The presence of infection signs and other complications were significantly decreased as followed: extravasations $P= (.004)$, redness $P= (.000)$, the presence of swelling show no significant change because the sample was small $P=(.186)$, this indicate further monitoring to this signs over more than two months period for further data collection.

5- In case of signs of infection and other complication appear, the IV cannula post intervention became removed immediately, and replaced with other one in other place, the staff compliance is statistically has significant improve post intervention $P=(.031)$.

6- pre inter intervention non sterile dry cotton was applied on the exit sit, after intervention, a sterile swap became applied and then the exit site became covered with sterile gauze, there were a statistically significant improvement and change $P= (.040)$.

2- The staff adherence to do flushing with normal saline after drugs administration has significant different $P=(.000)$ but no statistically significant change.

3- Changing IV tubing compliance has no statistically significant change $P=(.357)$ because the nurses compliance pre and post intervention not worse, and there compliance was good before and after change.

4- In the NICU there was a policy to keep the child with the IV cannula during hospitalization, even it is not clinically indicate, although I teach them not to keep the cannula applied, they didn't comply with this standard. They justified by their fear of the child deterioration or choking during feeding, and this cannula keep for emergencies especially in the grower babies.

Independent Two Samples T-Test / Table 14.4 IVC maintenance and care

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
Hand hygiene done before accessing the IV cannula	Equal variances assumed	8.424	.004	1.517	177	.131
	Equal variances not assumed			1.522	176.239	.130
Gloves worn before accessing the cannula	Equal variances assumed	1.699	.194	2.296	177	.023
	Equal variances not assumed			2.293	173.483	.023
If the caps are removed for whatever reason is it replaced with a new one	Equal variances assumed	.454	.050	2.081	177	.039
	Equal variances not assumed			2.078	173.097	.039
When dressing to the cannula change is an a septic non touch technique used	Equal variances assumed	10.362	.003	3.144	170	.002
	Equal variances not assumed			3.140	168.215	.002
Extravasation	Equal variances assumed	5.972	.021	-3.106	177	.004
	Equal variances not assumed			-3.106	173.826	.005
Redness	Equal variances assumed	10.132	.002	-4.247	177	.000
	Equal variances not assumed			-4.247	176.804	.000
Swelling	Equal variances assumed	7.370	.007	-1.328	177	.186
	Equal variances not assumed			-1.348	174.381	.179
Is the cannula changed in case of one of the above seen	Equal variances assumed	6.661	.031	-2.131	172	.031
	Equal variances not assumed			-2.132	171.465	.031
Is flushing with N/S done after drug administration	Equal variances assumed	36.636	.000	-1.578	177	.116

	Equal variances not assumed			-1.546	147.310	.124
Is the IV tubing sets changed today	Equal variances assumed	20.495	.000	-.924	177	.357
	Equal variances not assumed			-.909	152.888	.365
Is the IV cannula still clinically indicated	Equal variances assumed	.110	.740	-.167	176	.867
	Equal variances not assumed			-.167	173.567	.868
If IV Cannula removed, is sterile swap and dressing applied on the exit site	Equal variances assumed	1.006	.000	-2.073	166	.040
	Equal variances not assumed			-2.073	154.227	.040

5.4 Study reliability

The children who received care by nurses after umbilical catheter insertion are the same group (48) who received umbilical catheter, I chose to observe the same children to follow these cases for the presence of signs of infections or any complication caused by those catheters.

Also During filling the peripheral IV care and maintenance checklist, I continue observing the same children⁸⁴ who received IV cannula to see the inactions signs that may be caused because of poor compliance during insertion.

6.5 Study validity

The observation checklists were completed, as I worked with the health care workers HCWs I was familiar with most of them, thus they behaved normally in the presence of me, they were unaware of being under observation, this allowed me to observe their level of compliance with the guidelines when they behave naturally

7.4 Analysis of the questionnaire (Staff perspectives and knowledge)

1.7.4 Findings

1- The nurses and doctors have good perception about the need for the presence of applicable strategies for HAIs prevention to enhance the patient care and outcome beside the presence of resources and equipment that need to apply these strategies, Nevertheless, they have less knowledge about these strategies and their rationales, as they said (we don't have knowledge about evidence based practice, we are really in need for education.), although they have high qualifications.

2- Other thing was their need of continuous supervision and strict restriction to emphasize their compliance they said (no one follow us or direct us to do the right practice).

In light of the above answers, I understand the staff needs, and become aware about the topics that need to be prepared for lectures and educational programs.

2.7.4 Group discussion during intervention period

The answers of the staff during the pre intervention period lead me to focus on education and group discussion, and helped me in choosing the proper material that focused on the weak points that will be discussed.

During group discussion,

the staff were asked what they knew about infection prevention & control standards?

Their answers showed the following;

1- Most of them know that hand hygiene can decrease transmission of infection between patients but they did not know the correct way and the moments for hand washing.

2- Most of them know that wearing gloves is one of the personal protective equipment for nurse and patient but they did not know the importance of other equipments as gown, mask and head cap for protecting the patient.

3- They know that the infection control standard can positively affect the patient outcome as hand washing and wearing sterile gloves but they did not know all elements of these standards are. Most of nurses explained the cause of this low value with the lack of time, resources, work overload and differing shift.

Post intervention period

After intervention and giving a teaching module to each one, they were asked to fill the post intervention knowledge and perspectives questionnaire, some of nurses showed a lot of annoyance related to re filling as they filled the questionnaire before. Filing of questionnaire started one week after intervention. The post intervention questions were the same as pre intervention. They were distributed to the same population in the same setting and given the same time for filling.

3.7.4 Result

The result of the Independent Two Samples T-Test that was calculated for each part of the questionnaire using the Pre intervention and Post intervention factor regarding the nurse's knowledge and perspectives show as statistically significant change between the majorities of answers post intervention as seen in table Q5.

one answer has no statistically significant change post intervention $P > 0.05$ (I have the ability to be a positive role model for my colleagues) $P = (.283)$. Because the majority of them agree that, they can be a positive role model in the pre and post intervention answers.

The result of the Independent Two Samples T-Test that calculated for each part of the questionnaire using the Pre intervention and Post intervention factor regarding the doctor's knowledge and perspectives show a statistically significant change between

twelve question $P < 0.05$ and six answers has no statistically significant change $P > 0.05$, these answers because they have strongly agree in their answers in the pre and post intervention questionnaire

1- I do not have time to comply with health care associated infection guidelines $P = .843$.

The work over load did not change pre and post intervention period.

2- The health care associated infection rate will likely decrease if I follow the guidelines and recommendations $P = .836$ **3-** The patients care will likely improve if I comply with the infection prevention strategies $P = .783$.

4- If I use the infection prevention strategies, this will positively affect the patient outcome $P = .462$

5- My ward is in need of health care associated infection guidelines $P = .167$

6- I expect that I will comply with HAI guidelines and recommendations if I have the knowledge about these guidelines $p = .545$

The staff knowledge and perspective towards the infection prevention strategies to prevent the health care associated infection (HAI) data analysis					
Table 15.4A					
	Independent Two Samples T-Tests: doctors		Independent Two Samples T-Tests: Nurses		
	Sig	Sig. (2-tailed)	Sig	Sig. (2-tailed)	
I am familiar with (HAI) guidelines and recommendation	0.014	.030	.011	.026	
My hospital has HAI policies consist of hand hygiene, disinfecting, cleaning and standard precaution	.002	.000	.073	.000	
I do not have time to comply with health care associated infection guidelines	.011	.843	.292	.002	
I am able to implement the HAI policies	.162	.049	.081	.000	
The HAI policies are easily applied in my ward	.706	.002	.057	.001	
The HAI infection rate will likely decrease if I follow the guidelines and recommendation	.008	.836	0.72	.013	.001
The patients care will likely improve if I comply with the infection prevention strategies	.049	.783	0.94	.002	.000
There is a sufficient leadership and supervisors who help me in implementing the HAI strategies in my ward	.003	.000	0.84	.277	.000
There are sufficient resources, and supplies to comply HAI practice guidelines	.222	.000	0.69	.023	.003

15.4. B: independent two samples T-Test staff knowledge and perspectives

	<u>Independent Two</u>		<u>Independent Two</u>	
	<u>Samples T-Tests</u>		<u>Tests</u>	
	<i>Sig</i>	Sig. (2-tailed)	<i>Sig.</i>	Sig. (2-tailed)
If I use the personal protective equipment, the transmission of infections will decrease	.217	.006	.000	
If I use the infection prevention strategies, this will positively affect the patient outcome	.154	.462	.009	.017
My ward is in need of health care associated infection guidelines	.313	.167	.023	.001
I have the ability to be appositive role model for my colleagues	.918	.014	.706	.283
I have the necessary knowledge to prevent infection in my sitting	.021	.004	.003	.001
I expect that I will comply with HAI guidelines and recommendations if I have the knowledge about these guidelines	.139	.545	.649	.000
I comply with the infection control strategies that applied by our organization infection control committee	.018	.015	.002	.001
I received training and lectures about the health care associated infection guidelines	.027	.000	.000	.000
The consistant of the infection control committee supervision will positively affect my compliance with the infection prevention strategies	.107	.009	.044	.000

Chapter 5

Discussion

the aims of this study was to improve the HCWs compliance with the updated guidelines by introducing CVCs and IV cannula insertion and care bundles to the professionals practice through teaching and training.

My observation for nurses in the NICU at Rafedia hospital had several significant findings; these findings indicated that the education and training programs can significantly improve the staff compliance with the evidence-based guidelines during vascular access device insertion and monitoring.

In addition, the staff are more likely to comply with those guidelines if they understand the rationale. For this reason, education is important for increasing the staff awareness with the rationale behind each evidence-based practice.

1.5 Staff compliance

The analysis of the collected data showed a statistically significant improvement in the staff compliance, The health care workers compliance with CVC insertion bundle were increased from 59%-82.8% after educational intervention; the central line maintenance and care bundle from 34.8%-63.05%; peripheral intravenous cannula insertion guidelines from 52.1%-73.2%; peripheral intravenous cannula care from 34.7%-68.2%

This compliance improvement decrease the catheter related infections. The central line associated infection rate decreased from about 50% from 3.12/1000catheter days during

the pre intervention study to 1.7/1000 catheter days during the post intervention P=.000;
the intravenous cannula related

The number of nurses in the NICU was 28 divided on three shifts, annual leaves and weekend, eight nurses on the morning shift, four nurses on the evening shift and four on the night shift, the incubators number are 35 and they are always occupied, the average patient nurse ratio PNR is 8.7/1. The recommended PNR should be 1:1 for intensive care patients, 2:1 for high dependency and 4:1 for low dependency[12*]. This ratio reflects the working overload and lack of time for commitment, they said during the group discussion: (we as staff is committed to these guidelines but the ward lay out and the patient –nurse ratio interfere with the ease of commitment). This finding indicates the need for further human and qualified resources.

2.5 Vascular access devices related infections

Complications decreased from 42.2% during the pre intervention period to 17.8% during the post intervention period, and there was a statistically significant decrease P=0.002.

During my observation in the NICU, the complications that were recorded included local infections such as redness, swelling and presence of pus around the insertion site which finally developed to blood stream infection confirmed by positive blood cultures for some children who were severely low birth weight and small gestational age , On the other hand , the complications of IV cannula were mostly local, such as redness in the insertion site, infiltration, extravasation and sometimes presence of pus for the IV cannula when the dressing was not changed daily.

3.5 The dressing regimens

The dressing over the umbilical catheter and IV cannula were mostly gauze dressing under unsterile adhesive plaster that was applied in a tight manner, and does not allow insertion site inspection. The [CDC in their guidelines for prevention of intravascular catheter related infection] found that the risk for CRBSI does not differ between transparent and gauze dressing if a gauze dressing is changed daily. The gauze dressing is more preferable in case of oozing around the catheter insertion site. On the other hand catheter colonization for catheters with transparent dressings was 5.7% compared with 4.6% of those dressed with gauze. This data indicated that there are no significant differences between dressing types in CRBSI, catheter tip or skin colonizing (CDC guidelines 2011). The benefit of transparent dressing is the long duration of its presence for seven days, and the gauze dressing must be changed daily, this allow for several manipulation in addition the number of manipulations are within the risk factors of complications.

4.5 Antiseptic solutions

It was been noted that the solutions used for skin preparation and dressing regimens in the NICU at Rafedi Hospital was the povidone Iodine 10% solution for umbilical catheter and Alcohol 70% for IV cannula. The chlorohexidin 0.5% in Alcohol was not available. American academy of pediatrics published a guidelines for the clinician rendering pediatric care in 2012 by Richard A. said that reduction of CLABSI was 50% compared with Povidon Iodine 10%, on the other side the using of impregnated gauze dressing with chlorohexadin 0.5% in alcohol70% in very low birth weight infants can reduce the CVC

colonizing but can't reduced the incidence of CLABSI, however, the chlorhexidine 5% caused contact dermatitis for 15% of neonates less than 1000gm.

The Royal College of Physicians of Ireland in their guidelines updated in 2009, for the prevention of catheter related infection [9*] recommended that 0.5-1% chlorhexidine is the optimal range for neonates less than two months.

5.5 Working environment

The NICU at Rafedi Hospital does not meet the recommendations for adequate spacing that was: the space should be provided for two parents, monitors, ventilators and other equipment. In addition to a space for staff to perform sterile procedures.[12], the recommendations didn't determine the limit space in meters between incubators. See **figure 1.5**, which showed the space between the incubators.



Figure 1.5: This very little space considered one of the risk factors for spread of infection between patients.

Chapter 6

Conclusions

1.6 knowledge, practices attitudes , resources and administrative support

This was the first study in Rafedi Hospital to evaluate and improve the staff compliance with updated guidelines(CDC guidelines for prevention of intravascular catheter related infections), the findings showed that the most important reasons for non-compliance before my intervention were:

1- Lack of training and educational programs. 7.1% of nurses only had received any forms of lectures and training, these were the nurses who had a high diploma in neonatal nursing . None of the doctor has received any lectures or training

2- Lack of time and work overload, 74.4% of nurses agree that they do not have time to comply with the guidelines in the proper way because of work overload, this proportion is confirmed by the patient nurse ratio that was 8.7:1, eight to nine infants per nurse with different intensive care categories ranging from low to high dependency.

3- Lack of sufficient resources, 71.4% of HCW (nurses and doctors) agree that there is a shortage of resources to support proper compliance as soap, towel paper, clean gloves, Alco gel, special set for umbilical catheter dressing, , masks, and sterile gowns.

4- Lack of HCWs knowledge about the strategies to prevent HAI 65% of them agreed that they did not have knowledge.

These were the Main reasons for lack of compliance, other reasons included emergencies, lack of strict supervision and absence of written protocols or local guidelines.

5-- low patient nurses ration, 1:8,7.

7- Poor administrator follows up and lack of performance feedback.

8- Lack of health care interest in the NICU as a high risk unit .

This audit emphasized the need for a system within the NICU that takes into account staff competencies, resources and administrative support. This audit highlighted that despite having a few local policy and procedure manuals, there are certain procedures that need to be updated in line of new evidence and standards for minimizing risk in units such as NICUs. Staffs do their best within such a closed unit which is highly stressful especially when there is a lack of resources and support. Watching infants suffer from infections is highly stressful for all ; staff although adhering to certain practices such as hand washing and wearing gloves , did not always do these activates fully or for the same aim .

2.6 Challenges remain and were obvious within following standards:

1- The five moments for hand hygiene emphasized by the WHO as steps to reduce the risk of infection were clearly deficient in the opportunity of “Hand hygiene before touching the patient”, Accessing the central line, was not seen as an aseptic techniques and also missed changing the IV set and “After touching the patient surroundings”. Were also challenges

2- Daily review of the central line necessity. A new evidence based standard that was new to all concerned

3- Compliance with maximal barrier precautions during umbilical catheter insertion in the absence of a full set that included all necessary materials an issue related directly to resources

4- Using transparent dressing to allow insertion site inspection.

5- Daily changing to the central line and IV cannula dressing (gauze dressing)

6- Flushing the IV set after drugs administration.

7- Committed with two attempts to insert IV cannula then call for help.

10- Removing the un- necessary IV cannula.

3.6 Recommendations:

In light of the results of this study, and the above-mentioned conclusions, the following recommendations may be valuable in improving the staff compliance with the standard to decrease the health care associated infections.

1- Recommendations related to staff.

- 1- Continuous monitoring of staff practice through clinical audit, at least annual audit.
- 2- Continuous educational programs to provide the HCW with the updated standards.
- 3- Periodical assessment of the knowledge and the compliance of the HCWs who insert and maintain the vascular access devices.
- 3- Training programs for new employees must be done to make sure they are proficient to prevent multiple access attempts.
- 4- Motivation and rewards to increase the staff interest in their work.
- 5- Provide them with the needed resources and facilities to enhance their compliance. As soap, paper towels, Alcohol gel for hand hygiene, special dressing set and package for central line insertion, transparent dressing for the umbilical catheters, a prepared set consisting of all equipment for IV cannula insertion, latex gloves, disposable gown and mask for patient and staff protection.
- 6- Provide the neonatal ward with high-qualified nurses to increase the nurse patient ratio in line with international recommendations in such a high stress unit.

2- Recommendation related to the ward layout and infection

- 1- To decrease the neonatal infections, proper space should be available between incubators that allows for parents, monitor, ventilator and nurse.
- 2- A separated room should be specialized for the referred infants form outside the hospital to prevent infection from other units .
- 3- Special nurses should be assigned for the premature babies.
- 4- Special nurse should be assigned for the isolation room.
- 10- Setting up a surveillance system for the NICU to monitor the prevalence of microorganisms to alert staff on their practices and prevent outbreaks

4.6 The findings of my thesis raised some questions; their answers will be the aims of my future study in the NICU.

- 1- The relationship between type of dressing and the relationship between gestational age and incidence of infection among children with umbilical catheter
- 2- The relationship between different qualification of staff or years of experience and compliance with standards and guidelines.

Annex 1:

Categories and recommendations for CLABSI reduction practices from the Healthcare Infection Control Practices Advisory Committee of the Centers for Disease Control and Prevention*

Recommendation	Description	Category of Recommendation
Hand hygiene prior to catheter insertion	Decontaminate hands with either antiseptic-containing soaps or alcohol-based gels/foams before inserting, repairing, replacing, or dressing a CVC	Category IB
All inclusive catheter carts or kits	A catheter kit or cart contains all the equipment necessary for CVC insertion (needle, guide wire, introducers, etc.), and ensures sterility by minimizing interruptions during line placement	Category IB
Maximal sterile barrier precautions	Use a cap, mask, sterile gown, sterile gloves, and a sterile full body drape when inserting CVCs and PICCs or performing guide wire exchange(s)	Category IB
<u>Chlorhexidine</u> for skin anti-sepsis	Prepare clean skin with <u>chlorhexidine</u> preparation with alcohol before CVC insertion and during dressing changes	Category IA
Antimicrobial catheters	<u>Chlorhexidine/silver sulfadiazine</u> or <u>minocycline/rifampin</u> -impregnated CVCs are recommended only if the catheter is expected to remain in place 5 days or more <u>AND</u> the CVC will be inserted in an environment where the CLABSI rate remains high despite a comprehensive reduction strategy	Category IA
Subclavian vein insertion	Whenever possible, use the subclavian site, rather than the jugular or femoral sites in adults	Category IB

Recommendation	Description	Category of Recommendation
Disinfect hubs and needle-less connectors	Minimize contamination risk by scrubbing the access site with an appropriate antiseptic (<u>chlorhexidine</u> , <u>povidone iodine</u> , or 70% alcohol) prior to accessing the CVC	Category IA
Remove non-essential CVCs	Daily evaluation and prompt removal of CVCs that are no longer clinically warranted is an important aspect of CLABSI prevention; routine replacement of CVCs, PICCs, or hem dialysis catheters is not recommended	Category IA
<u>Chlorhexidine</u> cleansing	Daily cleansing using a 2% <u>chlorhexidine</u> solution or impregnated washcloth rather than soap and water in ICU- and hem dialysis patients is recommended	Category II
CVC dressing	Use either sterile gauze or sterile, transparent, semi permeable dressing to cover the CVC site	Category IA
<u>Chlorhexidine</u> sponge dressing	The use of <u>chlorhexidine</u> -impregnated sponge dressings is recommended for patients ≥ 2 months of age if the CLABSI rate is not decreasing despite adherence to basic prevention measures, including education and training, appropriate use of <u>chlorhexidine</u> for skin antisepsis and use of maximal sterile barrier precautions	Category 1B
Topical antibiotic use	Topical antibiotic use may promote fungemia or bacteremia in non-dialysis populations and is recommended only for hem dialysis catheter dressing	Category IB
Antibiotic or anti-infective “locks”	Instillation of supra-physiologic doses of an intravenous antibiotic or anti-infective	Category II

Recommendation	Description	Category of Recommendation
	solution into a catheter lumen between periods of CVC access is recommended only in those at high baseline risk for CLABSI	
Systemic antibiotic prophylaxis	The use of oral or intravenous antibiotic therapy either during insertion or following placement of a CVC is not recommended	Category IB
Educational interventions	Education regarding appropriate indications, method of placement, and surveillance for CLABSI are a critical component of a comprehensive CLABSI prevention program	Category IA
Catheter bundles or “checklists”	The use of five practices in unison at the time of CVC insertion, “the bundle,” is recommended. These interventions include hand hygiene prior to insertion; use of maximal sterile barrier precautions; <u>chlorhexidine</u> for skin antisepsis; avoidance of the femoral site of insertion; and prompt removal of catheters when no longer indicated	Category IB
Use of specialized CVC insertion teams	The use of trained personnel dedicated to the placement of CVCs in ICU and hospitalized patients is recommended	Category IA

*

Annex 2: Categories of recommendations:

- Category IA: Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies;
- Category IB: Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale; or an accepted practice (e.g., aseptic technique) supported by limited evidence.
- Category IC: Required by State or Federal regulations, rules, or standards.

- Category II: Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale.
- Unresolved Issue: No specific recommendations exist due to conflicting or insufficient evidence.

Note: Adapted from O'Grady, et al •

Annex 3:

اخي الموظف , اختي الموظفة: انتم يوميا على اتصال دائم ومباشر بالمرضى , لذلك فان رايتك في ذات الاهمية لوجود استراتيجيات لمنع العدوى اللتي تنتقل للاطفال حديثي الولادة اثناء تواجدهم في المستشفى, وكيف ان هناك علاقة بين تطبيق هذه الاستراتيجيات والحد من العدوى ,وعليه فان مشاركتك في هذا العمل سيكون له اثر كبير في تطوير العناية الصحية , وحماية المريض والعاملين على تقديم العناية للمريض . علما ان جميع هذه البيانات ستستخدم فقط لاغراض البحث العلمي ولن يطلع عليها أي جهة ثانية. شاكرة تعاونكم

شفاء بشارات
طالبة ماجستير/ صحة الطفل
جامعة القدس/ ابو ديس

ANNEX 3

The staff knowledge and perspective towered the infection prevention strategies to prevent the health care associated infection (HAI)

(1) Age: -

a) 21-30 years

b) 30-40 years

c) 40- 45 years

d) Above 45 years

(3) Year of experience in neonatal ward.

a) Less than five year.

b) 6 to 12 years.

C) 10 to 15 years.

d) Above 15 years.

(2) professional qualification

a) Basic B.Sc nursing(4 years)

b) post Basic B.Sc (2 years)

c) high diploma

d) master degree

4) Gender a) male b) female.

Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly agree
0	1	2	3	4	5

Question		Score
1	I am familiar with the health care associated infection (HAI) guidelines and recommendations.	
2	My hospital has HAI policies consist of hand hygiene, disinfecting, cleaning, and standard precaution.	
3	I do not have time to comply with health care associated infection guidelines.	
4	I am able to implement the hospital health care associated infection policies.	
5	The health care associated infection policies are easily applied in my ward.	
6	The health care associated infection rate will likely decrease if I follow the guidelines and recommendations.	
7	The patients care will likely improve if I comply with the infection prevention strategies.	
8	There is a sufficient leadership and supervisors who help me in implementing the infection prevention strategies in my ward.	
9	There are sufficient resources, supplies, and equipment to follow and comply with health care associated infection practice guidelines.	
10	My ward is in need for health care associated infection guidelines.	

Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly agree
0	1	2	3	4	5

Question		Score
11	If I use the personal protective equipment, the transmission of infections will decreased.	
12	If I use the infection prevention strategies, this will positively affect the patient out come.	
13	I have the ability to be appositve role model for my colleges.	
14	I have the necessary knowledge to prevent infection in my sitting.	
15	I expect that I will comply with HAI guidelines and recommendations if I have the knowledge about these guidelines.	
16	I comply with the infection control strategies that applied by our organization infection control committee.	
17	I received training and lectures about the health care associated infection guidelines.	
18	The consistant of the infection control committee supervision will positively affect my compliance with the infection prevention strategies.	

Annex 4

CVC insertion bundle checklist

Child Name -----date ----- time -----GA-----

Child weight-----Dr Experience-----

Insertion Site: (Jugular / Subclavian / Femoral / Umbilical) _____

Reason for Insertion: (New indication / Malfunction

I	Hand y hygiene	Yes	No
1-	Is hand hygein done before umbilical catheter insertion	<input type="checkbox"/>	<input type="checkbox"/>

II	Maximal Barrier precaution	yes	No
1-	Wearing cap	<input type="checkbox"/>	<input type="checkbox"/>
2-	Wearing mask	<input type="checkbox"/>	<input type="checkbox"/>
3-	Wearing sterile gown	<input type="checkbox"/>	<input type="checkbox"/>
4-	Wearing sterile gloves for the person who insert the catheter	<input type="checkbox"/>	<input type="checkbox"/>
5-	Covering the patient with sterile drape with an opening for the CVC insertion	<input type="checkbox"/>	<input type="checkbox"/>

III	Chloroxexadine skin antiseptic	Yes	No
1-	Prepares skin with anti septic 0.5% chlorohexadine or iodine povidone solution.	<input type="checkbox"/>	<input type="checkbox"/>
2-	Press the sponge of the antiseptic solution against the skin , using back and forth friction scrub for at least 30 second	<input type="checkbox"/>	<input type="checkbox"/>
3-	Allow the antiseptic to dry completely before puncturing for at least 2 minute	<input type="checkbox"/>	<input type="checkbox"/>

Comments -----

Annex 5:

CVC maintenance and care bundle checklist

Nurse qualification -----date-----delivery method-----

Child name -----GA -----WT-----AGE Day number ---

Hand hygiene			
I	Did the health care workers committed with the WHO five moments for hand hygiene	YES	NO
1-	Before touching the patient	<input type="checkbox"/>	<input type="checkbox"/>
2-	Before clean/aseptic procedure	<input type="checkbox"/>	<input type="checkbox"/>
3-	After body fluid exposure during CVC care	<input type="checkbox"/>	<input type="checkbox"/>
4-	After touching the patient	<input type="checkbox"/>	<input type="checkbox"/>
5-	After touching the patient surrounding	<input type="checkbox"/>	<input type="checkbox"/>

Accessing the central line catheter			
II	When accessing the central line is :	YES	NO
1-	Scrubbing the needless access device and hub done for 10- 15 seconds with chlorohexadine or 70% alcohol every time they make or break the connection?	<input type="checkbox"/>	<input type="checkbox"/>
2-	Complete aseptic technique before blood sample withdrawn	<input type="checkbox"/>	<input type="checkbox"/>
3-	Complete aseptic technique before blood culture withdrawn from the central line done?	<input type="checkbox"/>	<input type="checkbox"/>

4-	Flushing after blood withdrawal?	<input type="checkbox"/>	<input type="checkbox"/>
----	----------------------------------	--------------------------	--------------------------

III	Replacement of administration sets	YES	NO
1-	Is extension tubes and lines changed today ?	<input type="checkbox"/>	<input type="checkbox"/>
2-	Is the heparin lock, stopcock changed every 96 hours?	<input type="checkbox"/>	<input type="checkbox"/>
3-	If present, is TPN and intra lipid set changed every 24 hours?	<input type="checkbox"/>	<input type="checkbox"/>
4-	Is new covering device attached to the end of the set after each intermittent use ?	<input type="checkbox"/>	<input type="checkbox"/>
5-	Is blood remains in the IV set after maintenance?	<input type="checkbox"/>	<input type="checkbox"/>
6-	If blood remains in the IV set, does it changed?	<input type="checkbox"/>	<input type="checkbox"/>
7-	Are gloves worn before accessing the IV set?	<input type="checkbox"/>	<input type="checkbox"/>

8-	Does the child received blood or blood products ?	<input type="checkbox"/>	<input type="checkbox"/>
	Are blood transfusion and blood products sets changed within 24 hour?	<input type="checkbox"/>	<input type="checkbox"/>
10-	Is any thrombolytic agent as heparin done after difficulty Flushing or no blood returned to prevent obstruction.	<input type="checkbox"/>	<input type="checkbox"/>

If dressing changed, document the day of dressing:-----

IV	Dressing changing	YES	NO
1-	After removing the old dressing is Redness? Swelling ? Exudates? seen at the site of the catheter ?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
2-	Is oozing around the umbilical catheter was seen ?	<input type="checkbox"/>	<input type="checkbox"/>
3-	Is aseptic technique used when changing dressing?	<input type="checkbox"/>	<input type="checkbox"/>
4-	Is the site been cleaning with chlorhexadine or iodine for 30 seconds and allow drying completely?	<input type="checkbox"/>	<input type="checkbox"/>
5-	Is sponge dressing done every 24 hours?	<input type="checkbox"/>	<input type="checkbox"/>
6-	Is documentation on the line done by date and time?	<input type="checkbox"/>	<input type="checkbox"/>
7-	Is dressing change any time it has become loose ?	<input type="checkbox"/>	<input type="checkbox"/>

Annex 6:

V	The Daily nursing observation for the central line safety and complications	YES	NO
1-	Is the catheter secure ?	<input type="checkbox"/>	<input type="checkbox"/>
2-	Is dressing dry ?	<input type="checkbox"/>	<input type="checkbox"/>
3-	Are all connections hasn't leaking ?	<input type="checkbox"/>	<input type="checkbox"/>
4-	Is there any signs of local infection on the umbilical area redness ? Pus ? Swelling ?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
5-	Is the umbilical venous catheter changed if signs of infection seen? Document the catheter day	<input type="checkbox"/>	<input type="checkbox"/>
6-	Is there any changing in abdominal color , or presence of abdominal distention and discomfort :	<input type="checkbox"/>	<input type="checkbox"/>
8-	Is the catheter still clinically indicated?	<input type="checkbox"/>	<input type="checkbox"/>
9-	If the catheter removed: Is sterile technique used when removing the umbilical catheter ?	<input type="checkbox"/>	<input type="checkbox"/>
11-	Is documentation done after removing ?	<input type="checkbox"/>	<input type="checkbox"/>

Annex 7: Peripheral venous cannula insertion checklist

nurse educational degree -----date -----

child name -----GA-----WT-----AGE-----

delivery method-----

Insertion Site: -----

Yes No

- 1-** is hand hygiene done before cannula insertion
- hand rub with Alco gel soap and water
- 2-** is gloves worn for child and personal protection?
- 3-** are all equipment prepared before starting?
- 4-** is the baby transfer to a clean special insertion table ?
- if no why ?-----
- 5-** is the site for cannulation cleaned by chlorohexadine or alcohol 70% with circular motion for 30 seconds ?
- 6-** is the skin allowed to dry for 30-60 seconds ?
- 7-** does the nurse palpate the skin after disinfection to the site ?
- 8-** is more than two attempt done ?
- 9-** Is the cannula changed between each attempt ?
- 10-** what is the color of cannula that used for this baby
- Yellow blue
- 11-** is flushing done after cannula insertion ?
- 12-** What kind of dressing was done?
- Adhesive tape gauze dressing semi permeable tape
- Transparent dressing semi preamble dressing .
- 13-** is documentation done after insertion by date , time , nurse name ?

Annex 8: Daily Peripheral venous cannula care and maintenance

Nurse educational degree-----date -----

Child name-----GA-----WT-----AGE-----

Delivery method-----Day of cannula applied -----

Yes No

1- Hand hygiene done before accessing the IV cannula?

2- Gloves worn before accessing the cannula

3- When the caps removed for whatever reason is it replaced one? with a new

4- During inspection for the IV cannula dressing is it

loose Intact Soaked Dirty

5 according to the above result, Is the dressing changed?

6- When dressing to the cannula change is an a septic non touch

Technique used?

7- During inspection to the area around the insertion site is there any

extravasation redness swelling none

8- Is the cannula changed in case of one of the above seen?

9- Is flushing with N/S done after drug administration?

10- is the IV tubing set changed today

11- Is the IV cannula still clinically indicated?

If the IV cannula removed:

12- is sterile swap and dressing applied on the exit site

References

- 1- Frampton GK, Harris P, Cooper K, Cooper T, Cleland J, Jones J, *et al.*(2014) *Educational interventions for preventing vascular catheter bloodstream infections in critical care: evidence map, systematic review and economic evaluation. Health Technol Assess.* Retrieved from:
www.ncbi.nlm.nih.gov/pubmed/24602781
- 2- Peterson KD, Edward JR, (june2007). *Andrus ML: national health care safety network(NHCSN) report, data summary for 2006, issued, AMJ, infection control*2007,35:290-301. Retrieved from:
www.ncbi.nlm.nih.gov/pmc/articles/PMC3777364/
- 3- MOH , neonatal care procedural manual for hospitals (2010) , United States Agency for International Development. Retrieved from:
apps.who.int/iris/bitstream/10665/.../9789241503693_eng.pdf
- 4- Richard A, Polin MD, et al. (2012). *strategies for prevention of health care associated infection*AAP, www.pediatrics.org/cgi/doi/10.1542/peds-2012-0145
- 5- Boyd S, et al (2011) *Peripheral intravenous catheters:the road to quality improvement and safer patientcare. Journal of Hospital Infection; 77: 37-41.* Retrieved from:
www.ncbi.nlm.nih.gov/pubmed/21130520
- 6- The Joint Commission. (March 11, 2014).*Preventing Central Line–Associated Bloodstream Infections.* Retrieved from:
[.http://www.jointcommission.org/assets/1/18/CLABSI_Monograph.pdf](http://www.jointcommission.org/assets/1/18/CLABSI_Monograph.pdf).
- 7- Cane G, Chris N, (2014). *central line infection ,CRIBSI and CRBSI.* Retrieved from:
www.ncbi.nlm.nih.gov/pmc/articles/PMC3585494/
- 8- Cardinal Glennon Children's Medical Center, St. Louis, Missouri, USA. Umbilical catheters, placement, and complication management, 2006 Nov-Dec;29(6):346-52
- 9- Mermel LA, AllonM, Bou2aE,etal. Clinical practice guidelines for the diagnosis and management of ICIR:2009 updated by the infections disease society of America , *clin infect dis.* 2009;-us.[PubMed].
- 11- Cardinal Glennon Children's Medical Center, St Louis, Missouri, USA.(2006) *Umbilical catheters, placement, and complication management.* Retrieved from:
www.researchgate.net/.../6674867

12- center for disease control and prevention(CDC)(2001,2008,and 2009.MMMWR Morb mortal Wkly Rep 2011).*central line associated blood stream infection*. Retrieved from:

www.medscape.com/viewarticle/751959_3

13- MOH. neonatal care procedural manual for hospitals (2010) , United States Agency for International Development. Retrieved from:

apps.who.int/iris/bitstream/10665/.../9789241503693_eng.pdf

14- Pratt RJ¹, Pellowe CM, Wilson JA, Loveday HP et al.(2007).*epic2: National evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England*. Retrieved from:

www.ncbi.nlm.nih.gov/pubmed/17307562

15- Richard A, PolinMD et al.(2012).*strategies for prevention of health care associated infection.AAP*. Retrieved from:

www.pediatrics.org/cgi/doi/10.1542/peds-2012-0145

16- WHO guidelines on hand hygiene in health care,(2009) World Health Organization WHO/IER/PSP.www.who.int/gpsc/5may/tools/9789241597906/en/

17- WHO Pocket Book of hospital care for children.(2005) *Guidelines for the management of common illness with limited resources*. Retrieved from: whqlibdoc.who.int/publications/2005/9241546700.pdf

18- Naomi P, Lillian A. et al.(2011). *CDC Guidelines for the Prevention of Intravascular catheter Related Infections*. Retrieved from: <http://www.cdc.gov/hicpac/BSI/BSI-guidelines-2011.html>

19- neonatal care procedural manual for hospitals (2010) , United States Agency for International Development. Retrieved from:

apps.who.int/iris/bitstream/10665/.../9789241503693_eng.pdf

21- (WHO) *prevention blood stream infection from central line venous catheter* (February 2012). Retrieved from: www.who.int/patientsafety/implementation/bsi/en/

22- CDC.NHSN *surveillance for central line- associated blood stream infections national health care safety net work* (February 2001). CDC/NHSN. *surveillance definition of specific type of infections chapter in NHSN patient safety manual* (chapter 17) .

23- Richard E, et al. (1961-2011.). *Control of health associated infection*. Retrieved from:

www.cdc.gov/mmwr/preview/mmwrhtml/su6004a10.htm.

24- CDC/NHSN, (Jan 1 2014) *surveillance definition for type of infections*,

www.cdc.gov/nhsn/PDFs/.../17pscNosInfDef_current.pdf.

25- CDC/NHSN.(March 2009) *surveillance definition of HAI and criteria for specificity of infection in acute care sitting* . Retrieved from:

www.ncbi.nlm.nih.gov/pmc/articles/PMC3530249/.

26- MOH. neonatal care procedural manual for hospitals (2010) , United States Agency for International Development. Retrieved from:

apps.who.int/iris/bitstream/10665/.../9789241503693_eng.pdf

27- WHO health care associated infection Fact sheet ,(2010) . Retrieved from:

www.WHO.int/gspc WHO. infection control.

28- Duce G,(2002). *prevention of hospital acquire infection* , A practice guide, 2ed ed. WHO, Malta, PI-64. Retrieved from:

www.who.int/csr/resources/.../whocdscsreph200212.pdf

29- Bauman R. (2007) microbiology with disease *Controlling Microbial Growth in the Environment*. Retrieved from: www.amazon.com/Microbiology-With-Diseases.../0321742346.

30- Yasser E ,(sep.2011). *epidemiology of septicemia at neonatal intensive care unit in Gaza City*. library.iugaza.edu.ps/thesis/98372.pdf.

31- Richard A. Polin M, et al.(2012). *strategies for prevention of health care associated infection*.AAP. Retrieved from: www.pediatrics.org/cgi/doi/10.1542/peds-2012-0145

32- Frampton GK, Harris P, Cooper K, Cooper T, Cleland J, Jones J, *et al.*(2014) *Educational interventions for preventing vascular catheter bloodstream infections in critical care: evidence map, systematic review and economic evaluation*. *Health Techno Assess*. Retrieved from:

www.ncbi.nlm.nih.gov/pubmed/24602781

33. Jacinto A, Sandra L, brain S.(2011). *Neonatal intensive care* , seventh edition2011.

Retrieved from: www.amazon.co.uk/...Neonatal-Intensive/dp/0323067158

- 34-** HICPAC publications (2011) . *prevention of intravascular catheter related infections* retrieved from: <http://www.cdc.gov/hicpac/BSI/bsi-table-1-2011.html>
- 35-** Louis St, Cardinal Glenn on Children's Medical Center,(2006) . *Umbilical catheters, placement, and complication management*, retrieved from www.ncbi.nlm.nih.gov/pubmed/17122690.
- 36-** Naomi P, Lillian A. et al.(2011). *CDC Guidelines for the Prevention of Intravascular catheter Related Infections*. <http://www.cdc.gov/hicpac/BSI/BSI-guidelines-2011.html>
- 37-** CDC.NHSN *surveillance for central line- associated blood stream infections national health care safety net work* (February 2001). CDC/NHSN. *surveillance definition of specific type of infections chapter in NHSN patient safety manual* (chapter 17) .
- 38-** A. M. RIVERA, M.D. ; K. W. STRAUSS, M.D., F.A.C.P.(2005). *The history of peripheral intravenous catheters : How little plastic tubes revolutionized medicine*(*Acta Anaesth. Belg*, 56, 271-282). Retrieved from: www.researchgate.net/.../7501846
- 39-** Richard L. et al.!(February 2008) . *Nursing Made Incredibly Easy* Volume 6 Number 1 retrieved from: journals.lww.com/nursingmadeincrediblyeasy/toc/2008/01000
- 40-** Hospital infection control policy. (Sep_2011). *Bundle checklist for peripheral venous maintenance*, retrieved from: vinesaliba.com/.../Peripheral_Intravenous_Cannulation_Policy_-_Sep_2011.
- 41-** Robert S, Baltimore,MD, et al.(2011) *pediatrics.decreasing central line associated blood stream infection in the NICU*.March 16 3011. Retrieved from: www.science.gov/topicpages/c/clinical+settings+due.html
- 42-** The Joint Commission. *Preventing Central Line–Associated Bloodstream Infections: A Global Challenge, A Global Perspective*. Oakbrook Terrace, IL: The Joint Commission, 2012.http://www.jointcommission.org/assets/1/18/CLABSI_Monograph.pdf.
- 43-** center for disease controle and prevention(CDC)(2001,2008,and 2009.MMMWR Morb mortal Wkly Rep 2011).*central line associated blood stream infection*. www.medscape.com/viewarticle/751959_3

44 Richard A. Pollen, MD et al.(2012). *Strategies for prevention of health care associated infection*. AAP, retrieved from: www.pediatrics.org/cgi/doi/10.1542/peds-2012-0145

45- CLABSI Centers for disease control and prevention(2011). *Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-central line-associated Bloodstream Infection)*. retrieved from:
[www. CDC. Gov/s/pscmqnal/4psc-CLABSIcurrent .PDF](http://www.CDC.Gov/s/pscmqnal/4psc-CLABSIcurrent.PDF)

46- CDC.NHSN *surveillance for central line- associated blood stream infections national health care safety net work* (February 2001). CDC/NHSN. *surveillance definition of specific type of infections chapter in NHSN patient safety manual* (chapter 17) .

47- Health Protection Agency (HPA).(2012) *English National Point Prevalence Survey on Healthcare-associated, Infections and Antimicrobial Use, 2011: preliminary data*. 1–139. London retrieved from:
www.healthcareconferencesuk.co.uk/.../Paulineharrington_513.pdf

48, 50, 51- Frampton GK, Harris P, Cooper K, Cooper T, Cleland J, Jones J, *et al.*(2014) *Educational interventions for preventing vascular catheter bloodstream infections in critical care: evidence map, systematic review and economic evaluation*. *Health Techno Assess*. Retrieved from.
www.ncbi.nlm.nih.gov/pubmed/24602781

49- Hung jean T, et al,(2014). *the impact of central line associated blood stream infection , Department of intensive care medicine*, retrieved from: www.biomedcentral.com/1471-2334/14/356

52- Schulman J, Stricof R et al.(2011). *statewide NICU central line –associated blood stream infection rates decline after bundle and checklist*. *agency for Health Care Research and Quality* . retrieved from: www.biomedcentral.com/1471-2334/14/356.

List of content

Definitions.....	2
Abstract.....	3
Declaration	9
Acknowledgment.....	10
Abbreviations	11
Chapter 1 introduction.....	12
1.1 Overview.....	21
2.1 Significant	19
3.1 The aims.....	19
4.1 Objective:.....	19
5.1 Research hypothesis.....	19
6.1 Research questions:.....	19
7.1 Limitations and barriers.....	19
Chapter 2 literature review.....	21
1.2 Health care associated infection.....	21
1.1.2 Back ground	21
2.1.2 Epidemiology for HAI.....	22
3.1.2 The infections that Infants acquires during hospitalization may be.....	22
4.1.2 Surveillance of Health care associated infections in Palestine.....	23
2.2 Local study.....	22
3.2 diagnosis of sepsis at Rafedi Hospital.....	24
4.2 use and misuse of antibiotics.....	24
5.2 The Procedures and protocols references used in the NICU for infant care.....	25

6.2 Catheters used for venous and arterial access at Rafedia hospital NICU.....	26
1.6.2 Umbilical catheter	26
2.6.2 Peripheral venous cannula.....	27
7.2 Intravascular catheter related infection.....	28
8.2 Educational intervention	29
1.8.2 Overview	29
2.8.2 International studies	30
Chapter 3 methodology	32
1.3 the pre intervention period.....	23
1.1.3 Study design, sitting, population and period.....	32
2.1.3 Sample characteristics.....	32
1.2.1.3 The doctors	32
2.2.1.3Nurses.....	34
3.2.1.3 Characteristics of Target group	35
3.1.3 Data collection methods.....	36
1.3.1.3 Prior pilot criteria:.....	36
2.3.1.3 Questionnaire	37
3.3.1.3 Checklists	37
4.1.3. Central venous catheter CVC insertion bundle checklist.....	38
5.1.3. Central venous catheter (CVC) maintenance and care bundle checklist.....	38
6.1.3 Peripheral venous cannula insertion checklist.....	39
7.1.3 Peripheral venous cannula care and maintenance checklist.....	40
2.3 Intervention.....	41
1.2.3 Implementation phase.....	41
2.2.3 The topics that were covered during the educational program.....	41
3.3. Methodology During the Post intervention phase.....	42
1.3.3 Study design, setting, population , sampling and period.....	42
3.3.3 Data collection methods.....	43
Chapter analysis.....	44
1.4 analysis and result	44

1.1.4	analysis of CVC insertion checklist during the pre intervention period.....	44
2.1.4	Analysis of CVC insertion checklist during the post intervention period.....	45
3.1.4	Using Independent Two Samples T-Tests for comparison purposes.....	47
1.3.1.4	Hand Hygiene	47
2.3.1.4	Maximal Barrier Precaution.....	47
3.3.1.4	povidone iodine 10% skin antiseptic.....	48
4.1.4	Result of CVC insertion checklist	49
2.4	Analysis and results of CVC maintenance and care checklists during the pre intervention period.....	49
1.2.4	The staff compliance with CVC maintenance and care during the pre intervention period.....	50
1.1.2.4	Changing dressing.....	52
2.1.2.4	Daily observation for catheter safety.....	53
3.1.2.4	Presence of infection signs and other complications.....	53
4.1.2.4	Is the umbilical venous catheter changed when the previous complications occurred?.....	53
5.1.2.4	Catheter security.....	54
6.1.2.4	Catheter removal.....	55
2.2.4	Analysis of CVC care and maintenance checklist during the post intervention period.....	57
1.2.2.4	The staff compliance with CVC care and maintenance standard during the post intervention period.....	57
2.2.2.4	Dressing changing.....	59
3.2.2.4	Daily observation for catheter safety.....	61
4.2.2.4	Presence of infection signs and other complications.....	61
5.2.2.4	Is the umbilical venous catheter changed when the previous complications occurred?.....	62
6.2.2.4	Catheter security.....	62
7.2.2.4	Catheter removal.....	62
3.2.4	Independent Two Samples T-Tests:.....	63

4.2.4 Result of data analysis for CVC maintenance checklists.....	64
1.4.2.4 Hands Hygiene.....	64
2.4.2.4 Accessing the central line catheter.....	65
3.4.2.4 Replacement of administration sets.....	67
4.4.2.4 Dressing Changing.....	70
5.4.2.4 The daily nursing observation for the central line safety and complications.....	72
3.4 Analysis and results of intravenous cannula insertion checklists during the pre intervention period.....	73
1.3.4 Insertion sites.....	74
2.3.4 types of intravenous cannula.....	75
3.3.4 Staff compliance with intravenous cannula insertion standard during the pre intervention period.....	77
1.1.3.4 Hand hygiene.....	77
2.1.3.4 Wearing gloves.....	77
3.1.3.4 Preparing equipment.....	77
4.1.3.4 The transference of the baby to a special clean table	78
5.1.3.4 Prepare skin with antiseptic.....	78
6.1.3.4 Attempts for insertion.....	79
7.1.3.4 Documentation.....	79
2.3.4 Analysis of intravenous cannula insertion checklist during the post intervention..	79
1.2.3.4 Staff compliance with intravenous cannula insertion standard during the post intervention period.....	80
2.2.3.4 findings.....	81
3.2.3.4 Comments on the no significant change results.....	82
4.4 Analysis and results of intravenous cannula care and maintenance checklist during the pre intervention period.....	82
1.4.4 Staff compliance	83
1.1.4.4 Changing IV cannula caps.....	83
2.1.4.4 Flushing after medicine administration.....	83
3.1.4.4 Changing IV tubing	83

4.1.4.4 The dressing condition.....	84
5.1.4.4 Presence of complication in the insertion site area.....	84
6.1.4.4 The clinically indication of the IV cannula	85
7.1.4.4 IV cannula removal.....	85
2.4.4 Analysis of intravenous cannula care and maintenance checklist during the post intervention period.....	85
3.4.4. Data analysis using Independent Two Samples T-Tests.....	87
1.3.4.4 findings.....	87
5.4 Study reliability.....	90
6.4 study validity.....	90
7.4 Analysis of the questionnaire (Staff perspectives and knowledge.....	91
1.7.4 Findings	91
2.7.4 Group discussion during intervention period.....	91
3.7.4 Result	92
Chapter 5	
discussion.....	96
1.5 Staff compliance.....	96
2.5 Vascular access devices related infections.....	97
3.5 The dressing regimens	98
4.5 Antiseptic solutions	98
5.5 Infection signs.....	99
5.5 Working environment	
Chapter 6 conclusion.....	100
1.6 knowledge, practices attitudes , resources and administrative support.....	100
2.6 Challenges	101
3.6 Recommendations.....	102
References	126.127.128.129.

List of tables:

Table 1.3 doctors professionals and qualifications.....33

Table 2.3 doctor’s age groups.....33

Table 3.3 doctors experiences.....33

Table 4.3 doctors’ gender.....34

Table 5.3 nurses professionals and qualifications.....34.

Table 6.3 nurses age group.....35

Table 7.3 nurses experiences.....35

Table 8.3 nurses gender.....35

Table 1.4 central venous catheter (CVC) insertion compliance percentages pre intervention.....45

Table 2.4 CVC insertion compliance percentages post intervention.....46

Table 3.4 CVC maintenance nurses compliance percentages pre intervention.....51

Table 4.4 CVC maintenance nurses compliance percentages pre intervention.....55

Table 5.4 CVC maintenance nurses compliance percentages pre intervention.....56

Table 6.4 CVC maintenance nurses compliance percentages post intervention.....58

Table 7.7 CVC maintenance nurses compliance percentages post intervention.....60

Table 8.4 independent two- tailed samples test for WHO five moments nurses compliance.....65

Table 9.4 independent two- tailed samples test for the nursing compliance during accessing the central line.....66

Table 10.4 independent two- tailed samples test for nursing compliance during replacement the administration set.....	69
Table 11.4 independent two- tailed samples test for nursing compliance during dressing change on the umbilical venous catheter (UVC).....	71
Table 12.4 independent two- tailed samples test for my daily observation to the UVC.....	73
Table 13.4 independent two- tailed samples test for nursing compliance during intra venous (IVC) cannula insertion.....	80
Table 14.4 independent two- tailed samples test for nursing compliance during IVC maintenance and care.....	89
Table 15.4 A independent two- tailed samples test for staff knowledge and perspectives towered the health care associated infection prevention strategies.....	94
Table 15.4 B independent two- tailed samples test for staff knowledge and perspectives towered the health care associated infection prevention strategies.....	95

List of annexes

Annex 1 CDC Guidelines for prevention intravascular catheter related infections (2011).....	105
Annex 2 categories and recommendations for CDC guidelines.....	106
Annex 3 staff knowledge and perspectives survey.	108
Annex 4 CVC insertion checklist.....	112
Annex 5 CVC maintenance and care checklist.....	113.
Annex 6 peripheral venous cannula insertion checklist.....	116
Annex 7 peripheral venous cannula maintenance checklist	117
Annex 8 daily observation to the UVC.....	118

List of figures

Figure 1.1 types of isolates among positive blood cultures.....	18
Figure 1.4 umbilical catheter dressing pre interventions.....	52
Figure 2.4 the way of UVC secure post intervention.....	54
Figure 3.4 UVC dressing post intervention.....	59
Figure 4.4 multiple IVC insertion attempts.....	74

Figure 5.4 types of IVC.....	75
Figure 6.4 types of IVC dressing.....	76