Deanship of Graduate Studies

Al-Quds University

Effectiveness of Health Education Intervention Program on Minimizing Extravasation injuries among neonates in North West Bank Governmental hospitals; an intervention study

Rashad Mohammed Nayef Baddad

M.Sc. Thesis

Jerusalem – Palestine

1437   - 2016

Effectiveness of Health Education Intervention Program on Minimizing Extravasation injuries among neonates in North West Bank Governmental hospitals; an intervention study

Prepared by:

Rashad Mohammed Nayef Baddad

B.Sc. Al-Quds University – Palestine

Supervisor

Dr.Sumaya Sayej RN, MSN, PhD

A thesis submitted in partial fulfillment of requirements for the degree of Master of Pediatric Nursing –Nursing Department, Faculty of health professions –Al-Quds University

1437 –2016

Al Quds University

Deanship of Graduate Studies

Pediatric Nursing Program / Nursing Department

Thesis Approval

Effectiveness of Health Education Intervention Program on Minimizing Extravasation injuries among neonates in North West Bank Governmental hospitals; an intervention study

Prepared by: Rashad Mohammed Nayef Baddad

Registration No.: 21212641

Supervisor: Dr.Sumaya Sayej

Master thesis submitted and accepted 25/ 05 /2016

The names and signatures of the examining committee members are as follows:

The names and signatures of the examining committee members are as follows:

1. Head of the committee: Dr. Sumaya Sayej   Signature:

2. Internal Examiner: Dr. Farid Ghrayeb   Signature:
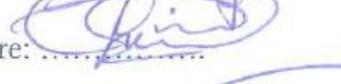
3. External Examiner: Dr. Aidah Alkaissi   Signature: aidah alkaiss

Jerusalem – Palestine

1437 - 2016

Dedication

Inspiration springs from Passion… Passion is born from unconstrained love, commitment, and a vision no one else can own. Thank you Mom…I am truly blessed by your love, and support. To my father soul who gave me everything …A huge hug for my wife &sons, Mohammed and Zaid—I love you very much. A huge hug for my brothers and sisters for their endless and unconditional love. Very special thanks to Dr. Sumaya Sayej, my advisor &supervisor, for her friendship, excellent direction, and unwavering encouragement.

Rashad Mohammed Nayef Baddad

Date: April 2nd, 2016

Declaration

I, the undersigned, hereby declare that this thesis entitled "Effectiveness of Health Education Intervention Program on Minimizing Extravasation injuries among neonates in North West Bank Governmental hospitals; an intervention study", submitted for the degree of master, is my own work, and that all the sources I have used or quoted have been indicated or acknowledged by means of completed references, and that this thesis (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed: ……………………………..

Rashad Mohammed Nayef Baddad

Date: April 2nd, 2016

Acknowledgments

The writing of this thesis has been one of the most significant academic challenges I have ever had to face. Without the support, patience and guidance of the following people, this study would not have been completed. It is to them that I owe my deepest gratitude.

First, I would like tothank all nurses who participated in this study, who constantly welcome me every time I visited their units, although they were very busy with their daily tasks; they have always been available to answer my questions.

Also I would like to express my thanks and gratitude to my advisor Dr. Sumaya Sayej. I am so deeply grateful for her help, professionalism, and valuable guidance throughout this study and through my entire program of study that I do not have enough words to express my deep and sincere appreciation. Her wisdom, knowledge and commitment to the highest standards inspired and motivated me.

Great thanks to Al-Quds University who gave me the opportunity to study at graduatelevel in my own country.

A special thanks goes to my colleagues for their unconditional support; who inspired my final effort despite the enormous work pressures we were facing together especially Walaa Bizreh, Sanaa Salahat, and Nour Hamoudah.

Finally my deepest gratitude goes to my family for their unflagging love and unconditional support throughout my life and my study, andI would like to pray for my father soul who gave me the basis for everything, to my mother who supported me, and I would like to express my sincere thanks to my wife, and my children Mohammed and Zaid who suffer a lot with me during my study.

Abstract

Extravasation injury (EVI) is the non-intentional leakage of infused fluids or drug into the surrounding tissues or other extra-vascular space can occur as a complication of NICU care with varying degrees of tissue damage, Although most leaked fluids resolve spontaneously after IV Cannula is removed; EVI remain an important cause of iatrogenic injuries in NICU's.

The purpose of the study was to examine the effectiveness of health education intervention program to neonatal nurses working in NICU's in North West Bank governmental hospitals on minimizing extravasation injuries among neonates.

This quasi-experimental study is designedwith intervention and control group and carried out among nurses working in five NICU's in five governmental hospitals in North West Bank.

Three experimental steps were followed to have the study completed which was: assessment of the NICU's nurses' knowledge and practices concerning IV cannula care and monitoring, implementation of the health education intervention program to the intervention group. And the posttest (post-intervention) data which obtained from the intervention and control groups to evaluate the effectiveness of the health education intervention program provided to intervention group under study and to compare the results of posttest with control group results.

A 35-items questionnaire developed by the researcher was given to 56 participants' nurses working in the five NICU's, the questionnaireincluded items related to neonatal nurses knowledge and practices, was pre-tested for validity and reliability in addition to pilot testing prior to data collection.

Multiple comparisons were made to indicate the significance of participants'results at both pre-test and post-test; at posttest intervention group and control group compared to evaluate the effectiveness of the education intervention program.

The major findings of the study at the post-test data showed a significant difference regarding I.V. cannula insertion and care for those who received the health education intervention when compared with those who did not received intervention. 34.6% of the intervention group nurses in pre-intervention observe the cannula site regularly improved to 61.5% in the post-intervention;

The intervention group nurses uses the forearm to apply intravenous cannula improved from 11.5% in pre- intervention to 57.7% in post-intervention; and compared to 15.5% in the posttest for the control group.

The methods used to examine the cannula patency revealed that 73.1% of the intervention group nurses flush the cannula by using aspiration of normal saline while it was 30.8% in pre-intervention data. The posttest results of the control group stay nearly the same in the pretest; which indicated that there were no improvements in the knowledge and practices of control group nurses.

Comparing the results of the pre-test with the post-test for the intervention group, and posttest-posttest of intervention group vs. control group showed significant improvement in the knowledge and practice of the intervention group at post-intervention, Although further research is required, we concluded that in this quasi-experimental study, choosing the proper site to apply IV cannula, regular check of IV cannula site, and flush the cannula through aspiration, in addition to continuous education of the neonatal nurses on the proper procedure for the insertion

and care of the intravenous cannula and strategies to minimize E.V.I. may decrease the morbidity associated with EVI.

The recommendations for the Ministry of Health are to adopt policies to ensure quality improvement in the governmental hospitals, regardless of the cost, by designing standard practices manuals and protocols to minimize and prevent the complications of the intravenous therapy and care of the intravenous cannula and enhance the utilization of it across NICU's.

العنوان: فعالية برنامج التعليم والتدريب حول خفض اصابات تسرب السوائل من الاوعية الدموية للاطفال حديثي الولادة للممرضين/ات العاملين باقسام حديثي الولادة في المستشفيات الحكومية شمال الضفة الغربية

إعداد: رشاد محمد نايف بداد

المشرفة: الدكتورة سمية صايج

ملخص الدراسة

إصابة التسرب هي اصابة تحدث نتيجة تسرب (تنضاح) غير مقصود للسوائل التي يتم اعطاؤها عن طريق الوريد إلى الأنسجة المحيطة بمكان الحقن خارج الأوعية الدموية وهذه الاصابة ممكن أن تؤدي الى درجات متفاوتة من تلف للأنسجة المحيطة بمكان التسرب وذلك حسب تركيز وكمية السوائل التي تم تسربها خارج تلك الاوعية الدموية، بالرغم من أن معظم الأعراض المصاحبة والمضاعفات الناتجة بسبب تسرب السوائل خارج الاوعية الدموية تحل ذاتيا بعد ازالة الابرة الوريدية من مكانها في جسم الطفل؛ الا ان هذه الاصابة تبقى أحد أهم أسباب الإصابات علاجية المنشأ التي تحدث في اقسام العناية المكثفة بالأطفال حديثي الولادة.

هدف هذه الدراسة هو دراسة فعالية برنامج تعليمي تدخلي لممرضي وممرضات الأطفال حديثي الولادة الذين يعملون في وحدات العناية المكثفة للاطفال حديثي الولادة في المستشفيات الحكومية في شمال الضفة الغربية حول التقليل من إصابات التسرب بين الأطفال حديثي الولادة.

تستند هذه الدراسة شبة التجريبية التي تم تنفيذها بين الممرضين والممرضات العاملين في وحدات العناية المكثفة للاطفال حديثي الولادة في المستشفيات الحكومية في شمال الضفة الغربية على نماذج مجموعة التدخل ومجموعة التحكم (الضابطة)، ولانجاز هذه الدراسة تم اتباع ثلاث خطوات تجريبية تضمنت ما يلي:

- تقييم معرفة الممرضين العاملين في وحدات العناية المكثفة للاطفال حديثي الولادة بالممارسات المتعلقة بتركيب ورعاية ومتابعة الإبر الوريدية.
- تنفيذ برنامج تعليمي تدخلي (تدريبي) لمجموعة التدخل يتضمن شرح مفصل لطريقة تركيب ومتابعة الإبر الوريدية اضافة الى استرتيجيات للتقليل من خطر إصابة التسرب.
- مقارنة نتائج الاختبار البعدي التي تم الحصول عليها من مجموعة التدخل ومجموعة التحكم (الضابطة) لتقييم فعالية البرنامج التعليمي التدريبي المقدم لمجموعة التدخل تحت الدراسة.

وقد طور الباحث نموذج استطلاع (استبيان) مكون من35 بند وقد شارك في تعبئته 56 ممرض وممرضة يعملون في خمس وحدات للعناية المكثفة للاطفال حديثي الولادة، وشمل الاستبيان البنود المتعلقة بمعرفة ومعلومات وممارسات ممرضي

وممرضات الاطفال حديثي الولادة في تركيب ومتابعة والعناية بالابر الوريدية، وقبل استخدام الاستبيان في الدراسة تم اختباره للتأكد من صحته وموثوقيته بالإضافة إلى اجراء اختبار تجريبي قبل البدء بجمع وتعبئة الاستبيان من قبل المشاركين في الدراسة.

بعد جمع الإستبيانات وتحليلها أجريت مقارنات متعددة لتوضيح أهمية نتائج المشاركين في كل من مرحلتي الاختبار القبلي (الاختبار المبدئي للحصول على قاعدة بيانات) و الاختبار البعدي (بعد التدخل لمجموعة التدخل)؛ بعد اجراء الاختبار البعدي حيث تم مقارنة نتائج مجموعة التدخل مع نتائج مجموعة التحكم (الضابطة) لتقييم فعالية برنامج التعليم التدريبي لمجموعة التحكم.

أظهرت النتائج الرئيسية للدراسة للإختبار البعدي لكلا مجموعتي الدراسة فرقا كبيرا فيما يتعلق بادخال الابر الوريدية والعناية بها لأولئك الذين تلقوا تدريب وتعليم حسب خطة البرنامج التعليمي التدخلي المبني حسب حاجيات الممرضين بالمقارنة مع أولئك الذين لم يتلقوا التدريب. وقد ارتفعت وتحسنت نسبة انتظام متابعة ومراقبة مكان ادخال الابرة الوريدية لمجموعة التدخل؛ حيث كانت 34.6% قبل البرنامج التعليمي وارتفعت إلى 61.5% في الاختبار البعدي (بعد البرنامج التعليمي).

ارتفعت نسبة ممرضي وممرضات مجموعة التدخل الذين يستخدمون الساعد لادخل وتركيب الابر الوريدية من 11.5% في الاختبار القبلي إلى 57.7% في الاختبار البعدي. ومقارنة مع 15.5% في الاختبار البعدي للمجموعة الضابطة يتبين ان البرنامج التعليمي ساعد في زيادة مهارة الممرضين في مجموعة التدخل.

كما أظهرت نتائج الدراسة (الإختبار البعدي) بخصوص الأساليب المستخدمة لفحص الابر الوريدية أن 73.1% من ممرضات مجموعة التدخل أصبحن يقمن بفحص الابر الوريدية عن طريق عمل سحب من الابرة الوريدية باستخدام سائل ملحي متعادلمقارنة مع 30.8% في نتائج الاختبار القبلي. نتائج الاختبار البعدي لمجموعة التحكم (الضابطة) بقيت نفسها تقريبا كما في الاختبار القبلي؛ ما يوضح أنه لم تكن هناك تحسينات في معرفة وممارسات ممرضات مجموعةالتحكم (الضابطة) اللواتي لم يتلقين برنامج تعليمي وتدريبي بعكس ممرضات مجموعة التدخل اللواتي نتائجهن تظهر تحسن ممارساتهن للعناية بالإبر الوريدية.

مقارنة نتائج الاختبار القبلي مع الاختبار البعدي لمجموعة التدخل، والاختبار البعدي لمجموعة التدخل مقابل الاختبار البعدي للمجموعة الضابطة أظهرت تحسنا ملحوظا في معرفة وممارسات مجموعة التدخل في مرحلة ما بعد التدخل (الاختبار البعدي أي بعد تقديم البرنامج التعليمي التدريبي) كما يظهر في نتائج الإختبار البعدي.

بالرغم من أن المزيد من الدراسات والبحوث مطلوبة في هذا المجال، فقد استنتجنا في هذه الدراسة شبه التجريبية ان اختيار الموقع المناسب لتركيب وادخال الابرة الوريدية، وفحص ومراقبة مكان تلك الابرة بشكل منتظم، وفحص الابرة الوريدية عن طريق السحب باستخدام حقنة سائل ملحي متعادل، بالإضافة إلى التعليم المستمر لممرضي وممرضات الأطفال حديثي الولادة على الإجراءات المناسبة لتركيب ورعاية الابر الوريدية قد يقلل من الإصابة بالأمراض المرتبطة بتسرب السوائل خارج الاوعية الدموية.

توصيات هذه الدراسة لوزارة الصحة هي إعتماد سياسات لضمان تحسين الجودة في المستشفيات الحكومية، بغض النظر عن التكلفة، من خلال تصميم أدلة وبروتوكولات موحدة لتقليل ومنع المضاعفات الناجمة عن العلاج عن طريق الوريد وتعزيز الاستفادة منهافي وحدات العناية المكثفة لحديثي الولادة.

List of Abbreviations

E.V.I.	Extravsation injury
I.V.	Intravenous
J.U.S.T.	Jordan University of Science and Technology
N.A.N.N.P.	National Association of Neonatal Nurse Practitioners
N.I.C.U.	Neonatal intensive care unit
P.C.B.S.	Palestinian Central Bureau of statistics
P.N.R.	Patient Nurse Ratio
R.C.N.	Royal Collage of Nursing
SPSS	Statistical Package for Social Science
T.P.N.	Total parenteral nutrition

List of Tables

List of Figures

List of annexes

Table of contents

Chapter One

Introduction

Introduction

The survival of an increasing number of hospitalized premature, very low birth weight and critically ill neonates enhances the need for parenteral nutrition to support their growth, as well as consistent vascular access for administration of additional intravenous fluids and medications. Health care providers especially nurses are always being challenged to improve the methods by which they provide safe and consistent vascular access to this vulnerable population. Some of these challenges had been overcome due to the rapid advances in understanding the neonatal growth, development, patho-physiology and treatment, in addition to the advances in medical technology (Petit & Mycoff, 2007).

Neonatal period refers to the period of less than twenty-eight days after birth (WHO, 2011). Wong (2011) divided neonatal period into early neonatal period and late neonatal period, the early neonatal period refers to the period before seven days of age, and the late neonatal period refers to the period from completion of seven days up to twenty-eight days of life.

Neonatal intensive care unit (NICU) to which the seriously ill neonate who requires specialized care for often admitted. NICU described by Buus-Frank et al (1996) is a special area of the hospital which combines advanced technology and highly skilled personnel trained in the art of neonatal intensive care to provide one-to-one nursing care for the seriously ill neonates; as well as a means for the graduation to one-to-three or one-to-four nursing care where neonates requiresless intensive care. The National Association of Neonatal Nurse Practitioners –

(NANNP, 2007)defined neonatal nursing as a subspecialty of nursing emerged in the 1970s, shortly after neonatology was recognized as a new science and a subspecialty of pediatrics. Further NANNP definedit as subspecialty of nursing that works with normal neonates, and neonates who are born with a variety of problems ranging from prematurity, birth defects, infection, cardiac malformations, and surgical problems to provide care, prevent complications, and to offer continuous monitoring of their health status. In addition to their clinical role the neonatal nurses has an educational role as they provide health education and consultation to the mothers and other family members since health education is a component of health promotion activities where the goal is to enhance and promote health(Freed et al. 2010).

In NICU's the use of intravenous cannula to provide treatment and nutrition is essential for neonates' recovery and survival; while many of these potent intravenous infusions may increase the potential for extravasation injuries (E.V.I.) which remains an important cause of iatrogenic injuries in neonatal intensive care units(Restieaux et al, 2013). Wilkins and Emmerson (2004) described E.V.I. as a non-intentional leakage of infused fluid into surrounding tissue; which may cause damage. Phillips, et al (2009) found that some of the commonly used neonatal infusions that may increase the potential for E.V.I. includes; total parenteral nutrition (TPN), calcium, potassium, bicarbonate, and dextrose in high concentrations; and some particular intravenous medications such as acyclovir, vancomycin, and inotropes like dopamine. In addition to the type and concentration of intravenous infusion there are other causes that may increase susceptibility to E.V.I. that will be discussed later.

Extravasation injuries among neonates may occur in the most closely monitored situations. E.V.I. remain uncommon, with an estimated incidence of 38 per 1000 neonates, with 70% of these injuries occurring in neonates of 26 weeks gestation or less according to a survey of

2

regional neonatal intensive care units (NICU's) in the United Kingdom (Wilkins and Emmerson, 2004), but this percentage may relatively low considering that the only regional NICU's in UK were surveyed.

Nurses are responsible for the provision of nursing care for neonates whether premature or un-well full term. Nurses clinical role encompasses provision of intensive care to neonates including insertion and care of the intravenous cannula and infusion lines, monitor I.V. fluids, total parenteral nutrition (TPN), and care of drugs on dropper machine and pump injectors like syringe pump (NANNP, 2012).

The NICU's in Palestine are distributed in governmental and non-governmental hospitals. The ministry of health provides health care services for all Palestinians including premature and well neonates. This study will be conducted in five governmental hospitals in North West Bank, the description of those hospitals discussed in the following part.

1.1. North West Bank Governmental Hospitals

In North West Bank there are five governmental hospitals; these hospitals contains NICU's with 62 nurses and 66 incubators according to the data in 2013 obtained directly from hospitals, the distribution of the nurses and incubators in each one of those hospitals illustrated in table (1.1) as following:

Table (1.1): Number of nurses and incubators in North West Bank governmental hospitals

Hospital Name	City	No. of incubators	No. of Nurses
Khalil Suliman	Jenin	18	18
Thabet Thabet	Tul-Karem	6	8
Rafidia	Nablus	32	24
Darwish Nazzal	Qalqilia	6	6
Yaser Arafat	Salfit	4	6
Total		**66**	**62**

The location of the NICUs differs in the five hospitals; in some hospitals the units were physically connected to the delivery, or gynecology and obstetrics departments, while in other hospitals are isolated units from other departments.

Harbarth, et al (1999) stated that one of the most important predictors of patient well-being is the amount of direct nursing care patients receive per day, the measure of nursing provision used is the patient–nurse ratio (PNR); this is the average number of nurses (calculated over a 24 hours period of shifts) and occupancy in terms of NICU census of midnight the previous day. Harbarth, et al (1999) also added that the international nursing standards recommend that nurse-patient ratio in neonatal intensive care unit should be 1:2 or 1:1. The PNR ratio in North West Bank governmental hospitals is higher and ranges from 1:7 to 1:10 (Forde, et al, 2010). Nurses in those units are not specialized in neonatal care due to lack of specific programs for neonatal nursing training. Instead, training of those nurses takes place on the ground in the course of their work, and their experience would be improved with focused NICU training.

1.2. Problem Statement

In neonatal intensive care units (NICU's) the use of intravenous access to provide nutrition and medication is essential for neonates' recovery and survival (Restieaux, et al, 2013).According to the Royal College of nursing (RCN, 2010) infusion therapy is significant part of the nurse's role and is referred to as an integral part of professional practice. Lavery(2010) added that intravenous cannulation and administration of I.V. therapy are seen as common nurses' practice in NICU's. Neonatal nurse defined as "a registered nurse who through study and practice becomes an expert in the care of newborns many of whom need extra attention and additional medical care" (Fox, 2011) pp 294-5.

Neonatal veins are small and fragile, and infusion lines are often required for long periods of time, this; in combination with a neonate's inability to communicate clearly like older children or adults this will increases their susceptibility to extravasation injuries which may occurs when fluid from an I.V. line leaks into the surrounding tissues or other extra-vascular space leading to tissue damage (Restieaux, et al,2013).Concerning the incidence of extravasation injuries Ramasethu (2004) found that the incidence of extravasations from intravenous catheters has been reported to vary from 23% to 63%.Thigpen (2007) reported that the degree of tissue damage due to extravasations is dependent upon; the volume of the infusate, its pH & osmolarity, the dissociation constant and pharmacological action of any drug being infused.

Higginson (2011) highlights a link between I.V. care delivered and a rise in complications risk. To minimize the complications of I.V. therapy especially extravasation injuries the nursing care of neonates requires proper procedures and techniques. Unfortunately there is no consensus on a proper procedure to standardize clinical practice of I.V. cannula and infusion line care and management, and there is lack of information regarding recognition, grading, prevention and

management of extravasation injuries. Also there is lack of education intervention programs and in-service education and training within the health care system for health care providers including neonatal nurses; in addition there are few specific training programs for neonatal nursing. Instead, training takes place on the floor in the course of their work.

There is lack of studies and information on the incidence and prevalence of extravasation injuries among neonates in NICU's in Palestine, and there is lack of research based treatments suitable for neonatal patients neither in West Bank nor in region, in addition there are no protocols for the prevention and management of extravasation injuries (E.V.I.). Only few reports (flagship project) done by USAID (Forde, 2010) on observation and recommendations regarding neonatal nursing at the NICU's of Rafidia hospital and the Palestinian Medical Complex in which there is a description of the structure of the NICU's, staffing, Nurse: patient ratio in NICU's.

In response to this problem, this study investigated several options for minimizing extravasation injuries through examining the effectiveness of nurses' education program on the care of intravenous cannula and infusion line to the neonatal nurses in North West Bank governmental hospitals. The researcher carries out an all inclusive participatory investigation into the practices that lead to minimize the incidence of extravasation injuries. Neonatal nurses in NICU's working in North West Bank governmental hospitals targeted for this study.

1.3. Significance of the Study

The purpose of this study was investigated several options for minimizing extravasation injuries through health education intervention program on the insertion and care of intravenous cannula and infusion line to the neonatal nurses working in North West Bank governmental hospitals. Thus, the results of this study will add knowledge to the field of health care and improve neonatal nursing clinical practice. In addition the findings may be used by health care professionals. This study is significant because it will provide nurses with the indispensable facts about the incidence, prevalence, causes, grading scales, and complications of extravasation injuries among neonates as well as prevention and management guidelines for insertion and care of intravenous cannula and infusion line since there were no studies done in this area regarding this matter.

This study will not only benefit the neonatal nurses but also the entire body of nurses as it will create a milieu of awareness about extravasation injuries and intervention protocols regarding the causes, prevention and management to minimize or prevent E.V.I.

This study utilized quasi-experimental design where intervention group compared with control group to assess the effectiveness of the health education intervention program therefore this study will be the basis for future plans of action by the administrators, and researchers. Furthermore, this study will serve as a theoretical model for future studies of the same nature. In addition, the future researchers will benefit from this study, and it will provide them the facts needed to compare their studies.

1.4. Conceptual and Operational Definitions of Study Variables

Neonates: The term neonatal comes from neo, "new", and natal, "pertaining to birth or origin". Neonatal period refers to the period of less than twenty-eight days after birth, the early neonatal period refers to the period before seven days of age, and the late neonatal period refers to the period from completion of seven days up to twenty-eight days of life (Wong, 2011).

Neonatal intensive care unit (NICU): is an intensive- care unit specialized in the care of ill or premature newborn infants. The first official ICU for neonates was established in 1961 at Vanderbilt University by Professor Mildred Stahlman, officially termed a NICU when Stahlman was the first to use a ventilator to assist a baby with breathing difficulties. A NICU is typically directed by one or more neonatologists and staffed by nurses and resident physicians (Fairman, et al, 2011).

Neonatal nurse: is a registered nurse who through study and practice becomes an expert in the care of newborns many of whom need extra attention and additional medical care. This type of nurse did not exist until the 1960s (Gatley, 1992).

Extravasation: Is the inadvertent leakage of a vesicant solution from its intended vascular pathway into the surrounding tissue. Extravasations injury can extend through the dermis to the hypodermis, muscle, or tendon tissues if not correctly managed (Gopalakrishan, et al 2012).

Infiltration: is the inadvertent leakage of a non-vesicant solution from its intended vascular pathway (vein) into the surrounding tissue (Doellman, 2009).

Vesicant: refers to any medication or fluid with the potential to cause blistering and severe tissue injury. Vesicant medications & solutions reported to cause extravasation injury like Antimicrobials, and Vasocompressive agents (Miller, et al, 2011).

Health Education: "any combination of learning experiences designed to facilitate voluntary adaptations of behavior conductive to health" (Green, et al, 1997).

1.5. Study Purpose and Objectives

1.5.1. Study purpose

The purpose of this study is to examine the effectiveness of health education intervention program to neonatal nurses working in NICU in North West Bank governmental hospitals on minimizing extravasation injuries among neonates. To achieve this purpose, the following measurable objectives were set:

1.5.2. Study Objectives

1. To asses knowledge and practice of nurses working in NICU's in North West Bank governmental hospitals on the proper procedure of insertion and care of intravenous cannula and infusion line at pre-test.

2. To asses knowledge and practice of nurses working in NICU's in North West Bank governmental hospitals regarding prevention and management of E.V.I. at pre-test.

3. To assess the health education intervention program effectiveness on prevention and management of E.V.I. among intervention group nurses through comparing pretest with posttest (Pretest – Posttest of the intervention group)

4. To assess the effectiveness of health education intervention program on the prevention and management of E.V.I. among intervention group nurses through comparing posttest intervention group with posttest control group (Posttest – Posttest Comparison).

1.6.   Research Question

This study will answer the following question:

Do educational intervention program makes a difference on (increase) knowledge and practice of nurses on minimizing extravasation injuries among neonates in the targeted units in the intervention group compared with the control group?

1.7.   Hypothesis

1. There is no significant difference at a level of< 0.05% in the nurses' knowledge and practices for I.V. cannula insertion and management among intervention and control groups as reflected in the posttest.

2. There is no significant difference at a level of < 0.05% in the nurses' knowledge and practices for I.V. cannula insertion and its management among intervention group nurses as a result of education intervention program at posttest when compared to pretest.

3. There is no significant difference at level of < 0.05% in the frequency of blocked cannulas among neonates in NICU's between intervention group and control group.

Summery

This first chapter provided an overview of the study background. It basically describes the problem statement, significance of the study, the purpose and the objectives of the study. Also it is includes the description of the neonatal intensive care units in North West Bank governmental hospitals.

Chapter Two

Review of Literature

Introduction

This chapter presents a review of literatures which is an objective, and critical summary of published research literature related to a topic under consideration for research (University of Melbourne Library, 2012). The reviewed literatures were relevant to the concepts, purpose and research question of the study. Also literatures related to the definition of E.V.I., incidence, signs and symptoms, grading scales, prevention, management history and recent management of E.V.I. were reviewed effectively too. The focus of this review was to assess neonatal nurses' knowledge, and practices to recognize, prevent and manage extravasation injuries of intravenous infusions among neonates in NICU's followed by the intended health education interventionprogram applicable to neonatal nurses. The conceptual framework of this study built on related literatures and the concepts of proper cannula insertion and care; in addition to the campaign for best practice in intravenous therapy "CLEAN IT" which used and discussed in details to answer the research question and to achieve its purpose and objectives.

This review of literature used as a guide for the development of the research tool, conceptual framework, and the health education intervention program that implemented for the intervention group with the guidelines to be followed by them. The organization of the sources presented is according to each topic. The literature search was complex and utilized different indexes like internet for health search at different websites like the Pub Med up to March 2014, nursing journals and the web of science up to May 2014, masters and PhD's thesis. In addition

Palestinian Universities such as Al-Quds and An-Najah Universities libraries, and Jordan University of Science and Technology (in Jordan) library have been utilized too for some of the books and journals used in this research. Some governmental departments' studies have been use too; such as the Palestinian Central Bureau of Statistics (PCBS), and Ministry of health (MOH) were also used.

2.1. Description of Extravasation Injuries (E.V.I.)

2.1.1. Identification of E.V.I.

The ability to insert intravenous (I.V.) cannula is an essential skill which performed mainly by nurses. By starting a peripheral I.V. we gain access to the peripheral circulation of a patient, which will enable us to sample blood as well as infuse fluids and I.V. medications. In addition I.V. cannula is essential to manage problems in all critically ill neonates (Lyon, 2005).

The I.V. cannula is one of the most common methods of delivering medications andfluids for replacement and nutrition in the neonatal intensive care units, but serious complications can result(Sawatzky-Dickson& Bodnaryk, 2006). Many preterm and ill full-term neonates in neonatal intensive care units (NICU's) requires intravenous nutrition and medications as part of their care and are particularly vulnerable to extravasation injuries (Irving, 1999).

Extravasation injuries defined as the non-intentional leakage of a drug or fluid from a vein into the surrounding tissue (extra-vascular space) during intravenous administration; that drug or fluid may cause damage to the surrounding tissue, nerves, tendons or joints or even skin necrosis

(MacCara, 1983; Irving, 2001; Weinstein, 2001; Allwood, 2002; Wilkins & Emmerson, 2004; Restieaux, et al, 2013).

Ramasethu (2004) defined it as "it is an inadvertent leakage of fluids into subcutaneous tissue from peripheral intravenous devices and said it is a common adverse event in newborns" (p.p. 492-493).Extravasation injuries are said to be a more severe complication because they involve the escape of potentially injurious solutions like blood or vesicant solutions like dopamine, and many chemotherapeutic agents from the vein into the surrounding tissues (Lamb, 2006).

Extravasation injuries and infiltrations are not synonyms; the major difference between infiltration and exreavasation is the type of fluid infused (Lamb, 2006). Sawatzky-Dickson& Bodnaryk (2006) also differentiate between extravasation and infiltration as he reported that when fluids administered intravenously leaks from the vein; it is defined as an infiltration, while when the fluid is toxic to the tissue; it is called an extravasation; which may cause tissue damage. Thigpen (2007) illustrated that infiltration and extravasation of intravenous fluids occurs when fluid comes out of the vessel, either by catheter dislodgement or erosion through the vessel; and both of them are complications of neonatal intensive care that results in varying degrees of morbidity.

2.1.2. Incidence, Causes, Signs and Symptoms of E.V.I.

Extravasation injuries may occur from the tip of the cannula or needle piercing the vessel wall, alternatively; distal obstruction of the vein due to thrombosis or venoconstriction from irritation of the vessel wall may lead to increased back pressure and leakage from the entry point of the needle (Ramasethu, 2004).

The rate of extravasation of intravenous fluid in routine infusions in neonates has been reported by Davies et al (1994) as 11%-58% in varying degrees, Ramasethu (2004) found that the incidence of extravasations from intravenous catheters has been reported to vary from 23% to 63%.Other report stated that the intravenous extravasations are estimated to occur in 11% of NICU patients (Thigpen, 2007).

Gault (1993) reported that E.V.I. depends on I.V. access location (central or peripheral); and elaborated that the infiltrate can cause damage potentially resulting in: skin loss, tendon and nerve damage, and limb amputation. Davies, et al (1994) illustrated that extravasation of intravenous infusion into the interstitial space may result from either displacement of the intravascular catheter or increased vascular permeability, some medications and infusions are more toxic to the veins than others. He further added that the mechanism of extravasations necrosis is not completely understood, but the degree of damage appears to be related to osmolality, pH and the dissociability of ions in the intravenous fluid.

Ramasethu (2004) found that the incidence of extravasations is related closely to the insertion site, duration of therapy, infusate administered, patient activity, and gestational age, the fragility of the skin, particularly in the first 2 weeks after birth, and the lack of subcutaneous tissue in preterm neonates makes them uniquely susceptible to injury and skin loss. Thigpen (2007) illustrated that extravasation injuries may involve deep tissue, including muscles and nerves, and if extravasation is next to a major artery in the forearm or leg, vascular flow can be obstructed and amputation required; he further added that the severity of damage depends on the volume and type of fluid or medication leaks into the affected tissue.

Age is a risk factor for E.V.I. particularly to those certainly very preterm neonates who are dependent on intravenous infusions for their survival are vulnerable to this type of injury; possibly due to need for smaller catheters and inability to communicate pain as an early warning sign (Garland et al,1992; Bellin, 2004; Wilkins & Emmerson, 2004; Gnanalingham, 2005). Most of E.V.I. occurs in neonates less than 26 weeks gestation, and this is most likely due to the immature skin of those neonates and the need for prolonged I.V. therapy (Wong, 1992; Thigpen, 2007).

The risk factors for E.V.I. may be related to the neonate himself due to inability to communicate due to his age, the technique of intravenous injection like the usage of power injector, less optimal injection sites including lower limb and small distal veins, large volume or high osmolarity of the vascient (Bellin, 2004).Neonates especially preterm are prone more to E.V.I. because they have the most immature skin which is easily damaged, their veins are small and fragile, intravenous lines are often required for long periods of time, and neonate's inability to communicate clearly increases the susceptibility to E.V.I. among them (Hadaway, 2000; Restieaux et al, 2013).

The sites most often implicated in E.V.I. include the dorsum of the hands, anticubital fossa, and near joints or joint spaces where there is little soft tissue protection for underlying structures, limbs with local vascular problems such as lymphoedema may have reduced venous flow causing pooling and potential leakage of infusates around the site of cannulation (Gault, 1997; Thigpen, 2007). Further Gault (1997) added that peripheral rather than central venous administration of chemotheraputic agents is more likely to be associated with frequent cannulation which is a risk factor for extravasation injuries which should be avoided.

A variety of commonly used intravenous fluids have been shown to cause significant tissue damage when infused out the veins such as antibiotics, chemotherapeutic agents, potassium, sodium bicarbonate, anticonvulsants and parenteral alimentation fluids containing calcium and dextrose saline of concentration greater than 10% which widely used to treat sick neonates (Wong, 1992; Gault, 1993; Chrystal, 1997; Kumar, 2001; Gnanalingham, 2005; Phillips, 2009). As well as some particular intravenous medications are also well known for their potential to cause extravasation injuries such as: acyclovir, vancomycin, and inotropes e.g. dopamine (Phillips, 2009).

Concerning the recognition of E.V.I., Weinstein (2001) reported that E.V.I. recognized if swelling, leakage or in-duration is visible from the cannula site, or if no blood returns via cannula, or if resistance is felt on the plunger of the syringe when drugs are given as a bolus and/ or reduction or absence of flow rate during an infusion. Sauerland (2006) found that a lack of blood return from the cannula is commonly quoted as a sign that E.V.I. has occurred, it is however, the most misleading of all signs and has been implicated in a number of serious incidents.

Brown (1979) reported that E.V.I. mainly occurs at night and go unnoticed. However, data from the National Extravasation Information Service green card reporting database shows that 44% of extravasations occur between the hours of 2pm and 10 pm, 10% occur between 10 pm and 6 am, and 38% occur between 6 am and 2 pm (Hawley, 2006); further he added that inexperienced personnel may pose a higher risk at any time, particularly during cytotoxic drugs administration.

2.1.3. Grading Scales for Assessing Damage of E.V.I.

Grading scales developed to assess and classify damage caused by E.V.I. in which the most severe complication present should determine the grade of the injury. Many authors present grading scales of the E.V.I. as present through revising the literatures, through comparison the external signs described in the most of those scales are indistinguishable.

Montgomery (1999) illustrates the grading scale that more accurately represents the concerns relating to neonatal population in whom those complications are most likely, Montgomery (1999) illustrates staging of E.V.I. into four stages and described the characteristics of each stage as following in table (2.1)

Table (2.1) stages of E.V.I. according to Montgomery (1999)

Stage	Characteristics
1	▪ Absence of redness and swelling. ▪ Flushes with difficulty.
2	▪ Slight swelling at site. ▪ Presence of redness. ▪ Good pulse below site.
3	▪ Moderate swelling above or below site. ▪ Blanching. ▪ Good pulse below extravasation site. ▪ Skin cool to touch.
4	▪ Severe swelling above or below site. ▪ Blanching. ▪ Pain at site. ▪ Decreased or absent pulse. ▪ Skin cool to touch. ▪ Skin breakdown or necrosis.

2.2. Prevention of E.V.I.

2.2.1. Strategies for Prevention of E.V.I.

Various strategies have been introduced in to reduce the risk of E.V.I. in preterm neonates including setting of central lines for the administration of TPN and infusions which contain glucose in concentrations greater than 10%.

It is clear that a number of techniques are being employed for prevention and monitoring of extravasation injuries like regular nursing observations and ensuring IV site visibility and Hourly recording of observations at the cannulation site for signs of edema, firmness or discoloration (Irving, 2001; Harris, et al, 2001; Hadaway, 2004;Jones, 2004;Ener, 2005; Restieaux, 2013).Sawatzky-Dickson (2006) reported that the management of I.V. extravasation injuries begins with prevention and the first step in prevention is to limit the amount of fluids administered through peripheral intravenous lines especially cytotoxic drugs; frequent observation of intravenous sites (at least hourly) helps to prevent injuries and limit tissue damage because the infusion can be discontinued at the first sign of extravasation. In addition Doherty (2010) recommended checking the IV cannula site hourly for redness, swelling, blanching and pain, and recording a description of these observations, to ensure the cannula site is not covered with clothing or blankets to allow for observation of the site.

Securing the cannula with a transparent dressing to allow unobstructed visibility at the insertion site, and suitable dressing to prevent movement of the cannula reported as important preventive measures of E.V.I. (Irving, 2001; Hadaway, 2004; Hadaway, 2005).Restieaux (2013) reported that it is clear that a number of techniques are being employed for prevention and monitoring of extravasation injuries like regular nursing observations and ensuring IV site visibility.

Hadaway (2004) illustrated that in order to prevent E.V.I. the nurse should; avoid scalp vein cannula where possible, and to use percutaneous long lines for long term calcium supplementation; however if calcium supplementation is only short term, this can be given via peripheral cannula, the site of which must be monitored closely.

Selection of a small-gauge catheter to minimize trauma to the vein and to let enough blood flow around the catheter to hemodilute the infused fluid; and this must be in an area where the device can be introduced easily and fastened securely, to select the vein puncture site carefully by using a distal vein so the nurse can perform successive proximal vein punctures if necessary, selection of an appropriate size catheter, use of appropriate fluids, stabilization of the catheter, and use of proper administration techniques were described measures to prevent E.V.I. (Jones, 2004;Ener, 2005; Hadaway, 2005; Infusion Nursing Standards of Practice, 2006)

The most appropriate site for intravenous cannulation is considered to be the forearm; however, it has to be accepted that this is not always going to be an available area, so the vessels in the dorsum of the hand are probably the next most appropriate location to consider; and as a general rule joints and creases should be avoided as these often represent a ''small'' anatomical space, with nerves and tendons present (Jones, 2004; Ener, 2005). In addition Hadaway (2005) recommended not to use the dorsum of the hand, the wrist, fingers, anticubital fossa, or other areas of flexion; previously damaged areas; and areas with compromised circulation, and not to probe for a vein.

Measures to prevent extravasation injuries also include careful insertion of peripheral venous cannula, gently flush the cannula with 5 to 10 ml of 0.9% sodium chloride solution before giving each dose of the drug, or every 1 to 2 hours for a continuous infusion, to reconfirm vein and catheter patency, while palpating the site for edema, aspirate from the catheter before injecting a

vesicant and to look for a blood returned, to hold the vesicant and asses the cannula placement if the nurse don't see blood return, and after the infusion complete to use 0.9% sodium chloride solution to flush the tubing and cannula, in addition regular inspection of the site and regulated delivery of intravenous fluids from continuous infusion pumps (Shah, 2005; Hadaway, 2005; Ener, 2005). Although lack of blood return doesn't always indicate extravasation injury likewise, the presence of blood return doesn't necessarily mean the cannula is properly placed (Hadaway, 2005). Additionally Hadaway (2005) recommends not administering a vasicant at an I.V. site that is more than 24 hours old; as the vein may already be irritated.

There are many studies discussed the usage of infusion pumps in the administration of intravenous fluids and medications to the neonates and its effect on extravasation injuries. Gault (1993) found that the occlusion alarms of positive pressure pumps may help to detect small rises in pressure suggesting an E.V.I. but such devices are not totally reliable. Irving (2001) illustrated that some infusion pumps have adjustable pressure limits that can be altered according to the patient, viscosity of the infused fluid and the length and bore of the tubing used, but he added that it should be noted that pumps which have preset alarm limits are often not sensitive enough to pick up early pressure changes in neonates; as initially there would be an increase in pressure due to resistance in the vessel, but this falls when the fluids are pumped into the surrounding tissue, as the vessels are very small in the neonate, so this change may be very subtle.

Shah (2005) reported that there are no universally agreed guidelines for pre-term neonates on what is an acceptable pressure for any particular weight or gestational age, cannulation site, rate of infusion, viscosity of the infused fluid and so on; this means that decisions regarding alarms tend to be subjective, which renders them virtually ineffective for accurate early detection of fluid leakage, and extravasation of infused fluids. Shah (2005) further added that those infusion

pump time which usually limited to an hour at a time may prevent the inadvertent leakage of a large amount of fluid before detection, but it is helpful to remember that although occlusion alarms on infusion pumps may be set to the lowest limit possible, increased pressure is not always registered. On the contrary other study stresses that there is currently no evidence that monitoring infusion pump pressures reduces the incidence of extravasation injuries (Gnanalingham, 2005).

Many literatures advised when infusion pump used to assess the intravenous site frequently for the correct infusion rate and pumping action and to set appropriate pressure limits for pumps that have this functionality, and to ensure the infusion pump is appropriate for neonates. And not use an adult infusion pumps, because the pump will continue infusing the drug even if extravastion occurs (Hadaway, 2006; Doherty, 2010). But recently, Clinical guidelines for peripheral I.V. device management for nurses stated in (2013) by the Royal Children's hospital in Melbourne stated that limiting the intravenous pump cycle to one hour may minimize the extent of tissue damage from extravasation providing the entry site is observed concurrently, but intravenous pumps do not always alert staff to an E.V.I. in progress.

2.2.2. Proper Procedures for Preventing E.V.I.

Intravenous cannulation, preparation, and administration of I.V. therapy is very much part of the nurses' role and is referred to as an integral part of the professional practice (RCN, 2010; Lavery, 2010; Curran, 2011).

Due to the identified risk and the wide spread use of I.V. therapy in NICU's; it is important to increase awareness of best practices and implement strategies to minimize the risk of E.V.I. For this purpose the professional development unit and infection prevention and control team at

Walsall Healthcare Trust developed and implemented a trust-wide education-based focus campaign, the campaign used a simple acronym – CLEAN IT - to describe and raise awareness of best practices of I.V. care and management (Baldwin, 2013). Each letter relates to a particular step in the I.V. therapy as described in the following table:

Table (2.2): The "Clean it" key messages of Walsall Healthcare Trust campaign

C	Cannula	1. Cannula site cleaned for a minimum of 30 seconds and allowed to dry before device inserted
		2. Cannula site cleaned with a chlorhoxidene – based product
		3. Cannula insertion and management using an aseptic non-touch technique.
		4. Cannula removed within 72 hours of insertion or record reason for prolonged dwell time
L	Line	1. Line labeled on use
		2. Line disposed of after disconnection and not left hanging between infusions.
		3. Line managed with an aseptic non-touch technique.
E	Evaluate	1. Evaluate patency of the cannula on use
		2. Evaluate the effectiveness of treatment daily; discontinue when no longer required.
A	Assess	Assess cannula site and record findings on the appropriate chart.
N	Note	1. Note the date and time of insertion of cannula
		2. Note any signs and symptoms of IV complications
IT	IV Therapy	1. Intravenous therapy given using aseptic technique
		2. Intravenous therapy flushed pre and post administration

In addition to the best practice campaign "CLEAN IT" the researcher reviewed many literatures regarding care of peripheral venous access of neonates. Since early identification is crucial, in order to circumvent any adverse outcomes Doherty (2010) suggested simple steps to follow when caring for a peripheral venous cannula site of neonates including the use of limbs in

preference to the scalp, with upper limbs in preference to lower limbs, to ensure a nurse is available to assist with cannulation and taping; while using transparent IV dressing recommended.

2.3. Management of Extravasation Injuries

Differing theories and protocols for early management of E.V.I. have been published over the years. Chandavasu et al (1986) suggested that multiple puncture wounds should be made in the affected limb and the extravasated fluid squeezed out, thus reducing the potential for damage.Beason (1990) recommended cooling the affected area to prevent spread of the irritating fluid and so reduce tissue damage. ConverselyGermain et al (1994) as cited in (Irving, 2001) found that heat applied to the area would cause vasodilation and encourage the spread and dilution of the damaging fluid.

The best management approach should be preventative and requires hyper vigilant monitoring of the intravenous site (Patnaik, 2004). The treatment required for E.V.I. depend on the drug extravasated, the site and extent of the injury and the gestation of the neonate (Casanova et al, 2001); further he added that management started with; stop the intravenous infusion and take the I.V. device out after an attempt has been made to aspirate the area through the device. Although most E.V.I. resolves spontaneously after the I.V. catheter is removed, I.V. extravasations and tissue sloughing do occur in NICU patients, so the goal in managing tissue damage after E.V.I. is to improve tissue perfusion and prevent progression of tissue necrosis (Thomas, 1997; Thigpen, 2007).

Many studies and reports illustrates that there is no universal, national or even regional agreement on the best practice for managing E.V.I., and each NICU tends to have its own

preferred method, this is despite the fact that there is limited evidence to support the use of any particular dressing in the preterm population (Gault, 1993; Davies, 1994; Wilkins and Emmerson,2004).

Gault (1997) illustrated that stopping the infusion is a common sense, and aspiration through the cannula in an attempt to remove some of the retained material has been recommended but in practice, achieves little as subcutaneous fat usually clogs the cannula. Ener (2004) commented that any signs or suspicion of E.V.I. should be assumed to have occurred and the infusion should be stopped. Bellin (2004) also reported that conservative management is adequate in most cases which include: limb elevation, apply of hot and cold compresses, and careful monitoring, since elevation of the affected limb is often useful to reduce edema by decreasing the hydrostatic pressure in capillaries, and application of heat compresses produces vasodilatation and thus re-absorption of extravasated fluid and edema, and cold compresses produces vasoconstriction and limits inflammation.

Sawatzky-Dickson (2006) illustrated that in spite of good evidence in favor of advanced wound management methods but the management for tissue damage has not been standardized, further he – the author -added that injury management varies from leaving the wound open to air and allowing it to dry out to treating with gauze dressings; leaving the wound undressed further jeopardizes healing by increasing the risk of further trauma to the damaged tissue caused by the infant moving the limb, also he added that warm compresses provide a symptomatic relief by reabsorbing infiltrating solutions due to local vasodilatation.

E.V.I. when occurs should be considered an emergency and any protocol should include immediately stop the infusion and disconnect the tubing to attach a syringe to the hub of the cannula and attempt to aspirate the remaining drug from it, then remove the cannula without placing pressure on the site, elevate the affected arm, and to photograph the site if possible, in addition the date, type, and time of the infusion, in addition to the size of the cannula, and the drug administered should be documented (Doellman, 2009),further he advised to apply either ice packs or warm compresses to the affected area, depending on the type of vesicant; for most extravasations the nurse will apply ice for 20 minutes four to six times a day for 24 to 48 hours, however treat extravasations from alkaloids and vasoconstricting drugs with warm compresses.

Despite the growing literature in wound management procedures, it appears to be little consensus between units and countries on how E.V.I. should be prevented and/or treated with much of the available evidence coming from case reports and clinical reviews and no studies have been done looking specifically at current practice across NICU's (Restieaux, et al, 2013). Guidelines for the management of E.V.I. stated by the Royal Children's Hospital in Melbourne (2013)according to the grade of the injury; since most extravasation injuries are of Grades 1 and Grade 2 and do not require extensive intervention to prevent long-term skin and soft tissue damage. Grade 3 & 4 injuries have a greater potential for skin necrosis, compartment syndrome and need for future plastic surgery, depending on the type of solution extravasated, and they put guidelines for management of extravasation injuries as described on table (2.3) below.

Table (2.3) Guidelines for management of extravasation injuries described by Royal Children's hospital

Grade 1	Grade 2	Grade 3	Grade 4
Stop infusion	Stop infusion	Stop infusion	Stop infusion
Remove cannula and splints / taps	Remove cannula and splints / taps	Leave the cannula in situ until review by physician	Leave the cannula in situ until review by physician
Elevate limb	Elevate limb	Consider irrigation of affected area	Photograph lesion – providing no delay in further treatment
		Remove constricting taps	Irrigate affected area
		Elevate limb	Elevate limb
			Inform neonatal consultant

2.4. Conceptual Framework

The original purpose of this study was to provide neonatal nurses with guidance for best practices and skills to minimize E.V.I. among neonates, and to underpin this with a theoretical and conceptual point of view. Literatures' identified early on in this study concerning the neonatal nurses practices regarding insertion and care of intravenous cannula and infusion line to minimize E.V.I., also prevention and management of E.V.I. were also investigated in more details earlier.

This part presents the conceptual framework and showed the usefulness of the literatures in the development of effective health education intervention program to the neonatal nurses to minimize E.V.I. among neonate. Smyth (2004) described some of the functions of a conceptual

framework to be "a tool to scaffold research and, therefore, to assist a researcher to make meaning of subsequent findings" and also that the framework "forms part of the agenda for negotiation to be tested, reviewed and reformed as a result of investigation".

In exploring the literatures, a range of different literatures were read, the criteria for including them being only that they discussed the proper procedures for insertion and care of the intravenous cannula and infusion line. As the literature review continued, other linked concepts were added, such as the grading scales of the E.V.I., signs and symptoms, prevention and management of the E.V.I., and then these concepts linked together.

In summary then, a framework can further research through (Conole et al, 2005):

- Providing a basis from which to interpret and form a coherent whole from further literature.
- Structuring evaluation activities.
- Integrating various factors involved in the design
- Enabling the articulation of the findings.
- Organizing the inclusion of any emergent categories.
- Providing a shared ground with other researchers for them to reflect upon and challenge the structure of the research.

2.4.1. Overview of the framework

The conceptual framework comprises five categories, which are:

a. **Category 1:** The Nurses' skills and practices.

Because of financial constraints in governmental hospitals not all consumables and devices needed to use according to the guidelines are offered by the Ministry of Health like transparent dressing and pressure sensitive syringe pumps. But whatever the case; care of the cannula and infusion line for safe administration and infusion of the medications and intravenous fluids should be comprehensive but this could not happen sometimes, their economic factor appear to form a serious constraint and should be considered.

Initial data were collected through a structured questionnaire (pretest), to measure the nurses' knowledge and practice about the intravenous cannula insertion and care of infusion line, distributed before the educational intervention program to assess the needs for education and training.

Thus, the first stage served as assessment of nurses' knowledge and practices, and the gaps included in the educational materials that nurses needs for their practice in intravenous cannula insertion and care of infusion line.

   b. **Category 2:** The signs and symptoms of the E.V.I. (Part 2.1.2. page 14).

   c. **Category 3:** The proper procedure for the insertion and care of the I.V. cannula. (Part2.2.2. page22).

   d. **Category 4:** The prevention strategies of the E.V.I. (Part 2 .2.1. page19).

   e. **Category 5:** The Nursing management procedures of the E.V.I. (Part 2.3. page24).

Figure (2.1): The interconnection between framework elements
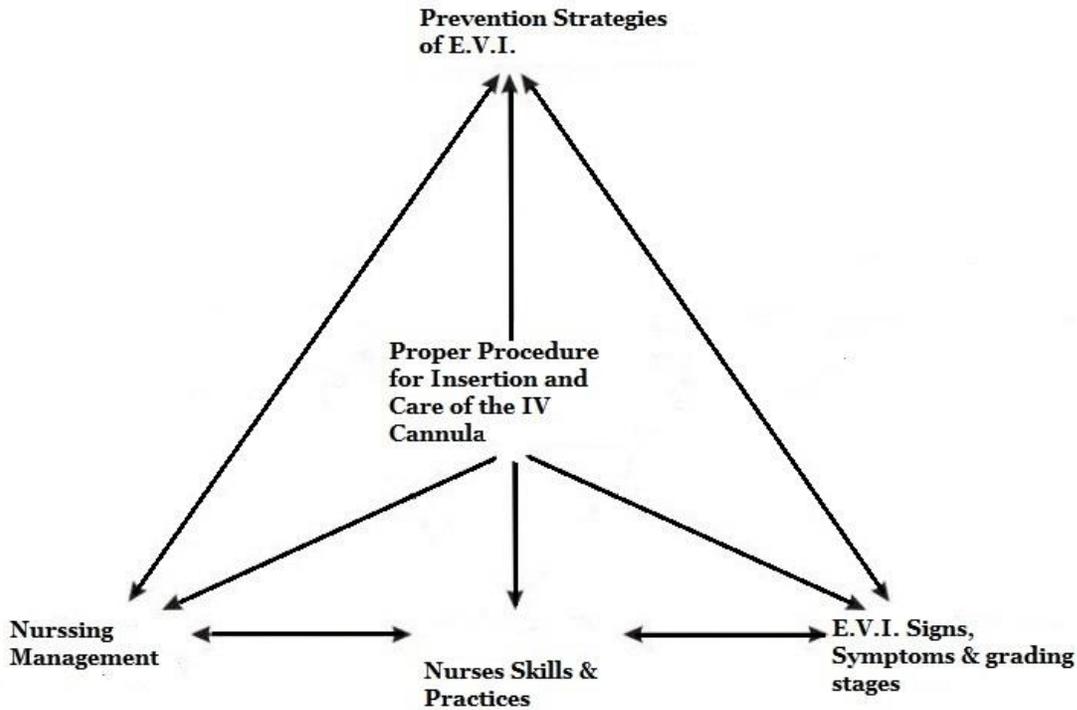
2.4.2.   The Educational Intervention program based on this conceptual framework as best practice for E.V.I. prevention and management

The goal of this educational program was to guide and enhance the skills and practices of the neonatal nurses working in NICU's in North West Bank governmental hospitals on the proper procedure to insert and care of the I.V. cannula and infusion line in order to minimize extravasation injuries among neonates.

To structure the design and implementing the health education intervention program about proper procedure of insertion and care of the I.V. cannula and infusion line in order to minimize

extravasation injuries among neonates, researcher distinguishes the five categories of the conceptual framework in more details (Refer to Part 4.2. Page 61).

Summery

This first chapter provided an overview of the literatures related to the study. It basically describes the extravasation injuries, its causes, signs and symptoms, grading scales, Nursing prevention and management. Also it includes the description of the proper procedure for intravenous care and management to prevent and minimize the extravasation injuries; in addition it describes the conceptual framework.

Chapter Three

Research Methodology

Introduction

This chapter describes the research methodology that used for this study which includes design, setting, population, sampling approaches and sample size, sampling method, research tool, data collection, and data analysis procedure. Moreover it presents the validity and reliability of the instrument that used for data collection and methods of data analysis, limitations of the study, and the ethical considerations.

3.1. The Study Design

The purpose of this study was to examine the effectiveness of health education intervention program to neonatal nurses in North West Bank governmental hospitals on minimizing E.V.I. among neonates. The researcher used quasi-experimental design to examine the relationship among the dependent and the independent variables and use a structured instrument to collect information. This quasi-experimental study utilized multiple comparisons to detect the effectiveness of the educational intervention through pre- and post- tests.

Quasi- experimental research design as described by Polit, Beck, & Hungler (2001)"it is like experimental design; intervention, control group and randomization, but lack either the randomization or control-group features that characterize true experiments, or both-features that strengthen the ability to make causal inferences" page 175.

32

This study lacks the random selection procedures since the neonatal nurses' sample selected was convenient and confined to the governmental hospitals NICU's in North West Bank. All targeted nurses in the five hospitals received the pretest and posttest; nurses in Jenin, Qalqilia, and Salfit governmental hospitals received the educational intervention program, while nurses in Rafidia, and Tulkarm governmental hospitals are the control group and did not received any educational intervention program.

To analyze the results for the differences between pre and post tests, quantitative approach used in this study because it emphasizes objectivity in the collection of data and analysis of information. It also allows analyzing data using numerical information through statistical procedures.

3.2. Study Setting

In West Bank there are three types of hospitals: public or governmental (responsible for provision of health care to the majority of Palestinian people), private (belongs to individuals or companies as investment), and hospitals managed by the United Nations Relief and Work Agency for Palestinian Refugees (UNRWA) and those managed by charitable societies. Based on the given facts, the availability of nurses, feasibility and time constraints; the study targeted nurses in North West Bank governmental hospitals.

The study conducted at NICU's in North West Bank five governmental hospitals; Khalil Suliman hospital in Jenin, Rafidia hospital in Nablus, Thabet Thabet hospital in Tulkarm, Darwish Nazzal hospital in Qalqilia, and Yaser Arafat hospital in Salfit. Those hospitals are equipped with 66

incubators and runned by 62 nurses were the application and care of intravenous access is one of nurses' job duties.

3.3. Study Population

The target population of this study was the total number of nurses working in neonatal intensive care units (NICU's) in the five governmental hospitals in North West Bank working with 66 incubators. NICU nurses in Jenin, Qalqilia, and Salfit governmental hospitals were intervention group, and NICU nurses in Rafidia, and Tulkarm governmental hospitals were control group.

The researcher has limited the study sample to governmental hospitals to have similar characteristics of the study population (have the same equipments and following the same polices and procedure), and to minimize the extraneous variables and external differences such as the unit preparation and assets of consumables and devices, as well as to increase the level of internal validity by having the similar settings.

The design of the study required three stages: first stage; the data collection (the pre-test or baseline data) from five NICU's nurses. For the second stage; the intervention stage was implemented for nurses in three hospitals which were Jenin, Salfit, and Qalqilia hospitals. This intervention was based on the results of the baseline data and concerns resulted from the analysis of the pre-test data. The health education package was developed by the researcher where the term intervention used means the health education activities carried by the health educator.

The intervention was introduced by a nurse who has experience in nursing education and NICU nursing care. The intervention was done in the presence of the researcher of the study to ensure

consistency and to check the quality of intervention and to control for any bias. The third stage; the post intervention data collected from the 5 NICU's nurses. A comparison of both groups under the different conditions, in which each group was assigned for, at either intervention or control group for the pre-test or the intervention and for those who did not have intervention.

3.4.   The Sampling Method and Approach

Non-probability sampling is less likely than probability sampling to produce accurate and representative samples; it is used in most nursing studies because the advantage of these sampling designs lies in their convenience and economy, in addition convenience samples are inexpensive, accessible, and usually less time-consuming to obtain than other samples (Polit, Beck, & Hungler, 1995). There are three primary methods of non-probability sampling are convenience, quota, and purposive (Polit, & Beck, 2003).

Sample size is the number of subjects in a sample, and it is a major issue in conducting and evaluating the quantitative research (Polit, Beck, & Hungler, 2001). Further they added that there is no simple equation to determine how large a sample is needed. In this study the researcher used a non-probability purposive sampling method.

Since this method - purposive sampling - based on the assumption that researcher's knowledge about population can be used to hand pick the cases to be included in the sample (Polit, Beck, & Hungler, 2001), so the researcher decided purposely to select the widest possible number of participants because he needs all nurses who are working in NICU's in North West Bank Governmental hospitals due to their limited number.

For the purpose of assigning the NICU's nurses into control and intervention group the researcher used purposive sampling which is based on the belief that researchers' knowledge about the population can be used to hand-pick sample members. Researchers might decide purposely to select subjects who are judged to be typical of the population or particularly knowledgeable about the issues under study (Polit, Beck, & Hungler, 2001).The researcher purposefully assigned the nurses working in the 5 NICU's as control and intervention group to have equal number for both groups participants. As a design strategy, this does not alter the risk of biases resulting from convenience sampling but strengthen the equivalence of the study groups. The total number of neonatal nurses in the five hospitals were 62 but 6 of them did not fill the questionnaire (5 of them were in vacations and maternity leaves and the other 1 nurse refused to fill the questionnaire), So a total of 56 nurses, with 28 nurses working in Jenin, Qlqilia, and Salfit governmental hospitals as intervention group, and 28 nurses working in Rafidia and Tulkarm governmental hospitals as control group were included in the study.

One straightforward way to increase the generalizability of a study is to select study participants from two more sites, such as from different hospitals, nursing homes, communities, and so on. Ideally, the two different sites would be sufficiently divergent that broader representation of the population would be obtained (Cormack, 2000; Polit, & Beck, 2003).For this reason, this study chose five hospitals to have the broadest sense of representativeness.

3.5. Research Instrument

The study instrument is a structured questionnaire developed by the study researcher and introduced to the targeted nurses. The questionnaire is composed of items related to socio-demographic characteristics of the participants and work experience, Nurses knowledge regarding E.V.I., and Nurses practices for cannula insertion and care and care of the infusion line.

Prior to the development of the instrument, the researcher has revised many international tools, some of those tools used as a reference guide for the development of this study instrument, while others gave insight to the broader aspect of the neonatal nurses knowledge and practices in NICU's.

One of these international tools revised was "Extravasation injuries among neonates" (Restieaux et al, 2013). This survey aimed at describing current extravasation policy in Australia and New Zealand NICU's, this tool is used as a resource for the researcher to develop the questionnaire, and it was a reference in adopting and modifying some of its items to be included in this study instrument. Altogether these tools have helped the researcher to develop questionnaire required to answer this study purpose, objectives and research question. Also, it was based on the study concepts and conceptual framework, and it was developed in English language. The questionnaire items were arranged under the following three categories:

I.   Socio-demographic data of nurses and NICU's settings.

II.   Items reflected nurses' knowledge and application of NICU's policies and procedures.

III. Items reflected the neonatal nurses' practices for cannula insertion and care in NICU's.

Category I, the socio-demographic and background data included name of the hospital the nurse working in, Nurses' educational level, gender, experience years, NICU experience, age, double shifts working, items related to gestational age, weight, time of stay of neonates admitted to NICU, also included two questions about number of neonates assigned daily to the nurses (workload), and the physicians assigned to the NICU.

Category II, knowledge of nurses and NICU protocols regarding E.V.I. the items arranged in a Likert scale of 3-point response format, this format was organized as; "Yes, No, Don't Know".

Category III, Nurses practices for cannula insertion and care in NICU, this category included items about the insertion and care of the I.V, cannula, common sites used to apply I.V. cannula, frequency of checking and changing cannula, method of securing and examining the cannula, another set of items were about complications of E.V.I. including swelling, redness, blockage, absence of backflow, the shift at which the cannula problems occurred, and items about the steps followed for early recognition and prevention of E.V.I.

3.6. Validity of the Questionnaire

Validity defined as it is the degree to which an instrument measures what it is supposed to be measuring (Polit, Beck, & Hungler, 2001). Also validity of an instrument is a determination of how well the instrument reflects the abstract concept being examined, in view of the fact that no instrument is completely valid (Burns and Grove, 2007).

The content validity of study questionnaire was established by distributing the questionnaire to experts including the research advisor; others were three lecturers in Palestinian universities who

are experts in nursing research; one of them was from Arab American University and the others were from An-Najah National University, one pediatrician working at Jenin governmental hospital, and one expert nurse in neonatal field, all those was examined the instrument and evaluated the initial contents. After revising the feedback from experts, the required changes made by the researcher of the study were adding or deleting some items needed. The tool was developed in English language and was revised and modified by the advisor and corrected according to her comments, and so the data collected in English language; there were no difficulties with nurses as their study in English.

To assess for working, adequacy, and coverage of items to the aspects of insertion and care of intravenous access and take their recommendations. To evaluate item clarity and response variance and to estimate the questionnaire reliability, a pilot testing was conducted.

3.7. Reliability of the Questionnaire

Reliability refers to the consistency with which an instrument measures the attribute; for example, if a spring scale gave a reading of 120 lb for a person's weight one minute and a reading of 150 lb the next minute, we would naturally be wary of using such unreliable scale (Polit, Beck, & Hungler, 2001). The less variation an instrument produces in repeated measurements of an attribute, the higher is its reliability. In addition Burns and Grove (2007) added that reliability is concerned with the consistency of the measurement technique. It takes into account such characteristics as dependability, consistency, accuracy, and comparability. Cronbach's Alpha coefficient is the most commonly used measure of reliability, so for this study

Cronbach's Alpha coefficient was around 0.70 which was calculated after the questionnaire distributed to the original sample (pilot testing).

3.8. Data Collection

Prior to the collection of the data, a pilot testing was conducted on fifteen neonatal nurses in which it allowed the researcher to evaluate items clarity and response variance and to estimate the questionnaire reliability, so those nurses' comments revealed that the questionnaire word and items was clear to them. Pilot testing helps predict the expected findings of the study and provides data to indicate the proposed study will produce the expected results (Talbot, 1995). The study design and study objectives required two data collection and two data analysis: the pre-intervention data and the post-intervention data.

The data was collected by the researcher himself by a structured questionnaire that was distributed among study population/ participants on pre and post test to evaluate the effectiveness of the intervention and pretesting strategies implemented for this study.

3.9. Data Analysis Procedures

Two data analysis were required too; for the first data (pre-intervention data) interpretation and discussion of the results are presented in the next chapter. The analyses have utilized the Statistical Package for Social and Sciences (SPSS) computer analysis for the two sets of the data version 18.

3.9.1. The Pre-intervention Data Analysis

The pre-intervention data analyses were conducted on 52 questionnaires. The quantitative data includes 35 items organized under three categories (demographic data, knowledge of the nurses, and practices of the nurses in their units). Eight items were ranked in a Likert scale under three measures. Ranking of items is a way of analyzing an issue in order to distinguish the relative importance of different aspects of the issue investigated (Brink and Wood, 1998). The data were computer analyzed by the SPSS system. And statistical level of significance used was 0.05.

3.9.2. The Post-intervention Data Analysis

Descriptive statistics were utilized to analyze the demographic characteristics of participants at pre-test and post test in frequencies and percentages. The T-test for independent group was the statistical techniques used to assess the difference between the groups' scores. The T-test for independent groups was utilized to compare differences between two group means, at pre-test to assess for the quality of the groups at the onset of the experiment. Also to compare for differences between each two groups on the post test for effects of pre-test, and the health education intervention.

To evaluate for effectiveness of the intervention and to answer the research question in an experimental research design, three distinct assumptions were concluded from Brink and Wood (1998) to measure the effectiveness of the program implemented; (1) the use of methods and tools of research that can be applied in an action setting "action research", (2) when the research question ask about effectiveness as the case of this study, and (3) when the research study incorporate some of the control techniques while using both quantitative and qualitative data

methods. This study have met these criteria and thus allowed to explain the analysis of the data as a result of the research design.

3.10. Ethical Considerations

The title and the research methods were approved by the higher studies nursing committee which allowed passing the first part of the thesis. Then as second step the higher studies council at Al-QUDS University approved it.

Ministry of health approached regarding study steps where they informed of the research and gave permission of involving nurses in NICU's in the study and allowed implementing the health education intervention program for the NICU's staff in the three governmental hospitals.

For the purpose of maintaining ethical and legal standards, every participant in the study received an explanation about the purpose of the study, confidentiality of the study through an informed consent attached with each questionnaire; in which the letter of agreement includes information about the nature of the study, why it is to be conducted and a statement assuring voluntary participation. Participants were assured that anonymity and confidentiality maintained at all stages of data collection.

3.11. Limitations of the Study

1. One of the most important limitations of this study worth mentioning was the lack of studies regarding neonatal extravasation injuries in local and regional areas. In addition, the main access that contained related literature provided by A-QUDS University was the

Toronto University access which provided a limited number of literature related to this topic. Therefore some difficulties have encountered the researcher in reviewing literature and writing the proposal of this study.

2. Health education requires time, resources, and consistency in education to affect the learners (Kiger, 1995). Since this study is limited to time, so this may not help in having a long time effect.

3. Data collection completed through a self administered questionnaire in which information obtained was what is asked and explained in the questionnaire, so there is always possibility that important unknown dimensions can be overlooked. In addition, the data collection of the questionnaire was lengthy, since self-administered questionnaire have taken time from both the researcher and the participants.

4. The fact that pretest-posttest design in the intervention group is a strong design, yet it does have some disadvantages and limitations. The main disadvantage of this design is the amount of time and resources required to conduct the study correctly. With the limited resources and time required to conduct this study by the researcher, there was a delay in research process. One of other disadvantages of this design is limited generalizability of the results.

Chapter Four

Data Analysis and Findings

Introduction

This chapter presents the analysis, main findings, interpretation and discussion of the results of the study using descriptive and inferential analysis. The study participants consisted of 52 nurses working in five NICU's in five governmental hospitals in North West Bank.

The descriptive statistics represents the participants' socio-demographic characteristics. The responses are ranked in ordinal measure for frequency, and percentages are presented in tables.

The inferential statistics used to test hypotheses. The t-test for independent group was the statistical techniques used to assess the difference between the groups'. According to Polit and Beck (2003) the parametric procedure for testing differences in group means is the t-test. The t-test can be used when there are two independent groups (e.g. experimental vs. control), and when the sample is paired or dependent (e.g. pre-treatment and post-treatment scores compared for a single group).

4.1. Pre-Intervention Data Analysis

The methodology of this study required two data collections and two data analyses to meet the purpose and objectives of the study, and to answer the research question of the study. The following data analysis represents the pre-test results for all targeted nurses participants (both the control and intervention groups working in NICU's in five governmental hospitals in North West

Bank). Four questionnaires were dropped out from analysis because they were not completed, six nurses from the total of 62 nurses did not fill the questionnaire (five of them were in vacations and the other one nurse refused to fill the questionnaire), and therefore 52 questionnaires were analyzed.

4.1.1. Analysis of category I- Part I

Socio - Demographic Characteristics and Work Experience in NICU for All Study Participants

Table (4.1) represents the participants' distribution according to their work place, education level, gender, age, years of experience, experience years in NICU's, and workload (double shifts). For the work place 36.5% of study participants work in Rafidia hospital, 25% work in Jenin Hospital, 13.5% from Tulkarm hospital, 13.5% from Qalqilia hospital, and 11.5% from Salfit hospital.

The participants are also distributed into intervention and control groups; nurses in Jenin, Qalqilia, and Salfit hospitals were the intervention group and represent 50% of the total population. Rafidia and Tulkarm hospitals were the control group and represent 50% of the total population, with the majority 86.5% are females and 13.5% are males. Also it is apparent that the majority of the participants were less than 40 years of age; 53.8% were less than 30 years, 34.6% age ranged between 30-40 years, and 11.5% only are older than 40 years, which means the NICU nurses' teams are at young age group.

The findings indicated that 46.2% of the NICU's nurses had bachelor degrees, 28.8% were practical nurses had diploma degree in nursing, 21.2% had high diploma degree in nursing, and

3.8% of them had master degree; those findings indicated a very good educational background of NICU's nurses.

Regarding work experience; around 53.8% have all their experience in NICU since graduation while the rest 46.2% are not, 50% of the participants have experience of 5-10 years, 26.9% worked less than 5 years, and 23.1% worked more than 10 years. The question on double shifts work indicated that 55.8% of the surveyed nurses have worked double shifts at least once per week.

The findings in table (4.1) indicated that the two study groups (intervention and control group) were similar in their characteristics described below.

Table (4.1): Summery of the socio-demographic characteristics of the participants – both the control and intervention group - (total of 52 participants)

Variable	Group	Intervention group		Control group		Total of Freq. for both groups	% of the total Freq.
		Freq.	%	Freq.	%		
1. Education level	Diploma degree (practical nurse)	8	30.8	7	26.9	15	28.8
	Bachelor degree (Registered nurse)	13	50	11	42.3	24	46.2
	High Diploma degree	5	19.2	6	23.1	11	21.2
	Master degree	0	0	2	7.7	2	3.8
	Total	26	100	26	100	52	100
2.Gender	Male	4	15.4	3	11.5	7	13.5
	Female	22	84.6	23	88.5	45	86.5
	Total	26	100	26	100	52	100
3. Age	less than 30 years	16	61.5	12	46.2	28	53.8
	30-40 years	8	30.8	10	38.5	18	34.6
	more than 40 years	2	7.7	4	15.4	6	11.5

		26	100	26	100	52	100
	Total	**26**	**100**	**26**	**100**	**52**	**100**
4. Years of experience	less than 5 years	**8**	**30.8**	**6**	**23.1**	**14**	**26.9**
	5-10 years	**13**	**50**	**13**	**50**	**26**	**50**
	more than 10 years	**5**	**19.2**	**7**	**26.9**	**12**	**23.1**
	Total	**26**	**100**	**26**	**100**	**52**	**100**
5.Years of experience in NICU	Yes	**14**	**53.8**	**14**	**53.8**	**28**	**53.8**
	No	**12**	**46.2**	**12**	**46.2**	**24**	**46.2**
	Total	**26**	**100**	**26**	**100**	**52**	**100**
6.If the nurse make double shifts during last week	Yes	**17**	**65.4**	**12**	**46.2**	**29**	**55.8**
	No	**9**	**34.6**	**14**	**53.8**	**23**	**44.2**
	Total	**26**	**100**	**26**	**100**	**52**	**100**

4.1.2. Analysis of category I- Part II

Study setting, neonates' characteristics and professional caring for them for all groups.

This part of the questionnaire analysis presents the participants experience and work load with

neonates in their units presented in table (4.2) below. For gestational age; 36.5% of the neonates

admitted to NICU's were 26 weeks and above, 26.9% were 24 weeks and above, 25% were 30

weeks and above, and 11.5 % were 28 weeks and above.

For neonates body weight; 40.4 % weight were less than 1000 gram, 30.8% weight varied from

1000 gram up to 2000 gram, 17.3% weight were varied from 2001- 2500 gram, and 11.5%

weight more than 2500 gram. For neonates' average stay in NICU's; 46.2% of the admitted

neonates average stay were 4 weeks and more, 25% stay 2 weeks, 19.2% stay 1 week, while

9.6% stay 3 weeks.

Regarding the participants workload in each shift; the data indicated that 44.2% of nurses were assigned to care for 6-7 neonates, 25% were usually assigned to care for 8 neonates or more, 21.2% were assigned to care for 4 or 5 neonates, and only 9.6% were assigned to care for 3 neonates or less. These results showed that the nurse-neonate ratio is not suitable for the nurses assigned to provide the optimum care for the neonates; since the international nursing standards recommend that nurse: neonate ratio in neonatal intensive care unit should be 1:2 or 1:1 (Harbarth, 1999), the nurse: neonate ratio in the surveyed NICU's is not congruent with the international standards and recommendations which eventually may lead to exhaustion, and this in turn will affect the quality of nursing care provided to the neonates in NICU's including the insertion, follow up and care of the I.V. infusions.

For the number of physicians usually assigned to provide medical care to the neonates in NICU's; 73.1% indicated that only 2 physicians, 21.2% indicated that 3 physicians, 3.8% indicated that 4 physicians, and 1.9% indicated that 5 physicians provide the medical care to the neonates in the NICU's.

The results indicated no differences in NICU's in terms of neonatal characteristics and professional caring for them, since the researcher chose the five NICU's with similar conditions as the five units in governmental hospitals and located in North West Bank.

Table (4.2): Neonates characteristics and professional caring for them (total of 52 participants).

Variable	Group	Intervention group		Control group		Total of Freq. for both groups	% of the total Freq.
		Freq.	%	Freq.	%		
1. Minimum gestational age admitted to the unit	30 weeks and above	9	34.6	4	15.4	13	25
	28 weeks and above	3	11.5	3	11.5	6	11.5
	26 weeks and above	8	30.8	11	42.3	19	36.5
	24 weeks and above	6	23.1	8	30.8	14	26.9
	Total	**26**	**100**	**26**	**100**	**52**	**100**
2. Neonate's weight on admission to NICU	Less than 1000 gm	7	26.9	14	53.8	21	40.4
	1000 gm – 2000 gm	9	34.6	7	26.9	16	30.8
	2001 gm – 2500 gm	6	23.1	3	11.5	9	17.3
	More than 2500 gm	4	15.4	2	7.7	6	11.5
	Total	**26**	**100**	**26**	**100**	**52**	**100**
3. average time for neonate stay in the unit	1 week	7	26.9	3	11.5	10	19.2
	2 week	7	26.9	6	23.1	13	25
	3 week	2	7.7	3	11.5	5	9.6
	4 week and more	10	38.5	14	53.8	24	46.2
	Total	**26**	**100**	**26**	**100**	**52**	**100**
4. Nurse – neonate ratio	3 and below	3	11.5	2	7.7	5	9.6
	4-5 neonates	6	23.1	5	19.2	11	21.2
	6-7 neonates	12	46.2	11	42.3	23	44.2
	8 and more neonates	5	19.2	8	30.8	13	25
	Total	**26**	**100**	**26**	**100**	**52**	**100**
5. No of physicians assigned for the unit	2 physicians	18	69.2	20	76.9	38	73.1
	3 physicians	8	30.8	3	11.5	11	21.2
	4 physicians	0	0	2	7.7	2	3.8
	5 physicians	0	0	1	3.8	1	1.9
	Total	**26**	**100**	**26**	**100**	**52**	**100**

4.1.3. Analysis of category I- Part III

Participants' knowledge about NICU's Polices and Protocols Regarding E.V.I. (for all groups)

Regarding participants' education and training on prevention and management of extravasation injuries the findings in table (4.3) showed that 76.9% of the nurses did not receive any type of education about extravasation injuries, and 23.1% received during their academic study or as a special training after graduation.

Regarding protocols availability in their NICU's; 69.2% of the participants do not have protocols about medications reconstitution and administration in their units, followed by 25% answered they have protocols, and 5.8% answered they don't know if there is any protocols in their units. To further understand the nurses' knowledge about list of drugs that may cause serious problems on extravasation 71.2% don't have list, 23.1% have lists, and 5.8% don't know if there is any list in their units.

Nurses experiences for extravasation injuries 44.2% of the participants did not experienced any significant E.V.I. in their units, followed by 40.4% don't know if it is happened in their units, and 15.4% experienced E.V.I. in their units.

Regarding protocols for the prevention and early recognition of E.V.I. 65.4% of nurses don't have those protocols in their units, 17.3% have protocols, and 17.3% don't know if there is a protocol or not. In addition, 76.9% of the participants don't have any protocol for the treatment of E.V.I. in their units, followed by 13.5% don't know if there are such protocols, and 9.6% have protocols.

In those NICU's who don't have protocols for the treatment of E.V.I. 44.2% don't have standard practices for the management of extravation injuries in their units, 34.6% don't know, and 21.2% they have standard practices in their units.

Concerning protocols for staging system to classify E.V.I. according to severity; 78.8% don't have, 19.2% don't know, and only 1.9% have a protocol to classify E.V.I. in their units.

The results in our study was not congruent with literatures as the results of a survey in 27 NICU's in Australia and New Zealand by Restieaux et al (2013); which revealed that 92% of the surveyed units have written policies and standard practices regarding recognition and prevention of E.V.I, and also 92% of the surveyed units have written policies and standard practices regarding treatment of E.V.I.

Table (4.3): Summery of participants' education and knowledge about NICU's Polices and Protocols Regarding E.V.I. (total of 52 participants).

	Intervention group						Control group						Total participants		
	YES		NO		DON'T KNOW		YES		NO		DON'T KNOW		YES	NO	DON'T KNOW
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	%	%	%
1. Did you receive any type of education or training on prevention or management of extravasation injuries	7	26.9	19	73.1	0	0	5	19.2	21	80.8	0	0	23.1	76.9	0
2. Does your unit have protocols for nurses about medication reconstitution and administration	6	23.1	18	69.2	2	7.7	7	26.9	18	69.2	1	3.8	25	69.2	5.8
3. Do you have in your unit a list of drugs that may cause serious problem on extravasation?	7	26.9	17	65.4	2	7.7	5	19.2	20	76.9	1	3.8	23.1	71.2	5.8
4. Have you ever experienced any significant extravasation injury in your unit?	5	19.2	12	46.2	9	34.6	3	11.5	11	42.3	12	46.2	15.4	44.2	40.4
5. Is there a protocol for prevention and early recognition of extravasation injuries in your unit?	4	15.4	17	65.4	5	19.2	5	19.2	17	65.4	4	15.4	17.3	65.4	17.3
6. Is there a protocol for the treatment of extravasation injuries in your unit?	3	11.5	20	76.9	3	11.5	2	7.7	20	76.9	4	15.4	9.6	76.9	13.5
7. If you don't have a protocol for the treatment of extravasation injuries in your unit do you have standard practices for the management of extravasation injuries in your unit?	6	23.1	11	42.3	9	34.6	5	19.2	12	46.2	9	34.6	21.2	44.2	34.6
8. Is there a protocol to classify extravasation injuries according to severity of extravasation injury?	1	3.8	18	69.2	7	26.9	0	0	23	88.5	3	11.5	1.9	78.8	19.2

52

4.1.4. Analysis of category II- Part I

Participants Knowledge and Practices for Cannula Insertion and Care in NICU's

Regarding the site most common used to apply I.V. cannula the analyzed data in table (4.4) showed that 40.4% of the participants' uses the dorsum of the hand to apply intravenous cannula, 19.2% use the ankle, 17.3% uses the scalp, 13.5% uses anticubital fossa, and 9.6% uses the forearm, the results of sites used for cannulation by study participants were not consistent with literatures in which the sites most often implicated in E.V.I. include the dorsum of the hand, anticubital fossa, and the ankle (Thigpen, 2007; Gault, 1997).

Concerning the intervals of changing the I.V. cannula 48.1% reported that they do not change the cannula site unless complications appears, 28.8% change it every 24 hours, 17.3% change the cannula site every 72 hours, and 5.8% change the cannula site every 48 hours. The results not consistent with the Campaign of best practices for IV care "CLEAN IT" which recommended removing the cannula within 72 hours of insertion (Baldwin, 2013).

The interval at which the participants' check the cannula site of assigned neonates; 63.5% check the cannula site only once at the beginning of their shift (once per 8 hours), 17.3% check site every 2 hours, 17.3% check site hourly, and 1.9% check it every 4 hours, those results were in opposition to the recommendations of the literatures (Irving, 2001; Hadaway, 2004; Sawatzky-Dickson, 2006) since all those studies recommended hourly check of the cannulation site.

Concerning the methods used to secure intravenous cannula 51.9% used leucoplast (zinc oxide stretchable plaster), 30.8% used micropore (paper plaster), and 17.3% used bandage, while no one of the participants used the transparent dressing (Tegaderm), the participants practices in

securing the intravenous cannula obscure the visibility of the insertion site which is not consistent of the literatures since the recommendations to use transparent dressing to ensure the visibility of the insertion site and to avoid leukoplast (Irving, 2001; Hadaway, 2004; Doherty, 2010).

The methods used to examine the patency of the I.V. cannula used by nurses in NICU's; 51.9% flush the cannula by pushing normal saline, 26.9% flush the cannula through aspiration of normal saline, around 19.2% were satisfied to look at the infusion if it is dropping then there is no need to check the cannula patency, and 1.9% do nothing to check cannula patency, Hadaway (2005) recommended to gently aspirate from the cannula before injecting drugs and to look for blood returned.

To further understand the prevalence and incidence of extravasation injuries the first two choices in item 5 in table (4.4) were explored in more details later in this chapter.

Table (4.4): Participants practices for cannula insertion and care in NICU's (total of 52 participants).

Variable	Group	Intervention group		Control group		Total of Freq. for both groups	% of the total Freq.
		Freq.	%	Freq.	%		
1. The most common site you use to apply intravenous cannula	The forearm	3	11.5	2	7.7	5	9.6
	Dorsum of the hand	12	46.2	9	34.6	21	40.4
	Anticubital fossa.	3	11.5	4	15.4	7	13.5
	The ankle.	4	15.4	6	23.1	10	19.2
	The scalp.	4	15.4	5	19.2	9	17.3
	Total	**26**	**100**	**26**	**100**	**52**	**100**
2.How often you change the cannula	Every 24 hours	7	26.9	8	30.8	15	28.8
	Every 48 hours	1	3.8	2	7.7	3	5.8
	Every 72 hours	5	19.2	4	15.4	9	17.3

	Not changed unless complications appears	13	50	12	46.2	25	48.1
	Total	**26**	**100**	**26**	**100**	**52**	**100**
3. The interval in which you check the cannula site for assigned neonates	Hourly.	4	15.4	5	19.2	9	17.3
	Every 2 hours.	5	19.2	4	15.4	9	17.3
	Every 4 hours.	0	0	1	3.8	1	1.9
	Once at the beginning of shift.	17	65.4	16	61.5	33	63.5
	Total	**26**	**100**	**26**	**100**	**52**	**100**
4. The way used to secure the intravenous cannula	Leucoplast (zinc oxide plaster).	13	50	14	53.8	27	51.9
	Bandage.	4	15.4	5	19.4	9	17.3
	Transparent dressing	0	0	0	0	0	0
	Micropore (paper plaster)	9	34.6	7	26.9	16	30.8
	Total	**26**	**100**	**26**	**100**	**52**	**100**
5. usually you examine the cannula of neonates for swelling/ extravasation by	Flush the cannula by pushing saline	14	53.8	13	50	27	51.9
	Flush the cannula by saline aspiration	8	30.8	6	23.1	14	26.9
	Look at infusion if it is dropping no need to check the cannula	4	15.4	6	23.1	10	19.2
	Do nothing	0	0	1	3.8	1	1.9
	Total	**26**	**100**	**26**	**100**	**52**	**100**

4.1.5. Analysis of category II- Part II

Participants Practices and regular check of neonates Cannula during shifts

Table (4.5) presents the participants practices and regular check of neonates' intravenous cannulas during different duty shifts; the results indicated that 48.1% of the participants found two neonates with swelling and/or redness around insertion site in the week prior to the date of pre-test data collection, 28.8% found 1 neonate, 13.5% found 3 neonates, and 9.6% found 4 neonates.

By referring to percentages of choices 1&2 in item 5 in table (4.4); through flush cannula by using aspiration of normal saline by those who answered that they used this technique throughout the week prior to the date of pre-test data collection; 50% of those nurses found 2 neonates without blood backflow, 21.4% found 3 neonates, 21.4% found one neonate, and 7.2% found 4 neonates. In addition through flush cannulas by pushing normal saline; 40.7% of participants found 3 neonates cannulas blocked, 29.6% found 2 neonates, 25.9% found one neonate, and 3.7% found 4 neonates.

The analyzed data showed that 48.1% of intervention group nurses found the problems in the intravenous cannulas like swelling, redness, and blockage at evening (B) shift (14:00 – 22:00), followed by 28.8 % at night (C) shift (22:00 – 07:00), and 23.1% at morning (A) shift (07:00 – 14:00), the result of participants consistent with Hawley (2006) regarding the incidence of redness, swelling, and blockage at evening shift more than any other shifts, while not consistent regarding morning and night shifts. The shift at which the neonatal nurse found the blocked cannulas before any signs of infiltration or extravasation injuries appear means that the nurse regularly check the insertion site of the IV cannula.

Table (4.5): Participants practices and regular check of neonates intravenous cannulas in their shifts (total of 52 participants).

Variable	Group	Intervention group		Control group		Total of Freq. for both groups	% of the total Freq.
		Freq.	%	Freq.	%		
you assigned to care for 6 neonates in the last week 1. By examining neonates how many you find with swelling/ redness around insertion site	1 neonate	7	26.9	8	30.8	15	28.8
	2 neonates	13	50	12	46.2	25	48.1
	3 neonates	3	11.5	4	15.4	7	13.5
	4 neonates	3	11.5	2	7.7	5	9.6
	Total	26	100	26	50	52	100

2. By aspiration how many cannulas you find with no blood return.	1 neonate	1	12.5	2	33.3	3	21.4
	2 neonates	4	50	3	50	7	50
	3 neonates	2	25	1	16.7	3	21.4
	4 neonates	1	12.5	0	0	1	7.2
	Total	**8**	**100**	**6**	**100**	**14**	**100**
3. By pushing saline how many cannulas you find blocked.	1 neonate	3	21.4	4	30.8	7	25.9
	2 neonates	4	28.6	4	30.8	8	29.6
	3 neonates	6	42.8	5	38.4	11	40.7
	4 neonates	1	7.2	0	0	1	3.7
	Total	**14**	**100**	**13**	**100**	**27**	**100**
4.The shift in which you find cannula problem (e.g. swelling, redness)	Shift A	5	19.2	7	26.9	12	23.1
	Shift B	13	50	12	46.2	25	48.1
	Shift C	8	30.8	7	26.9	15	28.8
	Total	**26**	**100**	**26**	**100**	**52**	**100**

4.1.6. Analysis of category II- Part III

Participants Practices for the Prevention of E.V.I. in NICU's

Table (4.6) represents the neonatal nurses' skills and practices to prevent E.V.I. For early recognition and prevention E.V.I. 32.7% only observe the cannula site regularly, and also 32.7% do nothing, 25% flush the cannula of normal saline before administration of potential harmful substances, and 9.6% flush the cannula of normal saline after administration of potential harmful substances.

For the purpose of administration of potassium, calcium, bicarbonates and high concentration dextrose in NICU's; 30.8% of the participants use dropper machine, 25% use syringe pumps, 23.1% uses slow intravenous administration via volue set, and 21.2% use intravenous regulator.

In addition 38.5% administers the doses of total parenetral nutrition (TPN) via peripheral access, and 61.5% do not. It is worth to say that the nurses who administer TPN via peripheral access emphasized that they only do that at the morning shifts.

In addition they were asked about administration and infusing of vasoactive substances (e.g. intropes like dopamine) via peripheral access; 23.1% answered yes, 67.3% answered no, and 9.6% answered do not know how to administer dopamine to the neonates they care for.

Question number 9 in table (4.6) aimed to verify the cycles at which the neonatal nurses check the syringe pumps to early detect any leakage from the intravenous cannula to minimize the possibility of extravasation injuries; 80.8% answered that this function is not applicable as the majority of syringe pumps found in NICU's are too old and this function is not available on the most of those pumps, 9.6% set the cycle at 1 hours (hourly intervals), 5.8% set the cycle at 8 hours intervals so they check the cannula one time during their shifts, and 3.8% set the cycle at 4 hours and check the cannula at the beginning, mid and end of their shifts, these results are not consistent with Hadaway (2006) who advised to assess the IV site frequently because pump will continue infusing the drug if E.V.I. occurs.

Question number 10 in table (4.6) designed to verify the nurses' action when extravasation injury is suspect; 57.7% remove the intravenous cannula and stop infusion, 17.3% apply cold compresses, 15.4% apply warm compresses, and 9.6% elevate the affected limb on pillow, the removal of the IV cannula is consistent with literatures as it is the second step to do after stop the infusion if E.V.I. suspected (Bellin, 2004).

The above results showed that the intervention and control group neonatal nurses results were almost the same results.

Table (4.6): Participants practices to prevent E.V.I. in their NICU's (total of 52 participants).

Variable	Group	Intervention group Freq.	Intervention group %	Control group Freq.	Control group %	Total of Freq. for both groups	% of the total Freq.
5.Practices by nurses to prevent E.V.I.	Observe the cannula site regularly	9	34.6	8	30.8	17	32.7
	Use transparent dressing to keep the skin around the cannula tip visible	0	0	0	0	0	0
	Flush the cannula of saline before administration of potentially harmful substance	6	23.1	7	26.9	13	25
	Flush the cannula of saline after administration of potentially harmfull substance	2	7.7	3	11.5	5	9.6
	Do nothing	9	34.6	8	30.8	17	32.7
	Total	**26**	**100**	**26**	**100**	**52**	**100**
6.The way of administration of K^+, HCO3, high concentration dextrose	Dropper machine.	7	26.9	9	34.6	16	30.8
	Syringe pump.	6	23.1	7	26.9	13	25
	Intravenous regulator.	6	23.1	5	19.2	11	21.2
	Slow intravenous administration via volue set.	7	26.9	5	19.2	12	23.1
	Total	**26**	**100**	**26**	**100**	**52**	**100**
7. Do you infuse TPN via peripheral access	Yes	12	46.2	8	30.8	20	38.5
	No	14	53.8	18	69.2	32	61.5
	Total	**26**	**100**	**26**	**100**	**52**	**100**
8. Do you infuse vasoactive substance (e.g. dopamine) via peripheral access	Yes	5	19.2	7	26.9	12	23.1
	No	17	65.4	18	69.2	35	67.3
	Do not know	4	15.4	1	3.8	5	9.5
	Total	**26**	**100**	**26**	**100**	**52**	**100**
9. Intravenous infusion pump	1 hour	3	11.5	2	7.7	5	9.6

cycle set at	4 hours	**2**	7.7	0	**0**	2	**3.8**
	8 hours	**1**	3.8	2	7.7	3	**5.8**
	Not applicable	**20**	76.9	22	84.6	42	**80.8**
	Total	26	**100**	26	**100**	52	**100**
10. If E.V.I. suspected what action by the nurse applied	Remove the intravenous cannula and stop infusion.	14	53.8	16	61.5	30	**57.7**
	Elevate the affected limb on pillow.	1	3.8	4	15.4	5	**9.6**
	Apply warm compresses.	6	23.1	2	7.7	8	**15.4**
	Apply cold compress.	5	19.2	4	15.4	9	**17.3**
	Total	26	**100**	26	**100**	52	**100**

4.2. The Education Intervention Program

The experimental step was the development of the educational intervention program (proper procedure of applying and care of intravenous cannula and infusion line) for the intervention group nurses. Based on needs assessment which indicated by the findings of pretest data and literature related to knowledge and practices of the neonatal nurses; the education intervention program was developed and implemented.

The objective for the education intervention program was to improve knowledge, skills and practices of the neonatal nurses for the purpose of minimizing the E.V.I. To achieve these objectives educational sessions gave detailed information about proper procedure of insertion and care of intravenous cannula and infusion line such as described below.

There were 26 nurses in Jenin, Salfit, and Qalqilia governmental hospitals as intervention group who received the educational intervention program. The nurses of the intervention group were divided into 3 groups, one group in each hospital were education program was given separately.

The education intervention program included two hours of direct education (Lecture presented to the neonatal nurses). Power point material based on principles of best practice of cannula insertion and care in addition to the strategies to prevent and minimize extrvasation injuries was implemented so the intervention group nurses, they learned content and basic skills they needed to provide care for the neonates they care for. Time used wisely to learn contents and basic skills.

In addition to the health education lectures; pocket reminder cards were offered to all intervention group neonatal nurses to be with them all over their duty shifts; which includes important points to be remembered in any shifts while they provide care to the neonates (refer to annex 5), frequent visits to remind the nurses of the importance to follow the recommendations of the health education lecture and reminder card was done, also phone calls with senior nurses were made to emphasize the continuity of the education. Good outcomes anticipated from intervention group nurses after the health education.

4.2.1. The process and components of health education intervention

1. Setting

The health education lectures were presented in the lecture rooms of the three hospitals of the intervention group (Khalil Suliman Hospital in Jenin, Yaser Arafat Hospital in Salfit, and Darwish Nazzal Hospital in Qalqilia).

Each lecture continued for two hours which includes power-point show with photos that explained the steps of best practice of cannula insertion.

2. Material content of the health education

The following material of the health education intervention program were collected from the related literatures and inspired from the "CLEAN IT" campaign for best IV practices.

Definition of E.V.I.

It is defined as the non-intentional leakage of infused fluid into surrounding tissue which may cause tissue damage and skin necrosis (Irving, 2001). Also E.V.I. defined as the injury that occurs when fluid from an IV line leaks into the surrounding tissues or other extra-vascular space (Restieaux, et al, 2013).

Incidence of E.V.I.

The rate of E.V.I. of intravenous fluid in routine infusions in neonates has been reported as 11-58% (Davies, 1994). Another study by Ramasethu (2004) showed that the incidence of E.V.I. from intravenous catheters has been reported to vary from 23% to 63%.

Causes of E.V.I.

E.V.I. could be related to one or more of the following causes:

- Dislodgment of cannula.
- Type of infused fluid (e.g. calcium, potassium, TPN).

- Neonatal veins (small and fragile and immature skin) especially those born below 26 weeks.

- Technique of intravenous injection like the usage of power injector (syringe pump).

- The use of less optimal injection sites including lower limb and small distal veins

Signs of E.V.I. on neonates are characterized by:

- Swelling around insertion site of cannula.

- No blood returns via cannula.

- Resistance is felt on the plunger of the syringe when saline is given as a bolus.

- Leakage or in-duration is visible from the cannula site.

Grading scales E.V.I.

Montgomery (1999) reported there are four stages of E.V.I. characterized as presented and explained to the intervention group nurses.

Stage	Characteristics
1	▪ Absence of redness and swelling. ▪ Flushes with difficulty.
2	▪ Slight swelling at site. ▪ Presence of redness. ▪ Good pulse below site.
3	▪ Moderate swelling above or below site. ▪ Blanching.

	▪ Good pulse below extravasation site.
	▪ Skin cool to touch.
4	▪ Severe swelling above or below site.
	▪ Blanching.
	▪ Pain at site.
	▪ Decreased or absent pulse.
	▪ Skin cool to touch.
	▪ Skin breakdown or necrosis.

3. Nursing care and intervention to prevent E.V.I.

Nursing practices and skills regarding proper insertion and care of intravenous cannula and infusion line to prevent and minimize the risk of E.V.I. among neonates explained as neonatal nurse should:

- Select the vein-puncture site carefully, using a distal vein so you can perform successive proximal vein-puncture if necessary.
- Don't use the dorsum of the hand, scalp vein, the wrist, fingers, antecubital fossa, or other areas of flexion; previously damaged areas; and areas with compromised circulation.
- Don't probe for a vein. If you don't penetrate it immediately, stop and begin again at another site.

- Select a small-gauge catheter to minimize trauma to the vein and to let enough blood flow around the catheter to hemodilute vesicants.

- Secure the cannula properly, preferably with a manufactured catheter stabilization device. Cover the vein -puncture site with a transparent dressing so you can see the area.

- Regular observation of cannula site, (at least hourly).

- Aspirate from the cannula before injecting a drug and look for a brisk blood return. Hold the drug and assess cannula placement if you don't see blood return. Lack of blood return doesn't always indicate E.V.I. Blood return may be impeded if the vein is small or the catheter lumen is pressed against the vein wall. Likewise, the presence of blood return doesn't necessarily mean the catheter is properly placed.

- Immediately before giving each dose of the drug gently flush the catheter with 5 to 10 ml of 0.9% sodium chloride solution while palpating the site to detect edema.

- Ensure that the drug has been properly diluted before injection or infusion. Dilution reduces the amount of drug that would reach subcutaneous tissue if E.V.I. Dilution also helps you to detect edema before the entire doses have been administered.

- Use a dropper machine to control the rate of drugs such as potassium chloride and assess the site frequently.

- Don't use adult syringe pump because it will continue infusing the drug even if E.V.I. occurs.

- After the infusion is complete, use 0.9% sodium chloride solution to flush the tubing and cannula.

-

If E.V.I. suspected you should follow the following:

- Stop infusion.

- Remove cannula.

- Elevate the affected limb.

- Warm or cold compresses according to the type of infusion extravasated.

-

Nursing care – Cannula insertion, what are the signs of a good vein?

1. Bouncy

2. Soft

3. above previous sites

4. Refills when depressed

5. Visible

6. Has a large lumen

7. Well supported

8. Straight

9. Easily palpable

Nursing care – Cannula insertion, what veins should you avoid?

1. Thrombosed / sclerosed / fibrosed

2. Inflamed / bruised

3. Thin / Fragile

4. Mobile

5. near bony prominences

6. Areas or sites of infection, oedema or phlebitis

7. Have undergone multiple previous punctures

8. Do not use if patient has IV fluid in situ

4.3. Post-Intervention Data Analysis of the Intervention group

In this part, a summary of the statistical analysis and methodological procedures for the second experimental step after the collection of the post-test (post-intervention) data is presented, 26 questionnaires were collected from the intervention group (nurses working in Jenin, Salfit, & Qalqilia governmental hospitals). The duration between the pre-test and post-test was 60 days.

4.3.1. Post-Intervention Analysis of Category II – Part I

Pretest - Posttest Comparison for the effectiveness of education intervention program on the intervention group regarding practices for cannula insertion and care in NICU's

The comparisons of the pre-test and post-test data aim to identify the effectiveness of the education intervention program implemented for the nurses assigned as intervention group.

The findings in table (4.7) showed that 46.2% of the intervention group nurses uses the dorsum of the hand to apply intravenous cannula in pretest compared to 34.6% in posttest, 15.4% use the ankle in pretest compared to 7.7% in the posttest, 11.5% use anticubital fossa in pretest compared to 0% (no body) in the posttest, and 15.4% use the scalp in pretest compared to 0% (no body) in posttest, in addition to 11.5% use the forearm in pretest compared to 57.7% in posttest. The decreased percentages of nurses who used dorsum of the hand, ankle, anticubital fossa, and scalp to apply intravenous cannula, and as an alternative there was increased percentages of intervention group nurses who used the forearm to apply cannula; all those were positive and significant changes (P = 0.003) in this group of neonatal nurses' practices regarding cannula insertion and it is well-matched with the education intervention program presented to them, in addition those positive changes were congruent with many literatures like Thigpen (2007) and

Gault (1997) as both reported that the sites that most common implicated in E.V.I. are dorsum of the hand, ankle, and anticubital fossa and so those sites should be avoided.

Concerning the intervals of changing the I.V. cannula; 50% of the intervention group nurses reported they do not change the cannula site unless complications appears in pretest compared to 23.1% in posttest, 26.9% change the cannula site every 24 hours in pretest compared to 3.8% in posttest, 19.2% change it every 72 hours in pretest compared to 73.1% in posttest, and 3.8% change the cannula site every 48 hours in pretest compared to 0% in posttest, these decreased results of changing the cannula site every 24 hours and 48 hours were significant (P = 0.000) and indicated that the neonatal nurses became more oriented to the care they provide to the IV cannula and infusion line which is well-matched with Baldwin (2013) and the education intervention program presented to them.

The interval in which the intervention group nurses check the cannula site of assigned neonates; 65.4% of them check the cannula site only once at the beginning of their shift in pre-test compared to 23.1% in post-test, 19.2% check site every 2 hours in pre-test compared to 26.9% in post-test, 15.4% check site hourly in pre-test compared to 34.6% in post-test, and 0% check site every 4 hours in pre-test compared to 15.4% in post-test, these results were significant (P = 0.000) and congruent with the education intervention program presented to them; in addition these results were consistent with literatures (Irving, 2001; sawatzky-Dickson, 2006; Restieaux et al, 2013).

Concerning the methods used to secure intravenous cannula 50% used leucoplast (stretchable zinc oxide plaster) in pre-test compared to 23.1% in post-test, 34.6% used micropore (paper plaster) in pre-test compared to 76.9% in post-test, 15.4% used bandage in pre-test compared to

0% in post-test, and 0% (no one) used transparent dressing (Tegaderm) with the same percentage in post-test, the decreased number of neonatal nurses who used leucoplast (stretchable zinc oxide plaster) was positive change (P = 0.000) due to education intervention program and well-matched with Doherty (2010), the use of bandage to secure the cannula was disappeared after the education intervention program since the neonatal nurses became oriented to the importance of checking the insertion site of the IV cannula and the importance of keeping the insertion site visible.

Concerning the usage of transparent dressing which is recommended widely in many literatures like (Hadaway, 2004; Ener, 2005; Sawatzky-Dickson, 2006; Restieaux et al, 2013) but this type of dressing is not available in the governmental hospitals.

The methods used to examine the cannula patency revealed that 53.8% of them flush the cannula by pushing normal saline in pre-test compared to 23.1% in post-test, 30.8% flush the cannula by using aspiration of normal saline in pre-test compared to 73.1% in post-test, and 15.4% were satisfied to look at the infusion if it is dropping then there is no need to check the cannula as in pre-test compared to 3.8% in post-test. The decreased number of nurses who push normal saline and increased those who aspirate from the cannula before injecting drugs was positive change (P = 0.047) due to education intervention program and well-matched with Hadaway (2005) who recommended to gently aspirate from the cannula before injecting drugs and to look for blood returned.

Table (4.7): Pretest - Posttest Comparison for the effectiveness of education intervention program on the intervention group regarding practices for cannula insertion and care in NICU's (total of 26 participants).

Variable	Group	PRE-INTERVENTION		POST-INTERVENTION		Paired T-test	P value
		Freq.	Percent	Freq.	Percent		
1. The most common site you use to apply intravenous cannula	The forearm	3	11.5	15	57.7	3.163	0.003
	Dorsum of the hand	12	46.2	9	34.6		
	Anticubital fossa.	3	11.5	0	0		
	The ankle.	4	15.4	2	7.7		
	The scalp.	4	15.4	0	0		
	Total	26	100	26	100		
2.How often you change the cannula	Every 24 hours	7	26.9	1	3.8	10.321	0.000
	Every 48 hours	1	3.8	0	0		
	Every 72 hours	5	19.2	19	73.1		
	Not changed unless complications appears	13	50	6	23.1		
	Total	26	100	26	100		
3. The interval in which you check the cannula site for assigned neonates	Hourly.	4	15.4	9	34.6	5.727	0.000
	Every 2 hours.	5	19.2	7	26.9		
	Every 4 hours.	0	0	4	15.4		
	Once at the beginning of shift.	17	65.4	6	23.1		
	Total	26	100	26	100		
4. The way used to secure the intravenous cannula	Leucoplast (zinc oxide plaster).	13	50	6	23.1	6.795	0.000
	Bandage.	4	15.4	0	0		
	Transparent dressing (tegaderm).	0	0	0	0		
	Micropore (paper plaster)	9	34.6	20	76.9		
	Total	26	100	26	100		
5. usually you examine the cannula of neonates for swelling/ extravasation by	Flush the cannula by pushing saline	14	53.8	6	23.1	2.034	0.047
	Flush the cannula by saline aspiration	8	30.8	19	73.1		
	Look at infusion if it is dropping no need to check the cannula	4	15.4	1	3.8		
	Do nothing	0	0	0	0		
	Total	26	100	26	100		

4.3.2. Post-Intervention Analysis of Category II – Part II

Pretest - Posttest Comparison for the effectiveness of education intervention program on the intervention group; regarding practices and regular check of neonatal Cannula during shifts

To further understand the prevalence and incidence of extravasation injuries the choices in item 5 in table (4.7) were explored with its choices in the following table. Table (4.8) below showed the results of the intervention group nurses asked if they assigned to care for 6 neonates in a single day of the week prior to collect the posttest; 50% answered that they often found two neonates with swelling and/or redness around insertion site in pre-test compared to 11.5% in post-test, 26.9% found 1 neonate in pre-test compared to 80.8% in post-test, 11.5% found 3 neonates in pre-test compared to 3.8% in post-test, and also 11.5% found 4 neonates in pre-test compared to 3.8% in post-test.

Through flush cannula by using aspiration of normal saline 50% of the intervention group nurses found 2 neonates without backflow in pre-test compared to 15.8% in post-test, 25% found 3 neonates in pre-test compared to 5.3% in post-test, 12.5% found one neonate in pre-test compared to 78.9% in post-test, and 12.5% found 4 neonates in pre-test compared to 0% in post-test. In addition through flush cannulas by pushing normal saline; around 42.8% of intervention group nurses found 3 neonates cannulas blocked in pre-test compared to 16.7% in post-test, around 28.6% found 2 neonates cannulas blocked in pre-test compared to 33.3% in post-test, 21.4% found one neonate in pre-test compared to 50% in post-test, and 7.2% found 4 neonates in pre-test compared to 0% in post-test.

The analyzed data showed that 50% of the intervention group nurses found the problems in the intravenous cannulas like swelling, redness, and blockage at evening (B) shift (14:00 – 22:00) in

pre-test compared to 42.3% in post-test, followed by 30.8 % at night (C) shift (22:00 – 07:00) in pre-test compared to 11.5% in post-test, and 19.2% at morning (A) shift (07:00 – 14:00) in pre-test compare to 50% in post-test.

The result of participants not consistent with Hawley (2006) since he found that incidence of E.V.I. mainly occurs at evening shift followed by morning shift and then the night shift; while in our study morning shift followed by evening shift and then the night shift; these results indicated that the neonatal nurses regular observation of the insertion site improved post the health education program especially at morning shift since they found the cannula problems at morning shift more than other shifts.

Table (4.8): Pretest - Posttest Comparison for the effectiveness of education intervention program on the intervention group regarding practices and regular check of neonates intravenous cannulas (total of 26 participants).

Variable	Group	PRE-INTERVENTION		POST-INTERVENTION		Paired T-test	P value
		Freq.	%	Freq.	%		
you assigned to care for 6 neonates in the last week 1. By examining neonates how many you found with swelling/ redness around insertion site	1 neonate	7	26.9	21	80.8	1.135	0.262
	2 neonates	13	50	3	11.5		
	3 neonates	3	11.5	1	3.8		
	4 neonates	3	11.5	1	3.8		
	Total	26	100	26	100		
2. By aspiration how many cannulas you found with no blood return.	1 neonate	1	12.5	15	78.9	0.486	0.631
	2 neonates	4	50	3	15.8		
	3 neonates	2	25	1	5.3		
	4 neonates	1	12.5	0	0		
	Total	8	100	19	100		
3. By pushing saline how	1 neonate	3	21.4	3	50	3.216	0.005
	2 neonates	4	28.6	2	33.3		

many cannulas you find blocked.	3 neonates	6	42.8	1	16.7		
	4 neonates	1	7.2	0	0		
	Total	**14**	**100**	**6**	**100**		
4.The shift in which you find cannula problem (e.g. swelling, redness)	Shift A	5	19.2	13	50	**2.431**	**0.019**
	Shift B	13	50	11	42.3		
	Shift C	8	30.8	3	11.5		
	Total	**26**	**100**	**26**	**100**		

4.3.3. Post- intervention Analysis of category II- Part III

Pretest - Posttest Comparison for the effectiveness of education intervention program on the intervention group Prevention Practices of E.V.I. in NICU's

Table (4.9) represents the pretest-posttest comparison of the intervention group nurses' practices and skills in dealing with neonates who assigned to care for. For the purpose of early recognition and prevention of E.V.I.; 34.6% of the intervention group nurses do nothing for the purpose of early recognition and prevention of extravastion injuries in pre-test compared to 0% in post-test. 34.6% observe and check the insertion site of the cannula regularly in pre-test compared to 61.5% in post-test, 23.1% flush the cannula of normal saline before administration of potential harmful substances in pre-test with the same percentage at post-test, 7.7% flush the cannula of normal saline after administration of potential harmful substances in pre-test compared to 15.4% in the post-test, and 0% use transparent dressing to keep the skin around the cannula tip visible in pre-test with the same percentage at post-test, so it is clear that the improvement and progress in the intervention group nurses practices for the purpose of early recognition and prevention of E.V.I. was significant (P = 0.000).

For the purpose of administration of potassium, calcium, bicarbonates and high concentration dextrose in NICU's; 26.9% use dropper machine in pre-test compared to 76.9% in post-test, 26.0% use slow intravenous administration via volue set in pre-test compared to 3.8% in post-test, 23.1% use syringe pump in pre-test compared to 11.5% in post-test, and also 23.1% use intravenous regulator in pre-test compared to 7.7% in post-test, the improvements regards the methods of administration of potassium, calcium, bicarbonates and high concentration dextrose were significant (P = 0.017) and showed that the education intervention program was effective. In addition the analyzed data showed that 46.2% infuse total parenteral nutrition (TPN) via peripheral access in pre-test compared to 23.1% in post-test, 53.8% did not in pre-test compared to 76.9% in post-test, the posttest results for the administration of TPN was congruent with Irving (2001) who advised to use central line for the administration of TPN.

In addition to asking about TPN we asked the intervention group nurses about administration and infusing of vasoactive substances and intropes like dopamine via peripheral access; 65.4% answered no at pre-test compared to 92.3% at post-test, 19.2% answered yes in pre-test compared to 7.7% in post-test, and 15.4% answered that they do not know how to administer dopamine in pre-test compared to 0% in post-test those results were significant (P = 0.000).

The analyzed data of question number 9 in table (4.9) was to verify the pump cycles at which the neonatal nurses check the syringe pumps to early detect any leakage or elevation of pressure from the intravenous cannula in order to minimize the possibility of extravasation injuries; 76.9% answered it is not applicable in their units in pre-test - as the majority of syringe pumps found in NICU's are too old and the function to set cycles is not available in most of those pumps - compared to 26.9% in post-tests. 11.5% set the cycle at 1 hours (hourly intervals)in pre-test compared to 19.2% in post-test, 7.7% set the cycle at 4 hours and check the cannula at the

beginning, mid and end of their shifts in pre-test compared to 23.1% in post-test, and 3.8% set the cycles at 8 hours intervals so they check the cannula one time during their shifts in pre-test compared to 30.8% in post-test. It's worth mentioning that education regarding the old pump cycles was to have more frequent check up to reduce the risk of E.V.I.

The pretest- posttest comparison showed a positive changes and significant progress (P = 0.000) in posttest results of the intervention group regarding the frequent check of the infusion pump even the majority of the available pumps were old. The progress in neonatal nurses practices regarding check the infusion pump as showed in posttest results are consistent with Hadaway (2006) who advised to assess the IV site frequently because pump will continue infusing the drug if E.V.I. occurs.

The comparison of the pre-test and post-test results of question number 10 in table (4.9) show the variations occurred due to education intervention program if the intervention group suspected extravasation injury; 53.8% of them stop infusion and removes the intravenous cannula at pre-test compared to 69.2% in post-test, 23.1% applied warm compresses in pre-test compared to 3.8% in post-test, 19.2% applied cold compresses in pre-test compared to 3.8% in post-test, and 3.8% elevate the affected limb on pillow in pre-test compared to 23.1% in post-test.

Table (4.9): Pretest - Posttest Comparison for the effectiveness of education intervention program on the intervention group Prevention Practices of E.V.I. in NICU's (total of 26 participants).

Variable	Group	Pre-Intervention Freq.	Pre-Intervention %	Post-Intervention Freq.	Post-Intervention %	Paired T-test	P value
5.Practices by nursesto prevent E.V.I.	Observe the cannula site regularly	9	34.6	16	61.5	4.177	0.000
	Use transparent dressing to keep the skin around the cannula tip visible	0	0	0	0		
	Flush the cannula of saline before administration of potentially harmful substance	6	23.1	6	23.1		
	Flush the cannula of saline after administration of potentially harmfull substance	2	7.7	4	15.4		
	Do nothing	9	34.6	0	0		
	Total	**26**	**100**	**26**	**100**		
6.The way of administration of K^+, HCO3, high concentration dextrose	Dropper machine.	7	26.9	20	76.9	2.466	0.017
	Syringe pump.	6	23.1	3	11.5		
	Intravenous regulator.	6	23.1	2	7.7		
	Slow intravenous administration via volue set.	7	26.9	1	3.8		
	Total	**26**	**100**	**26**	**100**		
7. Do you infuse TPN via peripheral access	Yes	12	46.2	6	23.1	1.829	0.073
	No	14	53.8	20	76.9		
	Total	**26**	**100**	**26**	**100**		
8. Do you infuse vasoactive substance (e.g. dopamine) via peripheral access	Yes	5	19.2	2	7.7	4.571	0.000
	No	17	65.4	24	92.3		
	Do not know	4	15.4	0	0		
	Total	**26**	**100**	**26**	**100**		
9. Intravenous infusion pump cycle set at	1 hour	3	11.5	5	19.2	7.989	0.000
	4 hours	2	7.7	6	23.1		
	8 hours	1	3.8	8	30.8		
	Not applicable	20	76.9	7	26.9		

	Total	26	100	26	100		
10. If E.V.I. suspected what action by the nurse applied	Stop infusion and remove the intravenous cannula.	14	53.8	18	69.2		
	Elevate the affected limb on pillow.	1	3.8	6	23.1	1.359	0.180
	Apply warm compresses.	6	23.1	1	3.8		
	Apply cold compress.	5	19.2	1	3.8		
	Total	26	100	26	100		

4.4.   Comparison of Post-test Analysis of intervention vs. control group

In this part, the posttest results of intervention group compared with the posttest of control group for the effectiveness of the education intervention program on the intervention group. Independent t-test was the statistical method used to check for the effectiveness of it.

4.4.1. Category II – Part I

Posttest-Posttest Comparison for the effectiveness of education intervention program on the intervention group vs. control group regarding practices for cannula insertion and care in NICU's

The findings in tables (4.10) below show the comparison of posttest results of intervention group vs. posttest of control group to identify the effectiveness of the education intervention program implemented for the nurses assigned as intervention group.

The posttest findings in table (4.10) showed that 57.7% of the intervention group nurses uses the forearm to apply intravenous cannula compared to 15.4% of the control group nurses, 34.6% of the intervention group use the dorsum of the hand compared to 42.3% of control group, 7.7% of the intervention group use the ankle compared to 11.5% of control group, 0% (no body) of the

intervention group use the anticubital fossa compared to 7.7% of control group, in addition to 0% (no body) use the scalp compared to 23.1% of control group.

The decreased percentages and grades of nurses who used dorsum of the hand, ankle, anticubital fossa, and scalp to apply intravenous cannula, and instead the increased percentages of intervention group nurses who used the forearm to apply cannula; all those were significant (P = 0.000) and positive changes in this group of neonatal nurses' practices regarding cannula insertion and it is well-matched with the education intervention program presented to them, in addition those positive changes were congruent with Thigpen (2007) and Gault (1997) as both reported that the sites that most common implicated in E.V.I. are dorsum of the hand, ankle, and anticubital fossa and so those sites should be avoided, while the control group who did not received any education their grades still the same of those in the pretest.

Concerning the intervals of changing the I.V. cannula; 73.1% of the intervention group nurses reported they change the cannula site every 72 hours compared to 30.8% control group, 23.1% of the intervention group did not change the cannula site unless complications appears compared to 46.2% of control group, 3.8% of intervention group change it every 24 hours compared to 19.2% of control group, and 0% (no body) of the intervention group change it every 48 hours compared to 3.8% of control group, these decreased results of changing the cannula site every 24 hours and 48 hours were significant (P = 0.000)and indicated that the neonatal nurses became more oriented to the care they provide to the IV cannula and infusion line which is well-matched with Baldwin (2013) and the education intervention program presented to them, while the control group nurses grades still the same of those in the pretest which exhibit their poor practices of regular cannula observation.

The interval in which the nurses check the cannula site of assigned neonates; 34.6% of the intervention group check the cannula site hourly compared to 11.5% of control group, 26.9% of the intervention group check site every 2 hours compared to 23.1% of control group, 23.1% of the intervention group check site once at the beginning of their shifts hourly compared to 61.5% of control group, and 15.4% of the intervention group check site every 4 hours compared to 3.8% of control group, these results means that education intervention program related to the importance of regular cannula observation and frequent checking was significantly improved (P = 0.000); since all studies recommended the hourly check of the insertion site (Irving, 2001; Sawatzky-Dickson, 2006; Restieaux et al, 2013). The results of control group nurses revealed their poor practices of regular cannula check.

Concerning the methods used to secure intravenous cannula; 76.9% of the intervention group nurses used micropore (paper plaster) compared to 42.3% of control group, 23.1% of the intervention group used leucoplast (stretchable zinc oxide plaster) compared to 50% of control group, 0% (no body) of intervention group used bandage compared to 7.7% of control group, 0% (no body) of the intervention group used transparent dressing with the same percentage in the control group, the decreased number of neonatal nurses who used leucoplast (stretchable zinc oxide plaster) was significant (P = 0.000) and positive change of the intervention group nurses thought to be due to education intervention program presented to the intervention group nurses and well-matched with Doherty (2010), the use of bandage to secure the cannula was disappeared after the education intervention program since the neonatal nurses became oriented to the importance of checking the insertion site of the IV cannula and the importance of keeping the insertion site visible.

Concerning the usage of transparent dressing which is recommended widely in many literatures like (Hadaway, 2004; Ener, 2005; Sawatzky-Dickson, 2006; Restieaux et al, 2013) but this type of dressing is not available in the governmental hospitals.

The methods used to examine the cannula patency revealed that 73.1% of the intervention group nurses flush the cannula by using aspiration of normal saline compared to 34.6% of the control group, 23.1% of the intervention group nurses flush the cannula by pushing normal saline compared to 38.5% of control group, and 3.8% of the intervention group nurses were satisfied to look at the infusion if it is dropping then there is no need to check the cannula compared to 26.9% of the control group. The decreased number of neonatal nurses who push normal saline and increased those who aspirate from the cannula before injecting drugs was positive and significant (P = 0.003) change of the intervention group nurses due to education intervention program and well-matched with Hadaway (2005) who recommended to gently aspirate from the cannula before injecting drugs and to look for blood returned. The posttest results of the control group stay nearly the same in the pretest; which indicated that there were no improvements in the skills and practices.

The conclusion from these significant findings should track the attention of the policy makers toward the importance that there is a need for continuously education of the neonatal nurses on the proper procedure for the insertion and care of the intravenous cannula and infusion line and strategies to minimize E.V.I.

Table (4.10): Posttest - Posttest Comparison for the effectiveness of education intervention program on the intervention group vs. control group regarding practices for cannula insertion and care in NICU's (total of 52 participants)

Variable	Group	Post-test of Intervention group		Post-test of Control group		T-test	P value
		Freq.	Percent	Freq.	Percent		
1. The most common site you use to apply intravenous cannula	The forearm	15	58	4	15.5	4.298	0.000
	Dorsum of the hand	9	34.62	11	42.31		
	Anticubital fossa.	0	0	2	7.69		
	The ankle.	2	7.69	3	11.54		
	The scalp.	0	0	6	23.08		
	Total	26	100	26	100		
2.How often you change the cannula	Every 24 hours	1	3.85	5	19.23	10.636	0.000
	Every 48 hours	0	0	1	3.85		
	Every 72 hours	19	73.08	8	30.77		
	Not changed unless complications appears	6	23.08	12	46.15		
	Total	26	100	26	100		
3. The interval in which you check the cannula site for assigned neonates	Hourly.	9	34.62	3	11.54	8.366	0.000
	Every 2 hours.	7	26.92	6	23.08		
	Every 4 hours.	4	15.38	1	3.85		
	Once at the beginning of shift.	6	23.08	16	61.5		
	Total	26	100	26	100		
4. The way used to secure the intravenous cannula	Leucoplast (zinc oxide plaster).	6	23.08	13	50	5.894	0.000
	Bandage.	0	0	2	7.69		
	Transparent dressing (tegaderm).	0	0	0	0		
	Micropore (paper plaster)	20	76.92	11	42.31		
	Total	26	100	26	100		
5. usually you examine the cannula of neonates for swelling/	Flush the cannula by pushing saline	6	23.08	10	38.46	3.068	0.003
	Flush the cannula by saline aspiration	19	73.08	9	34.62		
	Look at infusion if it is dropping no need to check the cannula	1	3.85	7	26.92		

| extravasation by | Do nothing | 0 | 0 | 0 | 0 | | |
| | **Total** | **26** | **100** | **26** | **100** | | |

4.4.2. Analysis of Category II – Part II

Posttest-Posttest Comparison for the effectiveness of education intervention program on the intervention group; regarding practices and regular check of neonatal Cannula during shifts

To further understand the prevalence and incidence of extravasation injuries the choices in item 5 in table (4.10) were explored with its choices in the following table. Table (4.11) below showed the comparison of posttest results of intervention group vs. posttest of control group when they assigned to care for 6 neonates in a single day of the week prior to collect the posttest; 80.8% of the intervention group nurses answered that they found one neonate with swelling and/or redness around insertion site compared to 26.9% of the control group, 11.5% found two neonates compared with 50% of the control group, 3.8% of the intervention group found three neonates compared to 11.5% of the control group, and also 3.8% of the intervention group found four neonates compared to 11.5% of the control group.

Through flush cannula by using aspiration of normal saline 78.9% of the intervention group nurses found one neonate without backflow compared to 12.5% of the control group, 15.8% found two neonates compared to 50% of the control group, 5.3% of the intervention group nurses found three neonates compared to 25% of the control group, and 0% (no body) of the intervention group found four neonates compared to 12.5% of the control group, these significant results($P = 0.029$) of the intervention group which showed a decreased number of neonates found with cannula blockage thought to be a result of the health education program presented to them.

83

In addition 50% of intervention group nurses who flush cannulas by pushing normal saline found one neonate cannula blocked compared to 21.5% of the control group nurses, 33.3% found two neonates cannulas blocked compared to28.6% of the control group, 16.7% of the intervention group nurses found three neonates compared to 42.9% of the control group, and 0% of the intervention group found four neonates compared to 7.1% of the control group, these significant changes (P = 0.035) of the intervention group thought to be a result of the education intervention program presented to them.

The analyzed data showed that 50% of the intervention group nurses found the problems in the intravenous cannulas like swelling, redness, and blockage at morning (A) shift (07:00 – 14:00) compared to 30.8% of the control group. 42.3% of the intervention group found the cannula blocked at evening (B) shift (14:00 – 22:00) compared to 38.5% of the control group, followed by 11.5 % of the intervention group nurses found it blocked at night (C) shift (22:00 – 07:00) compared to 30.8% of the control group.

The result of participants not consistent with Hawley (2006) since he found that incidence of E.V.I. mainly occurs at evening (B) shift followed by morning shift and then the night shift; these results indicated that the intervention group neonatal nurses regular observation of the insertion site improved post the health education intervention program especially at morning shift since they found the cannula problems at morning shift more than other shifts; while the problem still the same for the control group.

Table (4.11): Posttest - Posttest Comparison for the effectiveness of education intervention program on the intervention group vs. control group regarding practices and regular check of neonatal Cannula during shifts (total of 52 participants)

Variable	Group	Post-intervention of Intervention group		Post-test of Control group		T-test	P value
		Freq.	Percent	Freq.	Percent		
you assigned to care for 6 neonates in the last week 1. By examining neonates how many you find with swelling/ redness around insertion site	1 neonate	21	80.8	7	26.9	1.649	0.105
	2 neonates	3	11.5	13	50		
	3 neonates	1	3.8	3	11.5		
	4 neonates	1	3.8	3	11.5		
	Total	**26**	**100**	**26**	**100**		
2. By aspiration how many cannulas you find with no blood return.	1 neonate	15	78.9	1	12.5	2.309	0.029
	2 neonates	3	15.8	4	50		
	3 neonates	1	5.3	2	25		
	4 neonates	0	0	1	12.5		
	Total	**19**	**100**	**8**	**100**		
3. By pushing saline how many cannulas you find blocked.	1 neonate	3	50	3	21.4	2.269	0.035
	2 neonates	2	33.3	4	28.6		
	3 neonates	1	16.7	6	42.9		
	4 neonates	0	0	1	7.1		
	Total	**6**	**100**	**14**	**100**		
4.The shift in which you find cannula problem (e.g. swelling, redness)	Shift A	13	50	8	30.8	2.755	0.008
	Shift B	11	42.3	10	38.5		
	Shift C	3	11.5	8	30.8		
	Total	**26**	**100**	**26**	**100**		

4.4.3. Analysis of category II- Part III

Posttest - Posttest comparison for the effectiveness of education intervention program on the intervention group vs. control group regarding prevention practices of E.V.I. in NICU's

Table (4.12) showed the comparison of the posttest of the intervention group with the posttest of the control group regarding nurses' practices and skills in dealing with neonates who assigned to care for them. For the purpose of early recognition and prevention of E.V.I.; 61.5% of the intervention group nurses observe the cannula site regularly for the purpose of early recognition and prevention of extravastion injuries compared to 46.2% of the control group. 23.1% of the intervention group nurses flush the cannula of normal saline before administration of potential harmful substances compared to 26.9% of the control group, 15.4% of the intervention group nurses flush the cannula of normal saline after administration of potential harmful substances compared to 7.7% of the control group, 0% (no body) of the intervention group use transparent dressing to keep the skin around the cannula tip visible in pre-test with the same percentage of the control group, also 0% (no body) of the intervention group answered that he do nothing compared to 19% of the control group; the results of comparison of posttests for both control and intervention group showed a significant changes in nursing skills regarding prevention of E.V.I. (P = 0.001) that is thought to be as a result of education intervention program presented for the intervention group.

For the purpose of administration of potassium, calcium, bicarbonates and high concentration dextrose in NICU's; 76.9% of the intervention group nurses use dropper machine compared to 26.9% of the control group, 11.5% of the intervention group nurses use syringe pump compared to 38.5% of the control group, 7.7% of the intervention group nurses use intravenous regulator compared to 19.2% of the control group. 3.8% use slow intravenous administration via volue set

compared to 15.4% of the control group. These results showed significant changes in nursing skills regarding prevention of E.V.I. (P = 0.01) that is also thought to be a result of education intervention program presented for the intervention group.

In addition the analyzed data showed that 23.1% of the intervention group nurses infuse total parenteral nutrition (TPN) via peripheral access compared to 42.3% of the control group, and 76.9% of the intervention group did not infuse TPN via peripheral access compared to 57.7% of the control group, the posttest results of the intervention group for the administration of TPN was congruent with Irving (2001) who advised not to use the peripheral intravenous access for the administration of TPN, and to use central line for the administration of TPN; this effect thought to be due to health education program for the intervention group.

In addition to asking about TPN the participants were asked about administration and infusing of vasoactive substances and intropes like dopamine via peripheral access; 92.3% of the intervention group nurses answered no compared to 53.8% of the control group, 7.7% of the intervention group nurses answered yes compared to 26.9% of the control group, and 0% (no body) of the intervention group answered that they do not know how to administer dopamine compared to 19.2% of the control group. These results showed significant changes in nursing skills regarding administration of vasoactive substances for the purpose of prevention of E.V.I. (P = 0.000) that is also thought to be a result of education intervention program presented for the intervention group.

The analyzed data of question number 9 in table (4.12) was to verify the pump cycles at which the neonatal nurses check the syringe pumps to early detect any leakage or elevation of pressure from the intravenous cannula in order to minimize the possibility of extravasation injuries;

30.8% of the intervention group nurses set the cycles at 8 hours intervals so they check the cannula one time during their shifts compared to 19.2% of the control group, 26.9% of the intervention group nurses answered it is not applicable in their units compared to 61.5% of the control group nurses, 23.1% set the cycle at 4 hours compared to 11.5% of the control group, and 19.2 % of the intervention group nurses set the cycle at one hour cycles (hourly intervals) compared to 7.7% of the control group, It's noteworthy that education of the intervention group nurses regarding the old pump cycles was to have more frequent check up to reduce the risk of E.V.I.

The positive and significant change (P = 0.000) in intervention group nurses regarding the frequent check up of the pump even the majority of the available pumps were old well-matched with health education program. Even that these results are not consistent with Hadaway (2006) who advised to assess the IV site frequently because pump will continue infusing the drug if E.V.I. occurs, so major efforts need to be collaborated promote this practice among nurses to minimize the risk of E.V.I.

The comparison in question number 10 in table (4.12) to show the differences occurred due to education intervention program; 69.2% of the intervention group nurses stop infusion and removes the intravenous cannula compared to 42.3% of the control group, 23.1% of the intervention group nurses elevate the affected limb on pillow compared to 34.6% of the control group, 3.8% of the intervention group nurses applied cold compresses compared to 11.5% of the control group, and also 3.8% of the intervention group nurses applied warm compared to 11.5% of the control group.

Table (4.12): Posttest - Posttest comparison for the effectiveness of education intervention program on the intervention group vs. control group regarding prevention practices of E.V.I. in NICU's (total of 52 participants).

Variable	Group	Post-test of Intervention group		Post-test of Control group		T-test	P value
		Freq.	%	Freq.	%		
5.Practices by nursesto prevent E.V.I.	Observe the cannula site regularly	16	61.5	12	46.2	3.686	0.001
	Use transparent dressing to keep the skin around the cannula tip visible	0	0	0	0		
	Flush the cannula of saline before administration of potentially harmful substance	6	23.1	7	26.9		
	Flush the cannula of saline after administration of potentially harmfull substance	4	15.4	2	7.7		
	Do nothing	0	0	5	19.2		
	Total	26	100	26	100		
6.The way of administration of K^+, HCO3, high concentration dextrose	Dropper machine.	20	76.9	7	26.9	2.414	0.01
	Syringe pump.	3	11.5	10	38.5		
	Intravenous regulator.	2	7.7	5	19.2		
	Slow intravenous administration via volue set.	1	3.8	4	15.4		
	Total	26	100	26	100		
7. Do you infuse TPN via peripheral access	Yes	6	23.1	11	42.3	1.643	0.107
	No	20	76.9	15	57.7		
	Total	26	100	26	100		
8. Do you infuse vasoactive substance (e.g. dopamine) via peripheral access	Yes	2	7.7	7	26.9	4.217	0.000
	No	24	92.3	14	53.8		
	Do not know	0	0	5	19.2		
	Total	26	100	26	100		
9. Intravenous infusion pump cycle set at	1 hour	5	19.2	2	7.7	10.416	0.000
	4 hours	6	23.1	3	11.5		

	8 hours	8	30.8	5	19.2		
	Not applicable	7	26.9	16	61.5		
	Total	**26**	**100**	**26**	**100**		
10. If E.V.I. suspected what action by the nurse applied	Stop infusion and remove the intravenous cannula.	18	69.2	11	42.3	1.352	0.182
	Elevate the affected limb on pillow.	6	23.1	9	34.6		
	Apply warm compresses.	1	3.8	3	11.5		
	Apply cold compress.	1	3.8	3	11.5		
	Total	**26**	**100**	**26**	**100**		

Chapter Five

Discussion

Introduction

This chapter includes interpretation and discussion of the study findings and their relation with other studies. The chapter includes a thorough discussion of the findings of both the pre-and post tests.

The purpose of the study was to examine the effectiveness of health education intervention program to neonatal nurses in North West Bank governmental hospitals on minimizing extravasation injuries among neonates. In order to achieve this purpose, four objectives were set, and three experimental steps were followed: first, pre-intervention assessment or the pre-test, second, the health education intervention provided by a nurse expert in nursing education to the intervention group nurses; and third, the post intervention assessment or the post-test.

5.1. Pre-intervention data

This section will discuss the findings related to the pre-test for the intervention group VS control group, and the pre-test for the intervention group.

5.1.1. Pre-test for the intervention group VS control group.

Comparing the results of pre-test for the intervention group with the results of control group (Tables 4.1 – 4.6);the findings showed there were no significant differences between the two groups; and no statistical significance between groups as a result of independent t-test, so it's clear that the surveyed population(both groups of the study) have a low level of knowledge and

poor practice regarding insertion and care of intravenous cannula and infusion line in North West Bank governmental hospitals NICU's.

The conclusion from the pretest findings reflect the facts that the participant nursesof both intervention and control groups have poor practices concerning the insertion and care of intravenous cannula and infusion line, as an example of the poor practices as we mentioned earlier in chapter four; it is recommended in literatures to check the insertion site of the cannula hourly (Irving, 2001; Hadaway, 2004; Sawatzky-Dickson, 2006); while in our study the pretest result for both intervention and control groups only 17.3% of them check the insertion site hourly and the majority 63.5% check the cannula site only once at the beginning of their shifts. Also in our study 51.9% of the participants flush the cannula by pushing normal saline while Hadaway (2005) recommended to gently aspirate from the cannula before injecting drugs and to look for blood returned, thus education intervention program on practices that minimize and prevent extravasation injuries (E.V.I.) including insertion and care of intravenous cannula and infusion line and strategies to prevent E.V.I. is deemed necessary for both groups.

5.1.2. Pre-test for the intervention group

E.V.I. resulted in skin necrosis is an important cause of morbidity in neonatal populations. In this quasi-experimental study; our data suggested that an education intervention program to the intervention group neonatal nurses about the insertion and care of intravenous cannula and may decrease the morbidity associated with E.V.I.

Although it is hard to identify risk factors for E.V.I.; age is considered the most significant one. Neonates are known to have more extravasations possibly due to need for smaller catheters and inability to communicate pain as an early warning sign (Wilkins & Emmerson, 2004; Thigpen,

2007). So in this section, the most significant findings from the pre-test for the intervention group will be discussed.

The analyzed data in table (4.1) showed that 55.8% % of the intervention group nurses make double shifts at least once in their weekly schedule, which may affect their performance in the care they provided to the assigned neonates as it was shown that double shifts decreases performance of the nurses. By asking about the number of neonates assigned to each nurse 44.2% of the intervention group (table 4.2) nurses answered that they have 6-7 neonates to care for them in each shift. 76.9% of the intervention group (table 4.3) did not receive any education regarding E.V.I. and training on prevention and management.

As the complexity of neonatal care increases, NICU's are increasingly using evidence-based practice protocols (Restieaux, 2013); while the findings of our study (table 4.3) reveals that around 69.2% of the intervention group neonatal nurses don't have protocols about medication reconstitution and administration or list of medications that may cause serious problem on extravasation, 65.4% of them don't have protocols for prevention and early recognition of E.V.I. in their units (table 4.3), and 17.3% don't know if there are such protocols in their units (table 4.3), in addition 76.9% of intervention group nurses answered they don't have protocols for the treatment of E.V.I. in their units (table 4.3), those results were not consistent with literatures like Restieaux et al (2013) survey of 27 NICU's in Australian and New Zealand which reveals that approximately two thirds of the surveyed units have protocols for the prevention and management of E.V.I.

It is clear that a number of techniques are being employed for prevention and monitoring of E.V.I. regarding peripheral I.V. lines. The findings in our study reveals that 46% of the

intervention group nurses use the dorsum of the hand to apply intravenous cannula which is not consistent with recommendations of literatures as a study by Gault (1997) in which illustrated that thesites most often implicated in extravasation injuries include the dorsum of the hands. Another study by Hadaway (2005) suggested guidelines for preventing extravasation injuries and in which he recommended not to use the dorsum of the hand and the wrist.

Concerning the care of intravenous cannula the analyzed data showed that 50% of the intervention group nurses didn't change the cannula site unless complications appear, the interval in which the intervention group nurses check the cannula site for assigned neonates in pre-test results showed that 65% of the nurses check the cannula only one time at the beginning of their shift, which is not consistent with literatures like Irving (2001) who reported that various strategies have been introduced to try and reduce the risk of extravasation injury in neonates including hourly recording of observations at the cannulation site for signs of edema, firmness or discoloration; which is now routine practice in most neonatal units, another study illustrated that frequent observation of intravenous sites (at least hourly) helps to prevent injuries and limit tissue damage because the infusion can be discontinued at the first sign of extravasation (Sawatzky-Dickson, 2006).

Regarding the way used to secure the intravenous cannula the results of the study revealed that 50% of the intervention group nurses uses leucoplast (zinc oxide plaster) which is a stretchable plaster and obstruct visibility of the insertion site and 0% uses the transparent dressing to secure the intravenous site, yet in literatures the best way to monitor the site of insertion is to secure the cannula with a transparent dressing; as in Restieaux et al (2013) survey which showed that 75% of the NICU's nurses use transparent dressing, but this type of dressing is not offered by the

Ministry of Health but the neonatal nurses did not use another alternative type of plasters like MICROPRE in effective way.

The results of pre test data analysis revealed that 46% of the nurses infuse TPN via peripheral access, which is not consistent with the common practices in literatures; it is clear that most units in literatures take a cautious approach to peripheral TPN and Dopamine. The practice of peripheral dopamine infusion is similar, with the majority allowing this with significant qualifications and caution, and some disallowing it altogether. Fifty percent of units currently identify and document preparations posing particular risk, regarding central lines, it is well recognized these carry a risk of potentially serious harm (Menon, 2003). Nevertheless, it is possible to have a low rate of serious and life-threatening complications with strict adherence to safety criteria (Cartwright, 2004).

In our study in pre-test data analysis the majority of the intervention group neonatal nurses 76.9% answered that infusion pump cycles function is not applicable as the majority of syringe pumps found in NICU's are too old and this function is not available on the most of those pumps, whereas 11.5% set the cycle at 1 hours (hourly intervals); these results not consistent with literatures as the infusion pump time limited to an hour at a time may prevent the inadvertent leakage of a large amount of fluid before detection(Shah, 2005). In addition a clinical guidelines for nurses stated in (2013) by the Royal Children's hospital in Melbourne stated that limiting the intravenous pump cycle to one hour may minimize the extent of tissue damage from extravasation providing the entry site is observed concurrently.

In addition to pharmacological therapy, non-pharmacological management also needs to be considered in NICU's, which includes supportive local care, supportive care includes stop the

infusion and removal of the cannula, elevation of the affected limb, application of warm and cold compresses. In our study the results of the analyzed data in pre-test showed that 53.8% of the intervention group neonatal nurses remove the cannula; while there were 88% of the surveyed NICU's nurses in Australia and New Zeland remove the cannula (Restieaux, et al, 2013). Only 3.8% of them elevate the affected limb, while according to Restieaux et al (2013) there was 63% of the surveyed NICU's nurses elevate the affected limb; although it is useful as illustrated in literatures like Bellin (2004) who illustrated "that elevation is often useful to reduce edema by decreasing the hydrostatic pressure in capillaries"(p.95). Limb elevation and observation has shown to be effective especially when the E.V.I. resulted in swelling (Reynolds, 2007).

In addition to removal of intravenous cannula and elevation of the affected limb the analyzed data showed that 23.1% of the intervention group neonatal nurses apply warm compresses; and 19.2% apply cold compresses if they suspected E.V.I. in the pre-test data. Those low percentages about the application of warm and cold compresses is not congruent with literatures; like Brown (1979) who found that "warm compresses provide a symptomatic relief by reabsorbing infiltrating solutions due to local vasodilatation" (p.p. 145-50). Other studies talked about the application of warm and cold compresses like study of Bellin (2004) who found that heat produces vasodilatation and thus resorption of extravasated fluid and edema, while cold produces vasoconstriction and limits inflammation. Another study revealed that the immediate application of warm compresses reduced the volume of extravasated fluid in healthy volunteers (Hastings-Tolsma et al, 1993). In an experimental study, the application of cold was associated with a decrease in the size of skin ulcers produced by extravasation (Elam et al, 1991).

The conclusion from these findings reflect the facts the nurses from the intervention group have poor practices concerning the insertion and care of intravenous cannula and infusion line; thus

education intervention program on practices that minimize and prevent E.V.I. including insertion and care of intravenous cannula and infusion line is deemed necessary.

5.2. Intervention period

There was a clinically significant improvement among intervention group nurses skills and practices concerning insertion and care of the intravenous cannula and infusion line techniques as been noticed by the researcher from the results in the post-test (post-intervention), and as reported by head nurses and the supervisors. This indicates that the education intervention program was effective to improve the intervention group neonatal nurses' skills and practices regarding insertion and care of the intravenous cannula and infusion line for the purpose of preventing and minimizing E.V.I. among neonates they care for.

The results of our study are consistent with the study of Pick, Poortinga, and Givaudan (2003) which indicated that the main outcomes of education intervention programs are changes in objectives and actual performance.

5.3. Post – intervention data

This section will discuss the findings related to the comparison between pre and post tests for the intervention group, comparing the post-tests for the intervention and control groups.

5.3.1. Comparing pre with post-tests for the intervention group

Comparing the results of pre-test with the results of post-tests for the intervention groups showed that the practices and skills of the intervention group nurses have been improved and developed regarding the proper way of I.V. cannula insertion and care of it and infusion line care, which is well-matched with the education intervention program presented to them. This improvement indicates that the knowledge gain and skills development for the intervention group nurses ensured the effectiveness of the education intervention program.

The conclusion from these findings is that the educational intervention program had good effect on the nurses' knowledge and practices concerning the application and care of the intravenous cannula and infusion line.

5.3.2. Comparing the post-tests for the intervention and control groups

Comparing the post-test for the neonatal nurses' in both intervention and control groups showed that the intervention group neonatal nurses who had educational intervention program has a significant change and improvement of skills and practices regarding application and care of the I.V. cannula and infusion line than the control group who had no education intervention program as there is no differences in the percentages of the control group nurses (pre-test with the post-test).This is thought to be due to the education intervention program presented for the intervention group.

Although there were no differences between the average grades for the control group in the pre and post tests, however there were differences between the average grades for the intervention group in the pre and post tests. The conclusion from these findings is that the educational intervention program presented to the intervention group was so effective to make difference.

5.4. The Effectiveness of Intervention and Pre-test on the Participants.

The results obtained from the pre- intervention data were useful in the health education intervention program presented to the intervention group. The major finding of this study was the effect of interaction between pre-test and education intervention program on intervention group nurses' knowledge, skills and practices toward neonates they care for in their units. There may be several explanations for the appearance of this interaction effect; one explanation may be that the interaction effect was due to repetition, the pre-test questionnaire was filled out by the nursesbefore the intervention took place; this made nurses more prepared for the intervention.

In summary, the purpose of the study was to examine the effectiveness of education program to neonatal nurses in North West Bank governmental hospitals on minimizing extravasation injuries among neonates; the results obtained in this study indicated a change and improvement in the intervention group nurses' knowledge, skills, practices for whatever they were exposed to.

Summery

This chapter incorporated interpretation of the study findings in relation to previously conducted studies. An overview of the study research design, the instrument used for the study, data collection and data analysis procedures are also included. At last, the research findings of the study with elaboration on experimental strategies implemented influence the neonatal nurses' skills, practices and attitudes were discussed.

Chapter Six

Implications and Conclusions

Introduction

In this study, the researcher has evaluated the effectiveness of education intervention program presented to intervention group neonatal nurses working in North West Bank governmental hospitals on minimizing extravasation injuries among neonates. A quasi-experimental research method was used to evaluate for the intervention strategies implemented in this study.

Building on the findings of this study which have been analyzed by reference to related literatures, the researcher identified four main themes that incorporate the major contributions in this study; the first theme discusses the contribution of the study to developing a body of knowledge, the second theme deals with the implication of the research globally, the third theme is implication to the health care system in Palestine, in addition recommendations related to future research and for the improvement of health education activities.

6.1. Contribution of the Study to the Body of Knowledge

Prior to concentrate on any conclusions, it is valuable to mention that this study is the first study that conducted with the purpose of evaluating the effectiveness of health education intervention program to neonatal nurses working in NICU's at North West Bank governmental hospitals on minimizing extravasation injuries among neonates. Novelty: unique

It is anticipated therefore, that assessment of the pre-intervention data and the intervention outcomes would have practical and useful implications toward the use of health education strategies at both the policy-making and the academic professional levels. However, the lack of the research in Palestinian context makes comparison of this study findings and outcomes difficult at this stage.

At the post-intervention data or the last stage of the study, the main achievement was the improvement of the intervention group nurses knowledge, skills and practices regarding the insertion and care of the intravenous cannula and infusion line as a result of an effective health education program presented to them. Thus, the study contributes to the use of the health education as influencing factor on changing the nurses' attitudes positively toward a higher standards practice in NICU's.

6.2. Implications of the Research Globally

This study evaluated the effectiveness of health education program to neonatal nurses in North West Bank governmental hospitals on minimizing extravasation injuries among neonates. This study is considered innovative in the Palestinian and regional context. However, the lack of research in the local and regional literature makes comparisons of the study outcomes difficult.

This study has focused primarily on researches and literatures that conducted to minimize and/ or prevent E.V.I. among neonates. The results obtained at the pre-intervention data provided basis for the health education needs, the goals were set and the health educational activities were planned and then initiated. The design of this study and methodology used make this study useful in other studies, other countries, and on different population too.

6.3.   Implications to Health Care in Palestine

This study provided information about the neonatal intensive care units and nurses working in those units socio-demographic data, attitudes experience and practices in NICU's. Therefore, the researcher of the study has focused on influencing the knowledge, and improving skills and practices of the neonatal nurses through planned educational activities. The findings indicated that the health education intervention can influence the knowledge, attitudes and improve skills and practices of the neonatal nurses.

These research findings are very important to take into consideration in order to develop appropriate programs intended to promote and foster an optimum development of neonatal nurses' practices in the care of neonates especially the intravenous cannula and infusion lines. To foster an optimal development of neonatal nurses, actions should not only focus on newly graduated nurses, but should aim at improving all team members of the neonatal intensive care units in addition to the supervisors, this means that efforts should be made to educate head nurses about their nurses practices to improve their skills. It is easy to say that but it is not easy to implement, because the change is not an easy procedure and needs collaborative efforts at the national level.

Training programs to the nurses in NICU's are irregular and implemented when funding is available. Therefore, a need for ongoing development of those professionals with ongoing supervision of their performances through an evaluative research is one of the prime importance's to have an effective work of them and effective outcomes.

This quasi-experimental research study contributes to providing useful information about the NICU's nurses' skills and practices and care of the intravenous cannulas and infusion lines in

order to minimize and prevent E.V.I. Also it contributes to identify the effectiveness of the health education to facilitate change in the nurses' attitudes and improve their practices.

6.4. Recommendations

The following points are recommendations for future research. This study has focused primarily on quasi-experimental research that sets out to minimize the E.V.I. among neonates in north west bank governmental hospitals through health education intervention program presented to neonatal nurses working on NICU's in North West Bank governmental hospitals. Undoubtedly this is a topic that needs further exploration and identification to fully understand the effectiveness of health education intervention on the learners concerns and needs, so the generalizability and significance of any findings never come from one single study. Considering the limitation of the study mentioned earlier, the following points are worth looking at to be studied.

- The sample size is small and included only nurses in North West Bank governmental hospitals. Therefore, a larger sample from governmental and private hospitals in different areas of the West Bank and Gaza strip will lead to concrete conclusions about the neonatal nurses' attitudes and practices in NICU's.
- It's recommended for the Ministry of Health to adopt policies to ensure quality improvement in the governmental hospitals, regardless of the cost, by designing standard practices manuals and protocols to minimize and prevent the complications of the intravenous therapy and care of the intravenous cannula and enhances the utilization of it across NICU's.

- Requiring multidisciplinary approach from the health institutions along with the need to adopt a variety of strategies; to educate staff on the correct techniques for the administration of the drugs and nutrients via I.V. access.

- Further research needed to inform best practice in the area of EVI recognition and management, and to keep the neonatal staff vigilant, ensuring that guidelines for the prevention and treatment of EVI are available, and conscientiously followed.

- To ensure quality improvement in the health settings , regardless of the cost, by designing system to minimize and prevent the complications of the intravenous therapy and care of the intravenous access.

- There is a need for the Palestinian universities to emphasize the concept of health education/promotion through the different health teaching faculties available for graduating nurses, physicians and public health professionals in order to be oriented to the role of the health educator whether they play the role of the health educator or when the educated.

- There is a need also for ongoing development of nurses with ongoing supervision of their performances through the decision making bodies and joint coordination of the universities and NGO's, this important to have a control on such programs and to have an effective work of the educators and of effective outcomes of the learners.

- The intervention of the education program protocols can be used as a standard for care of the I.V. cannula and infusion line.

6.5. Conclusions

This study provided information about the neonatal nurses' practices and skills to insert and monitor intravenous cannula of the neonates they care for, in addition this study incorporates the proper procedure to insert intravenous cannula and care for to minimize and prevent E.V.I. in an attempt to minimize the E.V.I. among neonates in North West Bank governmental hospitals through an effective health education intervention program. The target population of the study was the total number of nurses working in neonatal intensive care units (NICU's) in the five governmental hospitals in North West Bank; Jenin, Rafidia, Tulkarm, Salfit, and Qalqilia, nurses in Jenin, and Qalqilia, and Salfit governmental hospitals as intervention group, and nurses in Rafidia, and Tulkarm governmental hospitals as control group.

Multiple comparisons were made to indicate the significance of participants' results at both pre-test and post-test; at posttest intervention group and control group compared to evaluate the effectiveness of the education intervention program.

The major findings of the study at the post-test data showed a significant difference regarding I.V. cannula insertion and care for those who received the health education intervention when compared with those who did not received intervention. 34.6% of the intervention group nurses in pre-intervention observe the cannula site regularly improved to 61.5% in the post-intervention;

The intervention group nurses uses the forearm to apply intravenous cannula improved from 11.5% in pre- intervention to 57.7% in post-intervention; and compared to 15.5% in the posttest for the control group.

The methods used to examine the cannula patency revealed that 73.1% of the intervention group nurses flush the cannula by using aspiration of normal saline while it was 30.8% in pre-intervention data. The posttest results of the control group stay nearly the same in the pretest; which indicated that there were no improvements in the knowledge and practices of control group nurses.

Comparing the results of the pre-test with the post-test for the intervention group, and posttest-posttest of intervention group vs. control group showed significant improvement in the knowledge and practice of the intervention group at post-intervention, Although further research is required, we concluded that in this quasi-experimental study, choosing the proper site to apply IV cannula, regular check of IV cannula site, and flush the cannula through aspiration, in addition to continuous education of the neonatal nurses on the proper procedure for the insertion and care of the intravenous cannula and strategies to minimize E.V.I. may decrease the morbidity associated with EVI.

Referring to the results of the study we conclude that there is no consensus on the management of extravasation injuries in neonates. Further research is needed to help prevent these injuries, and to determine which is the best treatment to aid healing and reduce scaring.
Also we conclude that this study results have important implications for the support of neonatal nurses' work in NICU's and it is instructive in several aspects and made the following contribution:

- The study design was helpful in identifying the nurses' practices and attitudes in NICU's at the assessment phase prior to the health education; which was helpful for the researcher of the study to use this approach in order to develop the appropriate interventions. Therefore, emphasis on the needs of the learners to be assessed prior to any intervention is of high importance to have an effective health education program.

- Educational programs on neonatal health should be in the context of the NICU's and hospitals level, also it is recommended to involve hospital supervisors to become supportive and understanding of the neonates concerns and problems; so they can help in follow-up the neonatal nurses activities during evening and night shifts, in addition to staff providing care for them.

- The findings of the study can be very helpful in sharing policies and programs related to neonates' health as well as for academic training programs for those who work with neonates in order to enhance the health and well being of the neonates.

Summery

This chapter integrates implications, recommendations, and conclusions based on the study findings. The researcher summarizes the main results and study findings in the conclusion and sort out the recommendations in points.

References

1. Allwood, M., Stanley, A., & Wright, P., editors. (2002). the cytotoxics handbook. (4th edition). New York: Radcliffe Medical Press.

2. Baldwin, W., et al (2013) Campaign for best practice in intravenous therapy. *Nursing Times;* 109: 33/34, 22-23.

3. Beason, R. (1990) Antineoplastic vesicant extravasation. Journal of Intravenous Nursing. 13(92) 111 – 114.

4. Bellin, M., Jakobsen, J., Thomsen, H., & Morcos S. (2004). Contrast Medium Extravasation Injury: Guidelines for prevention and management. JBR-BTR. 87:93-96.

5. Brink, P.J. & Wood, M. J., (1998). Advanced design in nursing research. (2nd edition). London: UK: Sage Publications.

6. Brown, A.S., Hoelzer, D.J., & Piercy, S.A. (1979). Skin necrosis from extravasation of intravenous fluids in children. *Plastic and Reconstructive Surgery*. 64(2):145–150.

7. Burns, N., & Grove, S.K. (2007). The practice of nursing research. (3rd edition). Copyright by W.B. Saunders Company.

8. Buus-Frank, M. E., Conner-Bronson, J., Mullaney, D., McNamara, L. M., Laurizio, V. A., & Edwards, W. H. (1996). Evaluation of the neonatal nurse practitioner role: the next frontier. *Neonatal Netw*ork*, 15*(5), 31–40.

9. Cartwright, D. (2004). Central venous lines in neonates: a study of 2186 catheters. Archive of Diseases Child Fetal Neonatal. Ed. 89(6):504–508.

10. Casanova D, Bardot J, Magalon G. (2001). Emergency treatment of accidental infusion leakage in the newborn: report of 14 cases. *British Journal of Plastic Surgery*. 54(5):396–399.

11. Chandanvasu, O., Garrow, E., Valda, V., Alsheikh, S., & Vega, S.D. (1986). A new method for the prevention of skin sloughs and necrosis secondary to intravenous infiltration. *American Journal of Perinatology*. 3(1):4- 5.

12. Chrystal, C. (1997) Administering Continuous Vesicant Chemotherapy in the Ambulatory Setting. *Journal of Intravenous Nursing*. 20(2): 78-88.

13. Conole, G., Littlejohn, A., Falconer, I. and Jeffery, A. (2005) Pedagogical review of learning activities and use cases, LADIE project report, JISC.

14. Cormack, D. (2000). The research process in nursing. (4th edition). London: Blackwell Science limited.

15. Curran, E. (2011) Intravenous drug preparation: the infection risks. *British Journal of Nursing*; 20: 14, 4-8.

16. Davies, J., Gault, D., & Buchdahl, R. (1994). Preventing the scars of neonatal intensive care. Archive of Disease Child Fetal Neonatal Ed.; 70:50 – 1.

17. Doellman, D., Hadaway, L., Bowe-Geddes, LA. (2009). Infiltration and Extravasation: update on prevention and management. Infusion Nursing 32(4):203-11.

18. Doherty, L. (2010). Extravasation: prevention, recognition and management. *Nursing standard 24,* 52, 48-55.

19. Elam E.A., Dorr R.T., Lagel K.E., Pond G.D. (1991). Cutaneous ulceration due to contrast extravasation: experimental assessment of injury and potential antidotes. Invest Radiol. 26: 13-16.

20. Ener, R.A., Meglathery, S.B., & Styler, M. (2004) Extravasation of systemic hemato-oncological therapies. Annals of Oncology. 15(6):858–862. [PubMed].

21. Fairman, J. A., Rowe, J. W., Hassmiller, S., & Shalala, D. (2011). Broadening the scope of nursing practice. *New England Journal of Medicine, 364*(3), 193–196.

22. Forde, D. & Gunkel, H. (2010). Observation and recommendations regarding neonatal nursing at the neonatal intensive care units of Rafidia hospital and the Palestine medical complex. Palestinian health sector reform and development project (Flagship project). http://www.usaid.org/flagship/palestinianhealthsector2010.pdf. Assessed July 10th, 2014.

23. Fox, M. (2011). Wound care in the Neonatal Intensive Care Unit. Neonatal network 30, 5, 291-303.

24. Freed, G. L., Dunham, K. M., Lamarand, K. E., Loveland-Cherry, C., & Martynn, K. K. (2010). Neonatal nurse practitioners: Distribution, roles, and scope of practice. American Board of Pediatrics Research Advisory Committee. *Pediatrics, 126*(5), 856–860.

25. Garland J., Havens P., Dunne W., Hintermeyer M., Bozzette M., Wincek J., Bromberger T., and Seavers M. (1992). Peripheral Intravenous Catheter Complications in Critically Ill Children: A Prospective Study.*PEDIATRICS* Vol. 89 (6) pp. 1145 -1150 Assessed on August 26th, 2014 from http://pediatrics.aappublications.org/content/89/6/1145.

26. Gatley, E. P. (1992). From novice to expert: The use of intuitive knowledge as a basis for district nurse education. *Nurse Education Today, 12*(2), 81–87.

27. Gault, D., & Challands, J. (1997). Extravasation of Drugs. In: Kaufman L, Ginsburg R, editors. *Anesthesia Review*. Vol. 13. Edinburgh, UK: Churchill Livingstone.

28. Gault, D.T. (1993). Extravasation injuries. British Journal of Plastic Surgery. 46(2):91-6.

29. Gnanalingham, M.G., Irving, V., & Shaw, N.J. (2005). Consensus on neonatal infusion pumps and pressure monitoring. *Archives of Disease in Childhood*. Fetal and Neonatal Edition. 90(1):93.

30. Gopalakrishan, P.N., Geol, N. and Banerjee, S. (2012) saline irrigation for the management of skin extravasation injury in neonates. The Coherence Library 2, 1-16.

31. Green, L.W. (1997). Evaluation and measurement: Some dilemmas for health education. American Journal of public health, 67, (2), 155-158.

32. Hadaway L. (2004). Preventing and managing peripheral extravasation. *Nursing.* 34(5):66-67.

33. Hadaway L. (2007). Emergency: infiltration and extravasation—preventing a complication of I.V. catheterization. *Am Journal Nursing.* 107(8):64-72.

34. Hadaway, L. (2000). I.V. Infiltration: Not just a Peripheral Problem. Nursing Management. November Issue.

35. Hadaway, L. (2006). Technology of flushing vascular access devices. *Journal of Infusion Nursing, 29,* 137–145.

36. Hadaway, L. C. (2005). Reopen the pipeline for I.V. therapy. *Nursing. 35,* 54–61.

37. Harbarth S., Sudre P., Dharan S., et al., (1999). *Outbreak of Enterobacter cloacae related to Understaffing Overcrowding and Poor Hygiene Practices.* Infection Control & Hospitals Epidemiology. 20(9): 598-603.

38. Harris, P.A., Bradley, S., & Moss A.L.H. (2001). Limiting the damage of iatrogenic extravasations injury in neonates. *Plastic and Reconstructive Surgery*. 107(3):893–894.

39. Hastings-Tolsma T.M., Yucha C.B., Tompkins J., Robson L., Szeverenyi N. (1993). Effect of warm and cold applications on the resolution of IV infiltrations. *Restorative Nursing Health*. 16: 171-178.

40. Hawley, I. (2006). Statistics from the National Extravasation Information Service green card reporting database. 1987–2006, http://www.extravasation.org.uk/stats.htm.

41. Higginson, R. (2011) IV therapy and infection control in patients in the community. *British Journal of Nursing*; 20: 3, pp152-155.

42. Infusion Nursing Standards of Practice. *Journal of Infusion Nurses.* 2006; 29(1 Suppl):S1-S92.

43. Irving, V. (1999). Neonatal iatrogenic skin injuries: a nursing perspective. *Journal of Neonatal Nursing.* 5:10–13.

44. Irving, V. (2001). Managing extravasation injuries in preterm neonates. *Nurse Times*, 97(35):40 - 46.

45. Jones, L., & Coe, P. (2004). Extravasations. *European Journal of Oncology nursing*. 8:355-358

46. Kiger, A. (1995). Teaching for health. (2nd edition). Edinburgh: Churchill Livingstone.

47. Kumar, R.J., Pegg S.P., & Kimble R.M. (2001). Management of extravasation injuries.*ANZ Journal of Surgery*. 23(7).285-9.

48. Lamb, H., de Chalain, T., Wright, T., et al. (2006). Intravenous cannulation management of infiltration injuries (including clysis). Auckland District Health Board. Retrieved October 16, 2013. From http://www.adhb.govt.nz/newborn/guidelines/vascularcatheter/IVInfiltrationInjuries.htm.

49. Lavery, I. (2010) Infection control in IV therapy: a review of the chain of infection. *British Journal of Nursing*; 19: 19, S6-S14.

50. Lyon S. (2005). Vascular Access Devices and the oncology Patient. Cancer Forum. 29(3): 140-144.

51. MacCara, M.E. (1983). Extravasation. A hazard of intravenous therapy. Drug Intelligence and Clinical Pharmacy. 17(10):713–717. Retrieved January 13, 2015. From*http://www.ncbi.nlm.nih.gov/pubmed/6628223*.

52. Menon, G. (2003). Neonatal long lines. Archives of Disease in Childhood. Fetal and Neonatal Edition. 88(4):F260-2. Accessed on October 21st, 2013. From http://fn.bmj.com/content/88/4/f260.1.full.html.

53. Miller, M.B., Cotton, M.C. and Buschbach, D. (2011). Chapter 10: Pharmacology in neonatal care. In Gardner, S.L., Carter, B.S., Enzman-Hines, M. and Hernandez, J.A. (eds) Neonatal Intensive Care. Mosby Elsevier, St. Louis, Missouri.

54. Montgomery LA, (1999). Haurahan K, Kottam K et al. Guideline for IV infiltrations in pediatric patients. *Pediatric Nursing*. 25(2): 167-9, 173-80.

55. National Association of Neonatal Nurse Practitioners. (2007). Neonatal Advanced Practice Nurses Shift Length, Fatigue, and Impact on Patient Safety. *Advances in Neonatal Care, 7*(6), 326–329.

56. National Association of Nurse Practitioner Faculties. (2012). Nurse practitioner corecompetencies. Retrieved December 27, 2014. From http://www.nonpf.com/associations/10789/files/NPCoreCompetenciesFinal2012.pdf.

57. Patnaik, S.K. (2004). Necrosis in extravasation incidents is a tip of the iceberg (Letter). Archives of Disease in Childhood. Fetal and Neonatal Edition. 89(3). Retrieved from: www.fn.bmj.com/cgi/eletters/89/3/F274-5.

58. Petit, J. and Mycoff, M. (2007). Peripherally inserted central catheters, Guidelines for practice. (Second edition). W. Lake Avenue: Glenview.

59. Phillips, R., Andrades, P., Grant, J., & Ray P. (2009). Deep dopamine extravasation injury: a case report. Journal of Plastic, Reconstructive & Aesthetic Surgery. 62(7), 222-224. Retrieved from http://www.jprasurg.com/article/S1748-6815(08)01153-4/abstract. doi:10.1016/j.bjps.2008.11.064.

60. Pick S., Poortinga Y., and Givaudan M. (2003). Integrating intervention theory and strategy in culture-sensitive health promotion programs. American Psychological Association. 34(4). 422-429.

61. Polit, D. E. & Hungler, B. (1995). The Practice of Nursing Research: Principles and Methods. (5th edition). Philadelphia: Lippincott Co.

62. Polit, D., & Beck, C. (2003). Nursing Research: Principles and Methods (7th edition). Philadelphia: Lippincott Williams & Wilkins.

63. Polit, D., Beck, C. & Hungler, B. (2001). Essentials of Nursing Research: Methods, Appraisal, and utilization (5th edition). Philadelphia: Lippincott.

64. Ramasethu, J. (2004). Pharmacology Review Prevention and Management of Extravasation Injuries in Neonates. *Neonatal Reviews*, 5(11):491–497.

65. Restieaux, M., Maw, A., Boadbent, R., Jackson, P., Barker, D., & Wheeler B. (2013). Neonatal Extravasation injury: prevention and management in Australia and newzeland-a survey of current practice.*BMX pediatrics* .13:34.

66. Reynolds, B.C. (2007). Neonatal extravasation injury; case report. *Infant 3(6)*, 230-232.

67. Royal College of Nursing (2010). Standards for Infusion Therapy. London: RCN. tinyurl.com/ RCN-infusion-standards.

68. Sauerland, C., Engelking, C., Wickham, R., & Corbi, D. (2006). Vesicant extravasation Part I: mechanisms, pathogenesis, and nursing care to reduce risk. *Oncology Nursing Forum.* 33(6):1134–1141. Retrieved August 28, 2014. From *http://www.ncbi.nlm.nih.gov/pubmed/17149396.*

69. Sawatzky-Dickson, D., and Bodnaryk, K. (2006). Neonatal Intravenous Extravasation injuries: Evaluation of a Wound Care Protocol. *Neonatal Network*. 25 (1):13- 21.

70. Shah, P.S., Ng, E., & Sinha, A.K. (2005). Heparin for prolonging peripheral intravenous catheter use in neonates. *Cochrane Database of Systematic Reviews*. (4). Retrieved October 19, 2014. From http*://www.ncbi.nlm.nih.gov/pubmed/16235300.*

71. Smyth, R. (2004). Exploring the usefulness of a conceptual framework as a research tool: A researcher's reflections, Issues *in Educational Research*, 14 (2); 167- 180.

72. Talbot, L., A. (1995). Principles and Practice of Nursing Research. St. Louis: MOSBY.

73. Thigpen, J. (2007). Peripheral Intravenous Extravasation: Nursing Procedure for initial treatment. *Neonatal Network*. 26(6). 379- 88.

74. Thomas, S., Rowe, H.N., Keats, J., & Morgan, R.J.H. (1997). The Management of extravasation injury in neonates. World Wide Wounds; (Edition 1).

75. University of Melbourne Library. (2012). *what is a literature review.* Retrieved August 23, 2014, from http://www.unimelb.libguides.com/lit_reviews

76. Weinstein, S.M. (2001). Principles and practice of intravenous therapy. (7th edition) Philadelphia: Lippincott.

77. WHO. (2011) Word Health Statistics. Retrieved August 14th, 2014, from (http://www.who.int/whosis/whostat /EN_WHS2011_Full.pdf).

78. Wilkins, C.E., & Emmerson, A.J. (2004). Extravasation injuries on regional neonatal units. Archives of Disease in Childhood. *Fetal and Neonatal Edition.* 89(3):F274-5.

79. Wong, (2011), Nursing care of infants and children, (9th edition), Canada: Elsevier.

80. Wong, A.F., & McCulloch, L.M. et al. (1992).Treatment of peripheral tissue ischaemia with topical nitroglycerin ointment in neonates. *Journal of Pediatrics*. 121(6):980 – 3.

81. www.rch.org. clinical guidelines peripheral I.V. device management. (2013). Retrieved May 12th, 2014, from www.rch.org: http://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Peripheral_Intravenous_I V_Device_Management.

Annex 1: Informed Consent

Informed consent

From the neonatal nurses in North West Bank Governmental hospitals

Agreement to take part in a research study

I am …………………………………………. and I have had the study explained to me by the investigator Rashad Baddad; I understand the study will assess Knowledge and practice of neonatal nurses in north west bank governmental hospitals .

I am willing to participate in this study and I understand that all information recorded will be completely confidential and anonymous.

Signature: ………………………………………………..

Date: …………………………………………..

Annex 2: Permission to participate in research study

I would like to inform you about the research that I will implement at the NICU at your hospital and to please your agreement.

The title of the research is "Minimizing Extravasation injuries among neonates in north West Bank Governmental hospitals; an intervention study". This research is one the requirements to graduate for master degree in Pediatric Nursing. The purpose of this study is to examine the effectiveness of education intervention program to neonatal nurses in North West Bank governmental hospitals on minimizing extravasation injuries among neonates.

For this purpose, the nurses will be in two groups (control group and intervention group) the investigator will collect data from both groups as a pre-test, will implement a training session for the intervention group, and will collect data from both groups.

All information recorded through data collection will be completely confidential and anonymous.

Thanks for your cooperation you can offer

Rashad Mohammed Baddad, RN

Annex 3: The Questionnaire

Nurses questionnaire on Extravasation injuries among neonatal population

This questionnaire is designated to assess nurses' knowledge and practice about extravasation injuries conducted at North West Bank governmental hospitals NICU's

Please circle the appropriate choice for you

Category I

I.   Demographic and Background data for nurses

1. **Name of the Hospital you are working in**

    a.   Khalil Suliman Hospital (Jenin)
    b.   Rafidia (Nablus)
    c.   Thabet Thabet (Tulkarm)
    d.   Yaser Arafat (Salfit)
    e.   Darwish Nazzal (Qalqilia)

2. **Nurses education level**

    a.   Diploma degree (practical nurse)   **b**. Bachelor degree (Registered nurse)
    c.   High Diploma degree   **d**. Master degree

3. **Gender of the nurse**

    a.   Male   **b**. Female

4. **Years of experience**

    a.   Less than 5 years   **b**. 5-10 year's   **c.** More than 10 years

5. **Does all of your experience years in neonatal unit**

    a.   Yes   **b**. No

6. **Is your age**

    a.   Less than 30 years   **b.** 30- 40 years   **c.** More than 40 years

7. **Did you work double shifts during the last week?**

    a.   Yes   **b**. No

1. **What is the minimum gestational age of neonates admitted to your unit**

      a.   30 weeks and above   **b**. 28 weeks and above
      c. 26weeks and above   **d**. 24 weeks and above

2. **What is the neonate's average body weight who admitted to our unit**

      a.   Less than 1000 gm   **b**. 1000 gm -2000 gm
      c. 2001 gm – 2500 gm   **d.** more than 2500 gm

3. **What is the average time for neonates' stay in your unit**

      a.   1 week   **b.** 2 weeks
      c. 3 weeks   **d.** 4 weeks and more.

4. **How many neonates you are usually assigned to care for**

      a.   3 and below   **b.** 4-5

      c. 6-7   **d.** 8 and more

5. **How many physicians are assigned for the unit you are working in**

      a.   2 physicians   **b.** 3 physicians

      c. 4 physicians   **d.** 5 physicians

Part III. Knowledge of Nurses & NICU polices regarding E.V.I.

Please check all statements that apply: **yes (Y), no (N), or (don't known) (D)**

Item	Y	N	D
1. Did you receive any type of education or training on prevention or management of extravasation injuries			
2. Does your unit have protocols for nurses about medication reconstitution and administration			
3. Do you have in your unit a list of drugs that may cause serious problem on extravasation?			
4. Have you ever experienced any significant extravasation injury in your unit?			
5. Is there a protocol for prevention and early recognition of extravasation injuries in your unit?			

6.	Is there a protocol for the treatment of extravasation injuries in your unit?		
7.	If you don't have a protocol for the treatment of extravasation injuries in your unit do you have standard practices for the management of extravasation injuries in your unit?		
8.	Is there a protocol to classify extravasation injuries according to severity of extravasation injury?		

Category II

I. Nurses practices and protocols for cannula insertion and care in NICU

1. **What is the most common site you use to apply intravenous cannula**
   a. The forearm.
   b. Dorsum of the hand.
   c. Anticubital fossa.
   d. The ankle.
   e. The scalp.

2. **How often do you change the cannula of the neonates you are caring for?**

   a. Every 24 hours
   b. Every 48 hours
   c. Every 72 hours
   d. Not changed unless complications appears

3. **What is the interval in which you check the cannula site of assigned neonates?**

   a. Hourly.
   b. Every 2 hours.
   c. Every 4 hours.
   d. Once at the beginning of shift.

4. **What do you use to secure the intravenous cannula?**

   a. Leucoplast (zinc oxide plaster).
   b. Bandage.
   c. Transparent dressing (tegaderm).
   d. Micropore (paper plaster)

5. **How do you examine the cannula of neonates you assigned for?**

   a. Flush the cannula by pushing saline.
   b. Flush the cannula by saline aspiration.
   c. It is satisfactory to look at infusion if it is dropping no need to check cannula.
   d. Do nothing.

II. Intervention group practices and regular check of neonates Cannula during shifts

1. **During the last week while you are examining cannula of assigned neonates how many neonates you find them with swelling and/or redness around insertion site of the cannula?**

       1   2   3   4

2. **While you are examining cannula of assigned neonates how many cannulas no blood return from it when you do aspiration**

       1   2   3   4

3. **While you are examining cannula of assigned neonates how many cannulas you find blocked when you do normal saline push**

       1   2   3   4

4. **At which shift you find cannula problem like (swelling, redness and block):**

Shift A   Shift B   Shift C

III.   Participants Practices for the Prevention of E.V.I. in NICU's

5. **For the purpose of early recognition and prevention of extravasation injuries which of these options do you do? (Select as many as applicable)**

   a. Observe the cannula site regularly.
   b. Use transparent dressing to keep the skin around the cannula tip visible.
   c. Flush the cannula of saline before administration of potentially harmful substances
   d. Flush the cannula of saline after administration of potentially harmful substances
   e. Do nothing like that
   f. Other (please specify)……………………………………………………….

6. **What is the way of administration of potassium, calcium, bicarbonates and high concentration dextrose?**

   a. Dropper machine.
   b. Syringe pump.
   c. Intravenous regulator.
   d. Slow intravenous administration via volue set.
   e. Pressure sensitive syringe pump.

7. **Do you infuse TPN (total parentral nutrition) via peripheral access?**

   a. Yes

b. No

8. **Do you infuse vasoactive substance (e.g. intropes like dopamine) via a peripheral access?**

   a. Yes
   b. No
   c. Don't know

9. **When you use intravenous pump to infuse drugs like potassium, calcium, and high concentration dextrose you set the Intravenous pump cycles are at:**

   a. 1 hour   **b.** 4 hours
   c. 8 hours   **d.** Not applicable.

10. **If you suspect extravasation injury which of the following actions you may apply? (Select as many as applicable)**

    a. Remove the intravenous cannula and stop infusion.
    b. Elevate the affected limb on pillow.
    c. Apply warm compresses.
    d. Apply cold compress.
    e. Saline washout with small incisions around the extravasation site.
    f. Other (please specify)…………………………………………………..

Annex 4: Pocket Reminder of neonatal nurses

Neonatal Nurse Reminder Card

- Select the vein-puncture site carefully, begin with distal vein
- Don't use the dorsum of the hand, scalp vein, the wrist, fingers, antecubital fossa, or other areas of flexion; previously damaged areas; and areas with compromised circulation.
- Don't probe for a vein. If you don't penetrate it immediately, stop and begin again at another site.
- Select a small-gauge catheter to minimize trauma to the vein and to let enough blood flow around the catheter to hemodilute vesicants.
- Secure the cannula properly
- Cover the vein -puncture site with a transparent dressing so you can see the area.
- Regular observation of cannula site, (at least hourly).
- Aspirate from the cannula before injecting a drug and look for a brisk blood return. Hold the drug and assess cannula placement if you don't see blood return. Lack of blood return doesn't always indicate E.V.I. Blood return may be impeded if the vein is small or the catheter lumen is pressed against the vein wall. Likewise, the presence of blood return doesn't necessarily mean the catheter is properly placed.
- Immediately before giving each dose of the drug gently flush the catheter with 5 to 10 ml of N/S 0.9% solution while palpating the site to detect edema.
- Ensure that the drug has been properly diluted before injection or infusion. Dilution reduces the amount of drug that would reach subcutaneous tissue if E.V.I. Dilution also helps you to detect edema before the entire doses have been administered.

- Use a dropper machine to control the rate of drugs such as KCL and assess the site frequently.
- Don't use adult syringe pump because it will continue infusing the drug even if E.V.I. occurs.
- flush the tubing and cannula by N/S 0.9% after the infusion is complete,

Grading Scale for E.V.I. (Montgomery, 1999)

Stage	Characteristics
1	- Absence of redness and swelling. - Flushes with difficulty.
2	- Slight swelling at site. - Presence of redness. - Good pulse below site.
3	- Moderate swelling above or below site. - Blanching. - Good pulse below extravasation site. - Skin cool to touch.
4	- Severe swelling above or below site. - Blanching. - Pain at site. - Decreased or absent pulse. - Skin cool to touch. - Skin breakdown or necrosis.

Rashad M. Baddad
RN MSN Candidate
Al-Quds University 2016

125

Annex 5: Information of reviewers of the questionnaire

1. **Aydah Qaisi, RN, MSN, PhD.**

   Dean of Nursing Collage

   An-Najah National University - Nablus

2. **Jamal Qaddoumi, RN, MSN, PhD**

   Lectures
   An-Najah National University- Nablus

3. **Imad Fashfshe, RN, MSN, PhD.**

   Vice dean of the Medical Allied Sciences

   Arab American University – Jenin

4. **Ashraf Shawqi Jarrar, MD.**

   Pediatrician

   Khalil Suliman governmental hospital – Jenin

Annex 6: Permission for Data Collection in governmental hospitals

Al- Quds University
Faculty of Health Professions
Nursing & midwife Department
Jerusalem-Abu Dies

جامعة القدس
كلية المهن الصحية
دائرة التمريض والقبالة
القدس-أبوديس

التاريخ:2014/09/6
الرقم: 17 /2014/09

حضرة الدكتور محمد أبو غالي المحترم
الإدارة العامة للمستشفيات

الموضوع : الطالب رشاد بداد

تحية طيبة وبعد ،

نرجو من حضرتكم السماح لطالب الماجستير "**رشاد محمد نايف بداد ورقمه 21212641** " بجمع المعلومات من المرضين والممرضات الذين يعملوا بأقسام الحضانة في كل من المستشفيات التالية "مستشفى رفيديا ، مستشفى جنين الحكومي ، مستشفى طولكرم الحكومي ، مستشفى سلفيت ومستشفى قلقيلة " حيث أن هذه المعلومات ستستخدم لأغراض البحث العلمي المتعلق برسالته وستتضمن معرفتهم وممارستهم بالنسبة للتسرب الوريدي من الأطفال حديثي الولادة بقسم العناية المشددة .

"Mimizing Extravasation injuries among Neonate "

وتفضلوا بقبول فائق الاحترام والتقدير،،،

منسقة برامج الدراسات العليا دائرة التمريض
د. سميه صالح

Annex 7: Health Education Intervention Program