

The Effectiveness of the Light Source Device on the Insertion of Cannulae into the Peripheral Veins in Children in Khartoum State Hospitals 2012

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“Getting a new idea adopted, even when it has obvious advantages, is often very difficult. Many innovations require a lengthy period, often of many years, from the time they become available to the time they are widely adopted. Therefore, a common problem for many individuals and organizations is how to speed up the rate of diffusion of an innovation”.

Djenta, 2005

Abstract: **Background:** Peripheral intravenous catheters are the most commonly inserted tubes. It is a time consuming procedure performed on the majority of general paediatric inpatients, with significant discomfort to patients and their caregivers. The use of Transillumination for the localization of veins for cannulation is an old technique; however, it is still not well known worldwide. Some studies found this technique to have a 100% success rate. There are no published studies from Sudan regarding use of transillumination for cannulae insertion. The device used in this study is simple, cheap, and safe and can be used in every procedure room in the hospital. **Purpose:** The purpose of this study was to evaluate the effectiveness of the light source device on the insertion of cannulae into the peripheral veins in children. **Methods:** This is a randomized clinical trial study, examined 246 inpatients children from the age of one month to 60 months who required peripheral catheter insertion at pediatric hospitals in Khartoum state (intervention group, n = 123), using a simple light source device. Data were collected by special assessment sheet which consist of two sections: 1. Demographic data of participants; 2. Observational checklist concerning cannulae insertion procedure. Data were analyzed by (SPSS) Data were compared at baseline data (control group, n = 123,) without using the device. Variables were the number of attempts per patient, success rate, the time to procedure completion and cost of total procedure calculated by number of cannulae, number of swab, and number of syringes used. **Results:** Successful cannulation was achieved at the first attempt 56.9% in the illumination group and 43.1% in the control group. The maximum number of attempts was three in illumination group compared to more than three attempts in control group. Two attempts were required in 45.3% of patients in the illumination group and in 54.7% of the control group; 3 attempts were needed in 28.6% and 71.4% of the groups, respectively (P =0.03). The percentage of procedures completed within less than 5 minutes increased when nurses used the transillumination light device compared to not using the device, (P =0.00). The result demonstrated that transillumination lower the total procedure cost by 46.9SDG .p.value= (0.004) y. **Conclusions:** Transillumination had more success rate, shorter duration of insertion and total cost of the procedure was reduced.

Keywords: Peripheral Intravenous Cannulae, children, Transillumination,

Definitions of Key Terms

- Peripheral Intravenous Cannulae: cannulae inserted into a small peripheral vein for therapeutic purposes such as administration of medications, fluids and/or blood products.
- Children: age from 1- 60 month old age.
- Transillumination: passage of strong cold light through peripheral veins to permit inspection by an observer on the opposite side.

Abbreviations

NO.	Abbreviations	
1	ACTH	Academy Charity Teaching Hospital
2	CHD	Congenital Heart Disease
3	CVL	Central Venous Line
4	DCA S	Data Collection Assessment Sheet
5	EMLA	Eutectic Mixture Of Local Anesthetics
6	KSPH	Khartoum State Pediatric Hospitals
7	LED	Light-Emitting Diode
8	MRN	Medical Record Number
9	SPSS	Statistical Package For Social Sciences
10	TPN	Total Parenteral Nutrition
11	UMST	University of Medical Sciences and Technology

1. Introduction

1.1 Background

Cannulae is a flexible tube containing a needle (stylet), which may be inserted into a peripheral vein (Phillips 2005, Weller 2005) Peripheral catheters are the most commonly inserted catheters with the numbers being inserted annually in the United Kingdom. It was estimated that in 500 bedded district general hospitals, 18,000 peripheral catheters were inserted in a single year (Waghorn1994).

Peripheral cannulation provides access for the purpose of intravenous (IV) hydration or (IV) administration of medications it usually inserted for short term therapy as well as for bolus injections or short infusions in the outpatient or day-unit setting (Royal College of Nursing 2005). Placement of peripheral pediatric intravenous (IV) catheters in infants and children is often technically difficult because of the small caliber and impalpability of the veins some time it was difficult, even in skilled hands. The process of establishing IV access may be divided into two phases: locating the vein and inserting the catheter. Sometimes the first phase is accomplished on the basis of anatomical landmarks alone. Many techniques have been proposed in the literature to

improve palpation or/and visualization of the target vein, such as tapping over the site, applying proximal tourniquets, local warming or having the arm hanging down. Transillumination with various devices has been used for many years in infants and neonates. The application of glyceryl trinitrate ointment with a eutectic mixture of local anesthetics or after eutectic mixture of local anesthetics removal has been found to positively impact on venous dilation, choice of cannulation site, and ease of cannulation.

Peripheral intravenous (PIV) line placement is a time-consuming procedure performed on the majority of general paediatric inpatients, with significant discomfort to patients (Pubmed2012).

Nurses play a role in managing materials and their costs in hospital units, providing knowledge and means for decision making, based on scientific evidence about care delivery. This will support their arguments to hospital management about needs in view of different product types

Transillumination is defined as passage of strong light through a body structure to permit inspection by an observer on the opposite side (Dorland 2007). The use of Transillumination technique for the localization of veins for cannulation is an old technique; however, it is still not well known in the world some study found this technique to have a 100% success rate in dark-colored and chubby babies. It was used for achieving vascular access which was described back in the 1970s (Gildersleve et al, 1975). Although it is a very useful technique, especially in the paediatric population, it has not gained significant popularity (Yativ et al). This may be largely due to the unavailable and costly cold light used. Previously published literature reports the use of a cold light source with a fiberoptic cable (Journal 2010). The disadvantage of this type of light source is the lack of availability in patient care areas of the hospital where vascular access is typically acquired. Fiberoptics are generally expensive, can be bulky to handle and quite difficult to carry on oneself (PE, 2011). Conditions associated with difficult vascular access include obesity, chronic illness, and hypovolemia (Blavias 2006, Spear 2011).

1.2 Justification

In a pediatric ward, Pediatric peripheral venipuncture (PPV) and pediatric peripheral intravenous cannulation (PPIVC) is often a difficult experience for patients, caregivers, and health care providers, and when unsuccessful, alternative procedures include intraosseous infusion, central venous access, and venous cut down were used, which are more invasive procedures and it require greater skill and are associated with increased morbidity, also all these will delay medications and fluid administration in children. Therefore, techniques that optimize peripheral line placement is essential and increased of dexterity is required in the cannulation of children.

During the clinical experience, the researcher had come across with patients having four and five; some time more trials of insertion used. Always health professionals used the

common light source available in the ward to visualize the veins but it was very difficult in most of the time.

There were no published studies from Sudan regarding use of illumination for purpose of cannulae insertion. Thus, the researcher designed a non randomized controlled trial to test the efficiency of trans-illumination on peripheral venous cannulation. The light sources which will be used in this study include simple cold light source device (torch), this sources is available everywhere and cheap.

The introduction of this simple technology may improve the workflow in pediatric hospitals, if minimize the time, number of trials, and thousands of Sudanese Pounds will be saved when total cost of the cannulae insertion is decreased.

1.3 Objectives

1.3.1 General Objective

The general objective of the study was to evaluate the effectiveness of the light source device (Transillumination) on the insertion of cannulae into the peripheral veins in children.

1.3.2 Specific Objectives

- 1) To assess the effectiveness of the light source device on cannulae insertion success rates.
- 2) To measure the effectiveness of the light source device on cannulae insertion time.
- 3) To assess the effectiveness of the light source device on the cost of peripheral intravenous cannulation in pediatric hospitals.
- 4) To find out association between some demographic variables and peripheral veins cannulation success rate in intervention and control group.

1.4 Research Questions

The research questions that the study addresses were:

- 1) What was the effect of using Transillumination of peripheral veins on the cannulae insertion success rates?
- 2) What was the effect of using Transillumination of peripheral veins on time of cannulae insertion?
- 3) What was the effect of using Transillumination of peripheral veins in the cost of cannulae insertion in health facilities?
- 4) Were there any association between some demographic variables (age, gender, skin color and medical diagnosis of children) and peripheral veins cannulation success rate in intervention and control group?

1.5 Research hypotheses

In order to answer the research questions, the study sets out the following hypotheses to be tested

Hypothesis 1:

Success rate of peripheral venous cannulation in children was higher when Transillumination of peripheral veins is used.

Hypothesis 2:

Time of peripheral venous cannulation in children was higher when Transillumination of peripheral veins is used.

Hypothesis 3:

Transillumination of peripheral veins will reduce the cost of cannulae insertion in pediatric hospitals.

Hypothesis 4:

There is a positive relationship between demographic variables (age, gender, skin color and medical diagnosis of children) and success rate of peripheral venous cannulation.

1.6 Theoretical Framework

Conceptual models broadly presents an understanding of the phenomenon of interest and reflects the assumptions and philosophic views of the model's designer.(Polit& Bick 2008)

Conceptualization is a process of forming ideas, which are utilized and forms conceptual framework adopted of research design it help the researcher to know what data need to be collected and given direction to an entire research process.

The researcher thus adopted Wiedenbach –The Helping Art of Clinical Nursing (1964) conceptual framework in a modified form, believing that venous access will be success from the first attempt, cost and time reduced after the using of illumination light.

Who is the theorist?

- Ernestine Wiedenbach was born in August 18, 1900, in Hamburg, Germany.
- Wiedenbach's conceptual model of nursing is called ' The Helping Art of Clinical Nursing".

Prescriptive Theory

Wiedenbach's prescriptive theory is based on three factors:

- **The central purpose** which the researcher recognizes as essential to the particular situation. .
- **The prescription** for the fulfillment of central purpose.
- **The realities:** are the immediate situations that influence the central purpose.

Conclusion

- a) Nursing is the practice of identification of a patient's need for help through
 - observation of presenting behaviors and symptoms
 - exploration of the meaning of those symptoms with the patient
 - determining the cause(s) of discomfort, and
 - Determining the patient's ability to resolve the discomfort or if the patient has a need for help from the nurse or other healthcare professionals.
- b) Nursing primarily consists of identifying a patient's need for help.
- c) The central purpose
In this study the central purpose is to achieve the success from the first attempts of veins cannulation, to shorter the time of procedure , reduce the cost of the procedure and minimize pain and discomfort of the child.
- d) The prescription.

In this study the prescription is to place a light source against the palmar or plantar surface of hand or foot to illuminate the vein.

e) The realities

It refers to the physical, physiological, emotional and spiritual factors that come into play in situation involving nursing action.

The five realities identified by E.Weidenbach are agent, recipient, goals, mean, and framework.

Agent

The agent is the researcher who directs all actions toward the goal.

Recipient:

The recipient are the patients who receive a researcher,s action or on whose behalf action was taken.

Goals:

The goal is the nurse's desired outcome, it direct the action and suggest the reasons for taking those actions here the goal is to maintain the 1st success of (PVC),to shorten the time of procedure and reducing the cost with illumination.

Mean:

The means are the activities and devices used by the nurse to achieve the goal. They include specific skills, procedures and techniques

1.7 Conceptual Framework

Framework

It refers to the facilities in which nursing is practiced. It comprises human, environmental, professional and organizational aspect of care .The framework in this study has been considered as the setting in which the study has been conducted in the hospital.

Nursing practice:

It consists of identifying need for help, ministering the needed help and validating that the needed help was met.

Identification:

It involves viewing the patient as an individual with unique experiences and understanding or the patient's perception of the condition. The researcher fulfills the flow chart assessment which includes the comment about cannulae insertion.

Ministration:

It refers to provision of needed help. Place the light source against the palmar or plantar surface of hand and foot. Illuminate the vein and examine for venous access.

Validating:

It refers to the collection of evidence that shows the need has been met as a direct result of action. In this study venous access was observed by using flowchart assessment in order to know the success rate, time of procedure and number of cannulae, swab, and syringes used in order to calculate the total cost of the procedure.

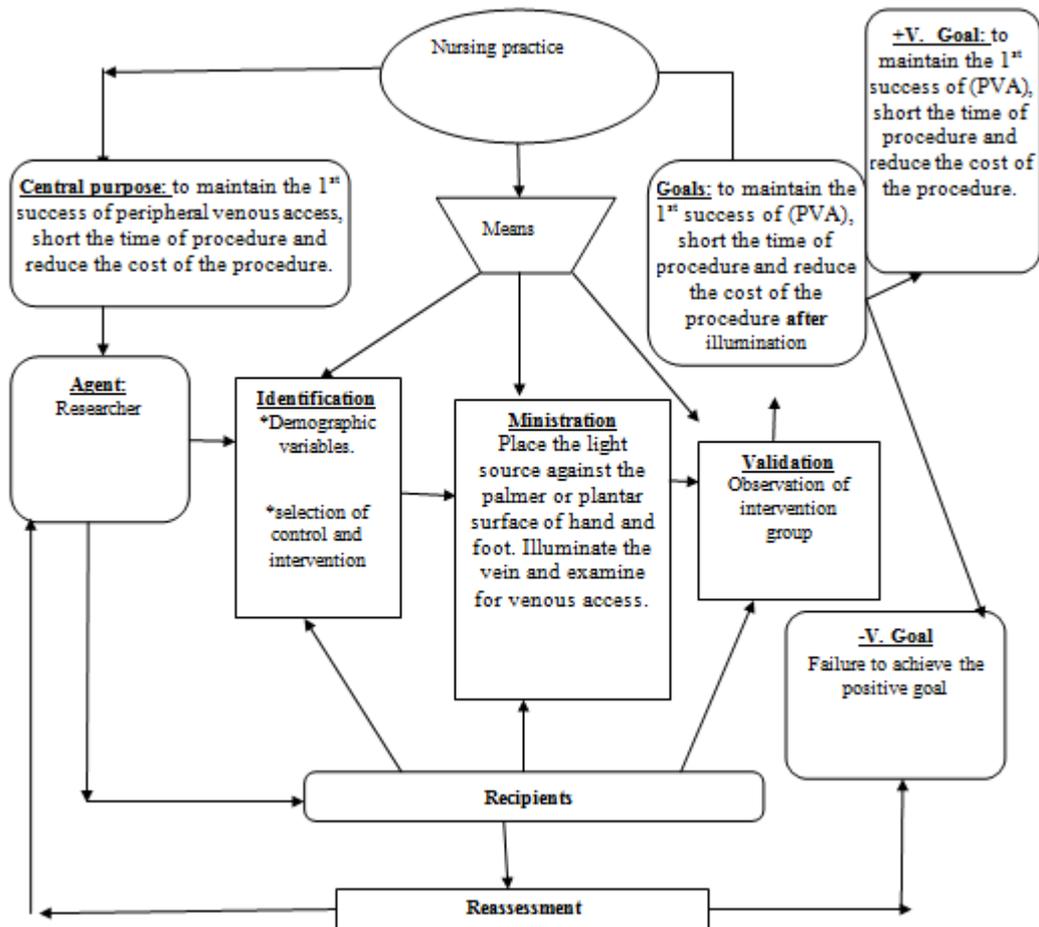


Figure 1: Modified Wiedenbach conceptual framework –The Helping Art of Clinical Nursing

1.8 Overview of the research

Chapter one provides an overview of the background and justification of the study, followed by the purpose and objectives of the study. Research questions and hypotheses were presented depended on the specific objectives of the study.. The structure of the thesis is outlined at the end of the chapter.

Chapter Two reviews the literature on peripheral venous cannulation in children. Definitions of peripheral venous cannulation, indication, contraindication, and procedure preparation as well as Transillumination and previous researches and studies are also presented.

Chapter Three outlines the methodology used in the study. Research design, place and duration of the study, population, sampling and sampling technique, operational definitions of variables are given and Conceptual framework used to conduct intervention was based on the Wiedenbach Theory- The Helping Art of Clinical Nursing -, and end of chapter described the interventional programme.

Chapter Four presents the results and discussion. Limitations of the current study are also outlined in this Chapter.

Chapter Five: concerning the conclusion of the study and recommendations expressed from the study. All annexes (questionnaire, consent form, ethical approval)were stated at the end of the thesis.

2. Literature Review

2.1 Introductions

Researcher rarely conduct research in an intellectual vacuum, a literature review is a critical and in depth evaluation of previous research. It is a summary and synopsis of a particular area of research, allowing anybody reading the research to establish why you are pursuing this particular research program. A good literature review expands upon the reasons behind selecting a particular research question (Polit & Beck, 2008)

In medicine, a peripheral venous catheter (PVC) or peripheral venous line or peripheral venous access catheter) is a catheter (small, flexible tube) placed into a peripheral vein in order to administer medication or fluids. Upon insertion, the line can be used to draw blood.

The catheter is introduced into the vein by a needle which is subsequently removed while the small tube of the cannulae remains in place. The catheter is then fixed by taping it to the patient's skin (unless there is allergy to adhesives). Newer catheters have been equipped with additional safety features to avoid needle stick injuries. Modern catheters consist of synthetic polymers such as Teflon (hence the often used term 'Venflon' for these venous catheters).

A peripheral venous catheter is the most commonly used vascular access in medicine. It is given to most emergency

room and surgical patients, and before some radiological imaging techniques using radiocontrast, for example. In the United States, more than 25 million patients get a peripheral venous line each year. (Soifer, Borzak, Edlin, Weinstein 1998)

A peripheral venous catheter is usually placed in a vein on the hand or arm. It should be distinguished from a central venous catheter which is inserted in a central vein (usually in the internal jugular vein of the neck or the subclavian vein of the chest), or an arterial catheter which can be placed in a peripheral as well as a central artery. In children, a local anesthetic gel (such as lidocaine) is applied to the insertion site to facilitate placement. The caliber of cannulae is commonly indicated in gauge.

Intravenous cannulation is a technique which is used to place a cannulae inside a vein for the purpose of providing venous access. There are a number of reasons why a doctor or medical team might want venous access. Cannulation can be performed at the scene of an emergency by first responders who want to make sure that they will have access to a vein and it is also routinely done in hospital settings. Intravenous cannulation is one of the earliest skills learned by health care providers like doctors, nurses, and paramedics.

In the intravenous cannulation procedure, a needle is used to gain access to the target vein so that cannulae can be placed. Cannulae are usually inserted for short term therapy as well as for bolus injections or short infusions in the outpatient or day-unit setting (Royal College of Nursing 2005).

“Establishing vascular access is one of the most common procedures carried out in the emergency department (ED) and a high priority for the care of a critically ill and unstable patient. The condition of the patient often plays a role in the likelihood of attaining vascular access. Conditions associated with difficult vascular access include obesity, chronic illness, hypovolemia, intravenous (IV) drug abuse, and vasculopathy (Blavias & Lyon, 2006; Chinnock, Thornton, & Hendey, 2007; Costantino, Parikh, Satz, & Fojtik, 2005; Miles, Salcedo, & Spear, 2011; Nafiu, Burke, Cowan, Tutuo, Maclean, & Tremper, 2010). Patients with difficult IV access are frequently subjected to repeated attempts by multiple practitioners.

Success rate and time to vascular cannulation are crucial to the optimal resuscitation of a critically-ill patient. This can be a challenging to even the most experienced emergency nurse. Failure rates of emergent IV access vary in the literature. Leidel, Kirchhoff, Bogner, Stegmaier, Mutschler, Kanz, and Braunstein (2009) identify a failure rate ranging from 10 to 40%. Katsogridakis, Seshadri, Sullivan, and Waltzman (2008) identifies success rates in multiple attempts for admitted patients at a children’s hospital ranges from 23% for physicians, 44% for nurses to 98% for IV nurse clinicians. The average time requirement for peripheral IV cannulation is reported at 2.5 to 13 minutes, with difficult IV access requiring as much as 30 minutes (Leidel et al., 2009). The number of attempts at IV cannulation for the pediatric patient ranges from 1 to 10 attempts (Katsogridakis et al., 2008). Utilization of anatomic

landmarks for peripheral IV access holds a 90% success rate (Costantino et al., 2005).

“The current literature on venous access in infants and children for acute intravascular access in the routine situation and in emergency or intensive care settings is reviewed. The various techniques for facilitating venous cannulation, such as application of local warmth, transillumination techniques and epidermal nitroglycerine, are described. Preferred sites for central venous access in infants and children are the external and internal jugular veins, the subclavian and axillary veins, and the femoral vein. The femoral venous cannulation appears to be the most safe and reliable technique in children of all ages, with a high success and low complication rates. Evidence from the reviewed literature strongly supports the use of real-time ultrasound techniques for venous cannulation in infants and children. Additionally, in emergency situations the intraosseous access has almost completely replaced saphenous cut down procedures in children and has decreased the need for immediate central venous access. Finding an accessible vein in infants is frequently difficult when the skin is colored, the infant is dehydrated, obese or shocked, or when the commonly accessible veins are exhausted”. Transillumination techniques have been used for many years to facilitate arterial puncture and venous access. (Nikolaus A Haas, 2004)

Transillumination

Many people have engaged in a form of transillumination by shining light through their fingers. If the area is dark, the fingers light up with a red glow, because the blood in the fingers absorbs light waves in other areas of the spectrum. This trick also works on feet and toes, as some may have already noted. Basic transillumination of this kind done with a flashlight is not far off from the techniques used in the examining room. By passing light through an area of tissue, a doctor can sometimes collect important information. Irregularities in the distribution of the light can indicate that there is a problem, such as a buildup of fluid where there shouldn't be, or a mass. Transillumination can sometimes be used to visualize clots in thin tissue, and it is also used in a procedure known as transilluminated phlebectomy, in which transillumination is used to guide a surgeon as she or he removes varicose veins.

Examinations of the ear, nose, and mouth often take advantage of transillumination. The bright light makes more structures visible, providing a complete picture, and variations in the light can be used to identify problems, as well. Transillumination is also used in the examination of breasts and testicles, or in the examination of infants, who are small enough that light can pass through their torsos as well as their extremities. In some cases, transillumination an area can rule out a potential diagnosis, allowing a doctor to move on to other diagnostic tests. In others, the transillumination may reveal a problem which additional testing can confirm, or the transillumination may be a diagnostic tool, with no additional testing needed to confirm a diagnosis. Over time, doctors become skilled at recognizing familiar patterns and shapes, learning to identify abnormalities of concern and to distinguish normal variations in the human body from pathologies which need

to be addressed with additional testing which can be used to gather information about treatment options. (S.E. Smith, 2012)

In medicine transillumination generally refers to the transmission of light through tissues of the body. A common example is the transmission of light through fingers, producing a red glow due to red blood cells absorbing other wavelengths of light. Organs analyzed include the sinuses, the breasts and the testes. It is widely used by pediatricians to shine light in bodies of infants and observe the amount of scattered light. Common examples of diagnostic applications are:

Transillumination of peripheral venous access

Holly A. Hess conducted a study investigating a Biomedical Device to Improve Pediatric Vascular Access success. The objective of the study is to evaluate the effectiveness of a vein-viewing device on the success of venipuncture performed by staff nurses on a pediatric surgical unit by non-randomized study which examined pediatric inpatients from the age of newborn to 17 years requiring vascular access at a tertiary care center in northeast Florida. The number of attempts, age of the patient, and time required to establish successful vascular access using a vein-viewing device were self-reported by nursing staff (experimental group, $n = 91$) as well as staff, patient, and parental comments about the device. These data were compared to baseline data (control group, $n = 150$) previously collected on the same unit without using the device. The variables were first-attempt success rate, and the time of procedure. Results when comparing the two groups, the first-attempt success rate increased from 49.3% to 80.2% and the percentage of procedures completed in 15 minutes or less increased from 52.8% to 86.7%. Results were statistically significant for all variables between the two groups and also when re-analyzed in subgroups controlling for age. Use of a vein-viewing device significantly improved first-attempt venipuncture success rate, decreased the number of attempts per patient, and decreased procedure time for the study population. The device was well received by patients, families, and staff. (Pediatric Nursing, 2010)

N.J. Cuper, et al conducted a study on difficult arterial cannulation in children: is a near-infrared vascular imaging system the answer? Mentioned that Arterial Cannulation is a common anesthetic procedure that can be challenging and time-consuming in small children. By visualizing the position of the radial artery, near-infrared vascular imaging systems (NIRVISs) might be of assistance in arterial cannulation, evaluated the effectiveness of an NIRVIS in arterial cannulation in infants. An observational study was conducted in patients up to 3 yr old, undergoing arterial cannulation before cardiothoracic surgery. Arterial cannulation was performed as usual in 38 patients, and subsequently with the NIRVIS in 39 patients. The study found that the time to successful cannulation was 547s (171–1183) without and 464 s (174–996) with the NIRVIS ($P=0.76$) and the time to first flashback of blood was 171 s (96–522) and 219 s (59–447), respectively ($P=0.38$). There was a tendency in favour of the NIRVIS in success at first attempt: 12/38 and 7/39, respectively ($P=0.29$) and in the

number of punctures: 6 (2–12) and 3 (1–7), respectively ($P=0.10$). So, study did not show a significant clinical improvement when NIR light was used during arterial cannulation in small children. There is a large difference between time to first flashback of blood and time to successful cannulation, indicating that inserting the cannulae, and not localizing the artery, is the main difficulty in arterial cannulation in children.

Eugen-Matthias Strehle, conducted a study about Near-Infrared Spectroscopy and Phlebotomy in Children. Phlebotomy and venous cannulation are the most frequently performed and the most distressing invasive procedures in pediatrics. Study assessed whether a novel vein imaging system was advantageous for the identification of superficial veins, thus reducing the number of skin punctures. The Vein Viewer was trialed in 50 children <16 years of age who required venous blood sampling or peripheral venous catheterization as part of their standard clinical care. A questionnaire with 10 questions about their experience of using this equipment was distributed to the pediatric doctors and nurses performing the procedures. During a 9-month period, 38 venipunctures and 12 cannulations were performed in 50 children (mean age 6.67 years). On average, 1.7 puncture attempts per child were necessary. Fifty questionnaires were completed by 11 consultants, 16 registrars, 20 senior house officers, and 3 nurses. Seventy-two percent rated the imaging device as useful, 8% as not useful, and 20% remained neutral. Visibility of the peripheral veins was improved in 76% of children, and the same as with room light in 24%. And the study concluded that Near-infrared technology facilitated venipuncture and venous cannulation in a pediatric. (TMJ-2010)

Phipps, Modic, and Walsh. Conducted a randomized controlled trial in preterm and term neonates in a level 3 Neonatal Intensive Care Unit to study the Vein Viewer versus standard technique for placement of peripherally inserted central catheters (PICCs) in neonates, determined that peripherally inserted central catheters are important but can be difficult to place in neonates. So, comparison between a near-infrared device, with standard techniques was conducted to determine if its use would increase successful line placement. Study found that The Vein Viewer improved successful placement with the most benefit seen in infants of greater GA. (Journal of Perinatology 2011)

K. HOSOKAWA conducted a study on Transillumination by light-emitting diode facilitates peripheral venous cannulation in infants and small children. Identified that, clinical usefulness of light-emitting diode (LED) has not been thoroughly studied. Study randomly assigned 136 infants and children weighing <15 kg, undergoing general anesthesia, to red LED-powered Transillumination (intervention, $n=67$) vs. the usual method (control, $n=69$) for peripheral venous cannulation. The primary and secondary study variables were the rate of successful cannulations at initial attempt, and the duration of insertion attempts, respectively. The success rates at first attempt were 75% and 61% (NS) and mean \pm SD times to successful venous access were 47 ± 34 and 68 ± 66 s (NS) in the two groups, respectively. The cannulation procedures were completed

significantly earlier in the intervention group than in the UM group $P=0.03$). In the subgroup of infants and children <2 years old, peripheral venous cannulation was successful at first attempt in 73% and 49% in the intervention group ($n=44$) and in the control group ($n=47$), respectively ($P=0.03$). study concluded that LED-powered Transillumination devices facilitated peripheral venous cannulation in small infants and children. (Wiley 2010)

(Natascha J Cuper, et al) conducted study aimed to evaluate the first time the value of visualizing veins by a prototype of a near-infrared (NIR) vascular imaging system for venipuncture in children. children (0-6 years) attending the clinical laboratory of a pediatric university hospital during a period of 2 months without ($n = 80$) and subsequently during a period of 1 month with a prototype of an NIR vascular imaging system ($n = 45$) was conducted. Failure rate (i.e., more than 1 puncture) and time of needle manipulation were determined. In intervention group, failure rate decreased from 10/80 to 1/45 ($P = .05$) and time decreased from 2 seconds (1-10) to 1 second (1-4, $P = .07$). study showed promising results on the value of an NIR vascular imaging system in facilitating venipuncture in children.

(J Routt Reigart) conducted Prospective study in hospitalized children younger than 19 years in general inpatient wards, study aimed to determine parameters of pediatric PIV placement, including success rates, time to success, and factors associated with success, observation of PIV placement by trained research staff. Successful placement was achieved in 95.8% (567/592) cases with a median time of 9 minutes. Children younger than 2 years were less likely to have success on the first attempt (38.9% vs 53.5%) and have longer time to success (11 minutes). Children younger than 2 years experienced lower first-attempt successful PIV placement and took longer. The overall success rate was similar to prior reports; these data are the first to show differential PIV success by patient age.

Shinya Yamzaki 2011 conducted study about the "Effects of a transmitted light device for pediatric peripheral venipuncture and intravenous cannulation. Pediatric peripheral venipuncture and intravenous cannulation are difficult. However, successful venipuncture and intravenous cannulation are absolutely required for pediatric clinical risk management. This study assessed the success rate of venipuncture and intravenous cannulation when transmitted light was applied to the pediatric dorsum manus. The subjects included 100 young children who were scheduled for dental treatment or oral surgery under general anesthesia. Anesthesia was induced, and insertion of an intravenous catheter into the dorsum manus was attempted with or without using transmitted light. The patients were evaluated to determine whether the venipuncture was successful, and whether the intravenous cannulation of the external catheter was successful. The success rate of venipuncture was 100% when transmitted light was used, and 83% when the transmitted light was not used ($P = 0.000016$). In addition, the success rate of intravenous cannulation was 88% when transmitted light was used, and 55% when the transmitted light was not used ($P = 0.0000002$). The shape of the vein in the dorsum manus can be clearly recognized when transmitted light is used. The use of light significantly

increased the success rate of intravenous cannulation, because it allowed direct confirmation of the direction to push the intravenous catheter forward. The use of transmitted light allows for more successful venipuncture and intravenous cannulation in young children." Auckland, N.Z.)

Outcome of Literature Review

Transillumination is a diagnostic technique in which bright light is projected at or through an area of interest. It can be used in the diagnosis and evaluation of a number of medical conditions, and can sometimes be a very useful quick medical test when a doctor wants to make a rapid evaluation. There are no risks associated with transillumination, and the procedure is painless for the patient. This makes it especially appealing for examinations of infants and children. Literature review has shown that there are benefits

3. Methodology

3.1 Introduction

This chapter outlines methods & procedure used to address the research questions for the study. The research questions were:

RQ1: What was the effect of using Transillumination of peripheral venous on the cannulae insertion success rates?

RQ2: What was the effect of using Transillumination of peripheral venous on time of peripheral intravenous (IV) cannulae insertion?

RQ3: What was the effect of using Transillumination of peripheral venous in the cost of cannulae insertion in health facilities?

RQ4: Were there any association between some demographic variables and peripheral venous success rate in intervention and control group?

Detailed descriptions about research design, place and duration of the study, population participated in the study by inclusion and exclusion criteria determined before, sample size of the study and sampling technique used, data collection method and method by which data were analyzed all these were discussed and applied to the study

3.2 Research design

Research design provides the backbone structure of the study. It determines how the study will be organized, when the data will be collected and when intervention if any will be implemented. (Polit, Hungler, 1991). The design of the present study is non randomized clinical trial, to evaluate the effectiveness of Transillumination on peripheral venous Cannulation in children in Khartoum state pediatric hospitals. The sequence of the design is represented in figure 1.2

3.3 Place & duration of study

3.3.1 Place of study

The physical location and condition in which data collection was took place in the study. (Polit, Hungler 1991) This study was conducted in Khartoum state pediatric hospitals which are:

- 1) Omdurman pediatric hospital (Mohamed Alamin Hamid) for control
- 2) Aalbulk pediatric hospital for control.
- 3) Alseweedi charity pediatric hospital for control
- 4) Jaafar Ibn Oaf hospital for intervention
- 5) Ahmed Gasim hospital for intervention
- 6) Abo sea'd hospitals for intervention

3.3.2 Duration of study

Total duration of the Study was from April 2009 to October 2012. Data collection took four months from April 2012 to August 2012.

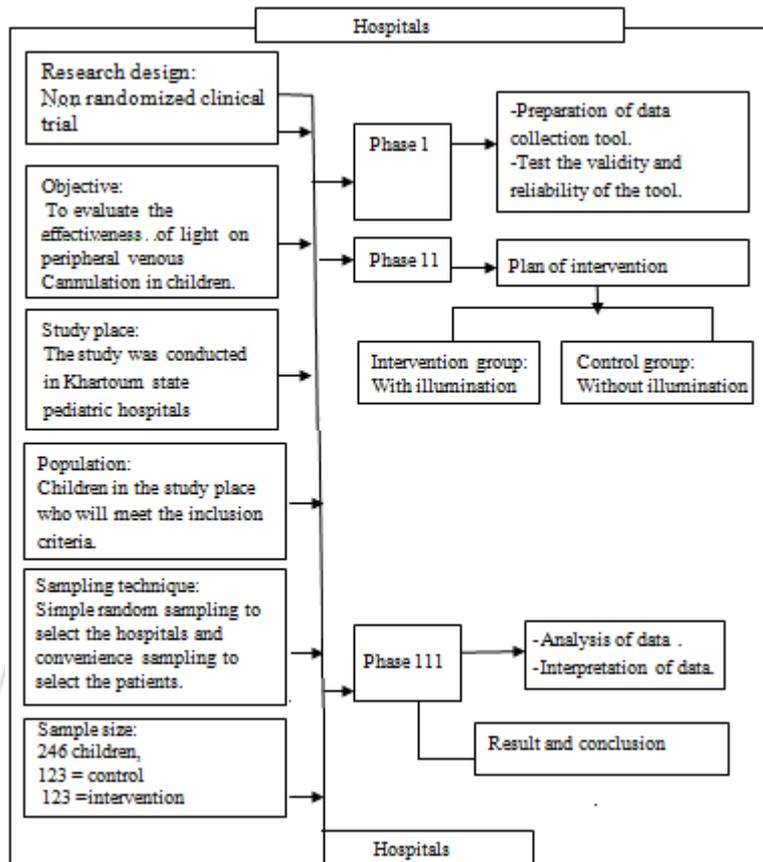


Figure 2: Sequences of research design

3.4 Population

A study population is a well defined set of elements that have certain properties like a set of people, (Wood & Haber 2002: 240 and Burns & Grove 2005: 341)

The main study populations were children in the study area who will meet the inclusion criteria.

3.5 Inclusion & exclusion criteria

3.5.1 Inclusion criteria

- 1) Hospitalized children needing peripheral (IV) access as decided by the treating doctors.
- 2) Age between 1 to 60 months.
- 3) Caregivers willing to participate in the study.

3.5.2 Exclusion criteria:

- 1) Hospitalized children with clear and visible veins.
- 2) Hospitalized children needing another type of access.

3.6 Sampling technique & sample size

Sampling is the process of selecting subjects from a designated population to represent the whole population (Wood & Haber 2002). Probability sampling method was used. Probability sampling allows every member or element

in the study population to stand an equal chance of being selected into the study (Bless, Hagson-Smith & Kagee 2006). Hospitals participated in the study were randomly selected and all accepted to participate in the study. Subjects selected were willing to participate in the study and no one dropped out from the study.

3.6.1 Sample Size

Khartoum state Paediatrics hospitals having admission rate of 3,402 children /month (MOH 2011). Using Morgan table for determining sample size for research activities from a given population **for precision (e) of ± 5% which are 246 children**, divided into two group **123 children** for cannulae only group without Transillumination (control group) and **123 children** for cannulae with Transillumination group (intervention group).

3.6.2 Sampling Techniques

In this method every member or element has chance of being selected to participate. Khartoum state Paediatrics hospitals are six hospitals therefore three hospitals will be selected randomly for cannulae with Transillumination group (intervention) and the other three hospitals will be for the cannulae only group (control).

Total numbers of participants from each hospital were selected according to the hospital admission rate per month

some hospitals have admission about 800 child per month and some have only 160 per month ,so the sample size from each hospital vary according to the admission per month. Convenience method was used to select the number decided from each hospital ,123 were selected as control group (cannulae only group) from Omdurman pediatric hospital (Mohamed Alamin Hamid), Aalbulk pediatric hospital and Alseweedi charity pediatric hospital, other 123 were selected as intervention group (cannulae with Transillumination group) from Jaafar Ibn Oaf hospital, Ahmed Gasim hospital and Abo sea'd hospitals till the total sample was completed.

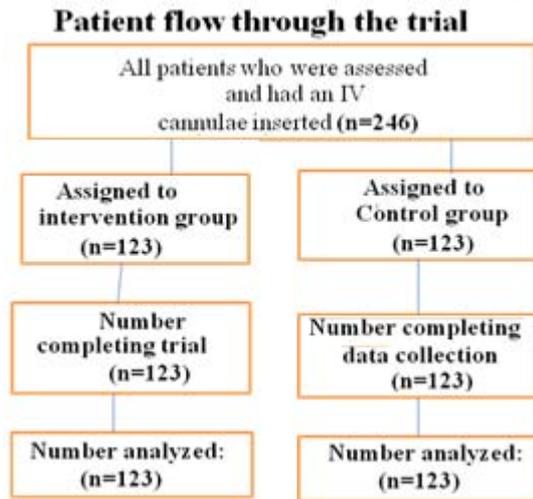


Figure 1.3: patients flow through the study

3.7 Variables

3.7.1 Dependent variables

Is the condition or a characteristic that appears and disappears as a result of independent variables (Polit , Hungler 1991) the dependent variables of this study are:

- 1) Success rate
- 2) Time of procedure
- 3) Total cost of the procedure

3.7.2 Independent variables

Is the condition or a characteristic that is manipulated by the researcher. (. (Polit, Hungler 1991)

The independent variables of this study are:

- 1) Demographic variables for children:
 - Age.
 - Gender
 - Skin color
 - Diagnosis
- 2) Health professional qualification level (who was insert the cannulae)
- 3) Transillumination light procedure(intervention vs non-intervention groups)

Table 3.1: Operational definitions of variables

Variables	Operational definition	Scale of measurement
1. Success rate	Numbers of trials of insertion of cannulae per patients.	Ordinal 1= 1 st attempt 2 = 2 nd attempt 3= 3 rd attempt 4= more than three attempt
2. Time of procedure	Amount of time from the start of the search for an appropriate vein (after skin preparation and application of the tourniquet) to successful insertion of the cannulae (calculated in minutes)	Ordinal 1= < 5 minutes 2= 5-10 minutes 3= > 10 minutes
3. Cost of procedure	Calculated by adding cost of cannulae + cost of alcohol swab +cost of syringes used for insertion.	Numeric/continuous In Sudanese Pound
4. Transillumination light	Portable cold light source (torch) used to illuminate the vein and examine for venous access. It should be placed against the palmer or plantar surface of the hand or foot.	Nominal Yes =used illumination No = not used illumination
5. Age	Age of children participated in the study calculated from date of birth until the date of interview. Measured in month and categories based on size of cannulae	Ordinal 1= 1-24 month 2= 25-36 month 3= 37-60 month
6. Gender	Gender of children participated in the study.	Nominal 1= Boy 2= Girl
7. Diagnosis	Final Diagnosis of children participated in the study as decided by treating physician. It taken from the patient.	Nominal 1=dehydration 2=infection 3=anemia 4= convulsions 5=CHD
8. Skin color	Skin Color of children participated in the study. It observed visually by the researcher.	Nominal 1= White 2=Fair skin color 3=Black color
9. Health professional qualification	Title of health professional who inserted the cannulae in pediatric hospitals.	Nominal 1= Registrar 2= House officer 3= Nurse

3.8 Procedure of data collection & Instruments:

3.8.1 Development of the instrument:

The flowchart assessment was prepared based on literature review, supervisor advice and researcher experience. The tool was written in English and Arabic language.

The following steps were taken to prepare the tool:

- 1) Review of literature.
- 2) Supervisor advice.
- 3) Researcher experience.

3.8.2 Description of the instruments The data collection tool consisted of: 1. Flowchart assessment: it consisted of two sections

- Demographic data.(section one): The demographic data include age of the child, gender, skin color and the diagnosis. The research teams were asked to take and record these before the procedure start.
- Structured observation sheet for cannulae insertion assessment was used for data collection where a decision is made prior to the observation on what is to be observed and how to ensure that every variable is observed in a similar manner in each instance (Burns & Grove 2005: 395). The research assistance team were asked to record the number of attempts for cannulae insertion, number of cannulae, swab, and syringes used, also the team were asked to measure and record the time needed to complete the procedure (grouped in three categories -less than 5 minutes, 5-10 minutes and over 10 minutes)

Transillumination light: this tool was used for Transillumination group

The Transillumination technique will be established with a cold-light source, the extremity should be stabilized and examined for venous access with the fibre optic light source, which was placed against the palmar or plantar surface of the hand or foot. The lights in the treatment room turned off and a device can be placed to visualize the veins. Venous visualization may also be possible, even with hematoma formation and with previously punctured veins. Surface veins appear darker and more defined than the diffuse lines of deep veins. Patients in which venous access was achieved after more than two attempts or in a longer time than 10 min are recorded.

Other instruments used in this study

- 1) Cannulae
Mainly pediatric size, 24gauge and 22gauge
- 2) Weight and height scales.
To measure the weight and height of the child.
- 3) Watch:
To measure the time.

3.8.3 Procedure of data collection

A written permission was taken from the general directors, quality control and nursing department of all hospitals under study, the quality control director and nursing superintendent of the hospital helped the researcher to get co-operation from the patients during the study. In three hospitals that were identified for control group the research team were observing the procedure of cannulae insertion as a routine without using the illumination device, and in the other three

hospitals which were selected for intervention the researcher or the research team assistant used the device for the first three children who needed IV access, then the health professional (nurse –house officer- registrar) who usually insert cannulae in the pediatric hospital and have minimum three years experience in pediatric field were asked to use the device and continue using this method until the completion of the sample size.

For cannulae only group the research team will collect data by filling section one in the Flowchart assessment and section two without using the device. For cannulae insertion by using illumination group the research team will collect data by filling the section one in the Flowchart assessment and continue to section two using the device.

For the intervention group the research team had to do the following:

- 1) Ask mothers about child age.
- 2) Take weight and height to the child.
- 3) Use the device to illuminate the vein for cannulae insertion.
- 4) Observe the procedure and record attempts of insertion and number of cannulae, swab, syringes used and time of the procedure during the trans-illumination.

For control group the research team had to do the following:

- 1) Ask mothers about child age.
- 2) Take weight and height to the child.
- 3) Observe the procedure and record attempts of insertion and number of cannulae, swab, syringes used and time of the procedure.

3.9 Data Management & Analysis

The data obtained were analyzed and tabulated according to the objectives of the study using descriptive and inferential statistical test which include:

- a) Frequency and percentage of demographic variables
- b) One sample 't' test for comparing the data of peripheral venous cannulation between intervention and control group.
- c) Descriptive statistics (crosstab) to find out the association between peripheral venous Cannulation and the selected demographic variables in the control and intervention groups.
- d) Data were presented in the form of tables and graphs to make it simple to understand.
- e) Data from the cannulae insertion only and cannulae insertion with Transillumination will be compared and analyzed by using the statistical package for social sciences (SPSS for windows Microsoft 2007) the outcome variables were:
 - The percent of attempts success per patient.
 - The number of cannulae, swab, and syringes used to calculate the total cost of the procedure.
 - The amount of time required to complete the procedure.
 - In addition the demographic data will be analyzed.

3.10 Ethical Consideration

Approval from University of Medical Sciences and Technology Graduate College was taken.(attached).Permission to collect data from the study area was requested from the Research Board in Ministry of Health-(Annexure attached) and hospitals managers (Annexes are attached) as recommended (Brynard & Hanekom 2005).

Written consents were obtained from the participants. Adequate information was provided to enable them to make an informed decision about their participation on a voluntary basis. (Annexes are attached) Information provided to participants included the purpose, description and benefits of the study. They were assured about maintaining the principle of anonymity and that they may withdraw from the study at any stage, without any negative consequences. De Vos et al (2002) recommend that research must be presented from accurate and complete facts taken from sources that have not been forced by the researcher.

3.11 Pilot Study

A pilot, or feasibility study, is a small experiment designed to test logistics and gather information prior to a larger study, in order to improve the latter's quality and efficiency. A pilot study can reveal deficiencies in the design of a proposed experiment or procedure and these can then be addressed before time and resources are expended on large scale studies. A good research strategy requires careful planning and a pilot study will often be a part of this strategy.

A pilot study is normally small in comparison with the main experiment and therefore can provide only limited information on the sources and magnitude of variation of response measures. A systematic review of the literature or even a single publication is a more appropriate source of information on variability. The pilot study may, however, provide vital information on the severity of proposed procedures or treatments.

This pilot study was conducted after written permission was taken from the general director of the (ACTH) .data collection was done from 1/4/2012-10/4/2012 in the (ACTH) after acceptance was taken. Twenty four subject was participate in this pilot study (10% of sample) to measure the authenticity of the tool and assured confidentiality. Data analysis was done using descriptive statistics; no significant problem was identified by the researcher.

3.12 Intervention programme

After the consent was taken from the participants or the parents", demographic data of the patients was recorded. Equipment was prepared and the patient was brought to the procedure room. Before cannulation was attempted (intervention group) a senior nurse or registrar categorized the veins as visible or invisible , if the vein is visible then the cannulae was inserted without using the device and the patient was excluded from the study. If the vein was not visible, then the procedure was started by using the device.

Data were collected by research team. The team had a practical session over one day on the how transillumination technique was used and how to fill of observational check list. The research teams were two senior nurses from outside hospitals under study.

The research teams used the device to insert cannulae for the first three patients in the peripheral veins (not included in the sample), then the health professional in the procedure room performed all the cannulae until the sample required was completed. All patients who met the inclusion criteria were included. Research team observed and recorded the attempts of cannulation , number of all facilities used to successfully complete the procedure (cannulae, swab, and syringes) and measured and recorded the time (in minutes) from the start of the search for an appropriate vein (after skin preparation and application of the tourniquet) to successful insertion of the cannulae. Successful cannulation was confirmed by the absence of signs of infiltration after saline solution administration. The room light was put off during the insertion of cannulae when using the illumination light, vein appears darker than the other veins.

3.13 Light source device

Light source device used in this study was composed of a small plastic box containing a pressure sensor and battery 3A and weighing approximately () with a battery life running about 200 h under typical use. Purchased for approximately 20 SDG, This cost can easily be justified if a few minutes of procedure room time can be saved by decreasing the time for successful achievement. The device is put under the palmar of the hands, and the light is put on, the baby hand is fist on the device, and the light circulates. The hemoglobin present in venous blood vessels absorbs light of this device and then reflects it until the vein is visualized clearly, the cannulae is fully inserted and the needle is removed. In most instances, it reduces the number of venous access attempts which can be especially beneficial in pediatric or awake patients by decreasing the pain and trauma typically associated with repeated venous access attempts.

4. Results & Discussion

4.1 Introduction

This chapter concerned with results and discussion of data collected through data collection assessment (DCA) of the peripheral venous Cannulation on children. Research results are analyzed and interpreted with the aim of finding scientific evidence on which recommendations could be based. Those recommendations are discussed in detail in chapter five of this study.

Data items on the questionnaire were analyzed by SPSS version 11, windows XP. The results were presented in frequency tables, and figures to make it simple to understand.

Cross-tabulations were used to show the relationship between different items in the data.

Table 4.1. Demonstrated the frequency and percentage of demographic variables of the children participated in the study, including age, gender, weight, height, diagnoses, skin color and title of health professional who insert the cannulae.

Variables	n	Percentage (%)
Groups		
Intervention	123	50%
Control	123	50
Gender		
Boy	120	48.7 %
Girl	126	51.3%
Age		
1-24	168	68.2 %
25-36	39	15.8 %
37-60	39	15.8%
Skin color		
White	49	19.9 %
Fair skin color	144	58.5%
Black	53	21.5%
Diagnosis		
Dehydration	83	33.7%
Infection	112	45.5 %
Anemia	23	9.3%
Convulsions	17	6.9 %
CHD.	11	4.4%

Table 4.2 chi-square test was used to provide information about the demographic differences between the children participated in the study. The results were used to address Hypothesis one: Success rate of Transillumination of peripheral venous in children is higher in intervention group compared to control group.

The results presented in figure 4-5 and 4-6 respectively were used to address Hypothesis two: Time of procedure of Transillumination of peripheral venous in children is shorter in intervention group compared to a control group.

An independent Samples t-Test was conducted to evaluate the hypothesis that Transillumination of peripheral venous will reduce the cost of cannulae insertion procedure in children, it was presented in Error bar figure, and in tables showed the cost of items used when insertion cannulae including number of cannulae, swab, and syringes.

The last results were concerning the hypothesis four: There is significant association between selected demographic variables (age, gender, skin color and medical diagnosis) Peripheral venous access in intervention and control group, using descriptive statistics, chi square test and were demonstrated in figures and tables.

The Statistical Package for the Social Science (SPSS) version 11 was used to analyse the data and statistical significance was set at alpha .05.

The results of the data are discussed according to the research questions examined and hypotheses. Limitations of the study are then discussed at the end of this chapter.

4.2 Results

4.2.1 Demographic data

Table 4.1: Frequency and percentage of demographic characteristic of sample.

Table 4.2: Demographic differences between control and intervention groups in Khartoum state pediatric hospitals 2012.(n=246)

Variables	intervention n (%)	control n (%)	Chi-square test	
			X ²	P-value
Gender				
Boy	57 (46.3)	63 (51.2)	59	0.262
Girl	66 (53.7)	60 (48.8)		
Age				
1-24	77 (62.6)	91 (74.0)	3.9	0.143
25-36	22 (17.9)	17 (13.8)		
37-60	24 (19.5)	15 (12.2)		
Skin Color				
White	19 (15.4)	30 (24.4)	3.5	0.173
Fair skin color	74 (60.2)	70 (56.9)		
Black	30 (24.4)	23 (18.7)		
Diagnosis				
Dehydration	31 (25.2)	52 (42.3)	14.4	0.006
Infection	60 (48.8)	52 (42.3)		
Anemia	16 (13.0)	7 (5.7)		
Convulsions	7 (5.7)	10 (8.1)		
CHD	9 (7.3)	2 (1.6)		

Table 4.1 shows Gender of patients in the intervention group 57(46.3%) were boys and 66(53.7%) were girls. While in the control group 63(51.2%) were boys and 60(48.8%) were girls. Numbers of boys who were participated in control group is more than boys in intervention group, and girls who were participated in the study from intervention group is more than number of girls participated in control group.(p=.262)

4.2.2 Procedure of cannulae insertion

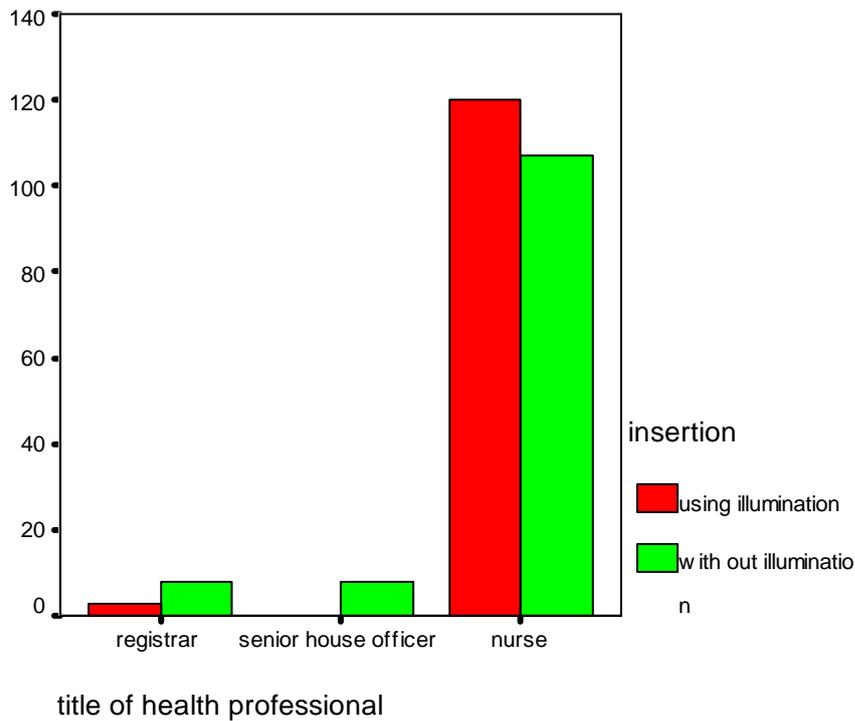


Figure 4.1: Frequency and percentage distribution of health professionals based on their qualification in intervention and control groups in Khartoum state pediatric hospitals. (n=246)

A two-way contingency table analysis was conducted to evaluate the title of health professional who inserted cannulae in pediatric hospitals in intervention & control groups. The two variables were group with two categories (intervention and control) and title with three categories (registrar, house officer and nurses). Groups title of health professional were found significantly related. Pearson chi-square (2,246) = 11.02, p.value = .004, in intervention group registrar were 3 (2.4%), house officer were 0 (0.2%) and

nurses were 120 (97.4%) while in the control group registrar were 8 (6.5%), house officer were 8 (6.5%) and nurses were 107 (87.0%)

4.2.3 Hypothesis 1:

Success rate of peripheral venous cannulation in children is higher in the group using Transillumination than in the control group.

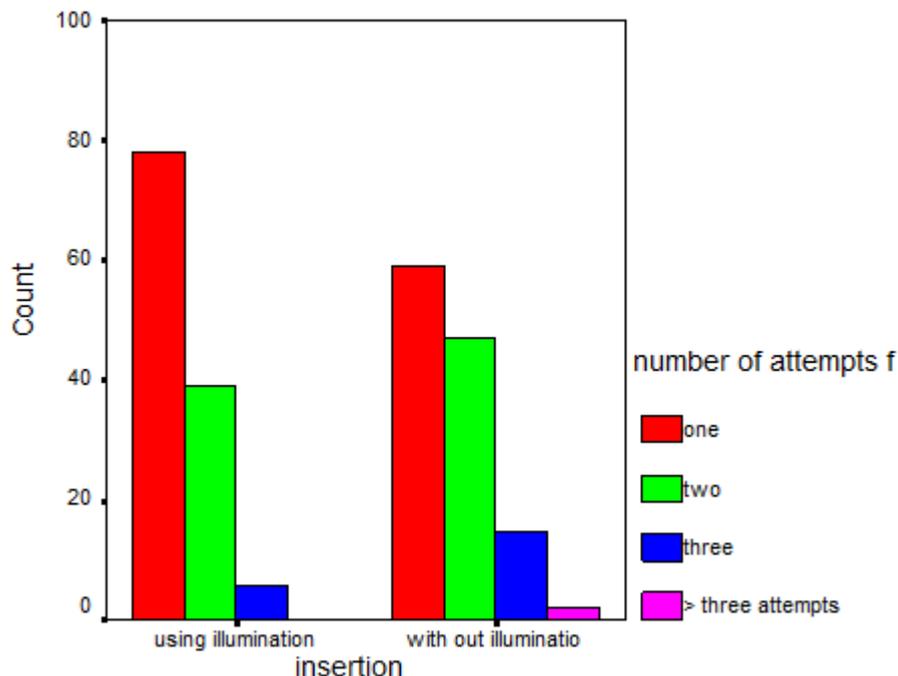


Figure 4.2: Frequency and percentage of intervention and control groups in Khartoum state pediatric hospitals. (n=246)

A two-way contingency table analysis was conducted to evaluate whether success rate were higher in intervention group. The two variables were group with two categories (intervention and control) and success rate with four categories (1st attempts , 2nd 1ttempts , 3rd attempts, more than three attempts) .Groups and success rate were found significantly related. Pearson chi-square (3,246) = 9.23,p.value 0.03.The proportions of success rate in intervention participants who were 1st attempt, 2nd attempts, 3rd attempts and >3 attempts were 0.43, 0.32, 0.05 and 0 respectively. More detailed frequencies and percentage in figure 4.3.(in the next page) .

Intervention group who participated in the study and successes in 1st attempts were 78 (43.4%), patients who successfully have cannulae insertion after two attempts were 39 (31.7%), patients who successfully have cannulae insertion after three attempts were 6 (4.9%) and who have successfully have cannulae insertion after more than three attempts 0 (0%).while in the control group patients who were successfully have one attempt 59 (48.0 %), patients who are successfully have cannulae insertion after two attempts were 47 (38.2%), patients who are successfully have cannulae insertion after three attempts were 15 (12.2%) and who have successfully have cannulae insertion after more than three attempts were 2 (1.6%)

n=246	
Intervention group n=123	Control group n=123
1 st attempt success n=78 Success rate =63.4% Failed n=45(36.6%)	1 st attempt success n=59 Success rate =48.0% Failed n=64(52.0%)
2 nd attempt success n=39 Success rate =31.7% Failed n=6(4.9%)	2 nd attempt success n=47 Success rate =38.2% Failed n=17(13.8%)
3 rd attempt success n=6 Success rate =4.9% Failed n=0(0%)	3 rd attempt success n=15 Success rate =12.2% Failed n=2(1.6%)
>3 attempts success n=0 Success rate =0% Failed n=0	>3 attempts success n=2 Success rate =1.6% Failed n=0

Figure 4.3: Number and percentage of success and failure rate of attempts for cannulae insertion in children in Khartoum state hospitals 2012.

4.2.4 Hypothesis 2:

Time of procedure of Transillumination of peripheral venous in children is shorter in intervention group compare to control group.

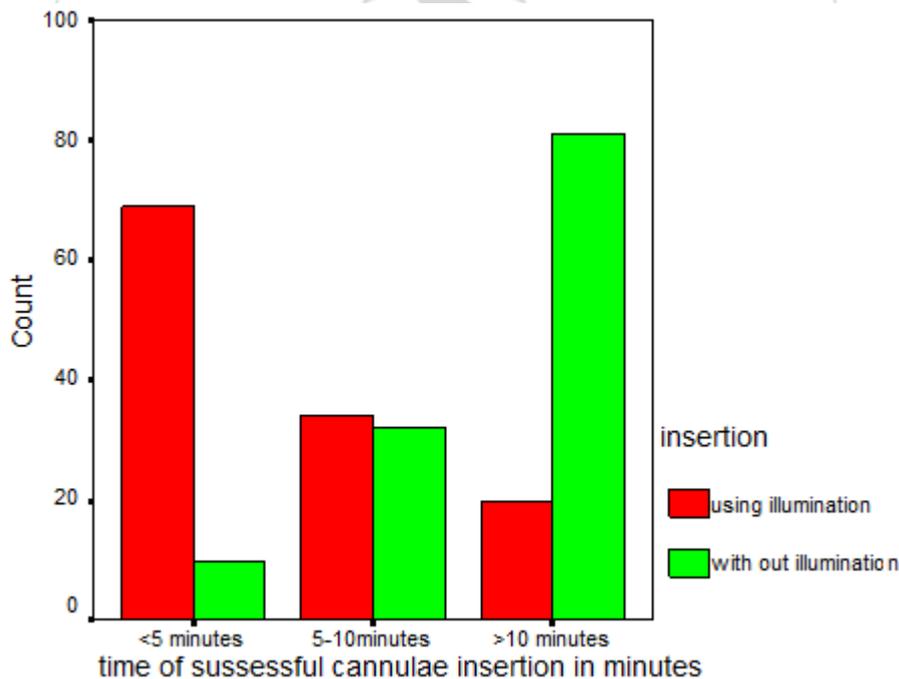


Figure 4.4: Time of cannulae insertion in the intervention and control groups in Khartoum state pediatric hospitals 2012.

A two-way contingency table analysis was conducted to evaluate whether time consumed was shorter in intervention group than control group. The two variables were group with two categories (intervention and control) and time was ordered with three, less than 5 minutes, 5-10 minutes, more than 10 minutes. Groups and time were found highly significant related. Pearson chi-square (2,246) = 80, 96: p.value .000.The proportions of time in intervention participants in less than 5 minutes, 5-10 minutes, more than

10 minutes were 0.87, 0.51, 0.20, respectively, more details were found below in the next page.

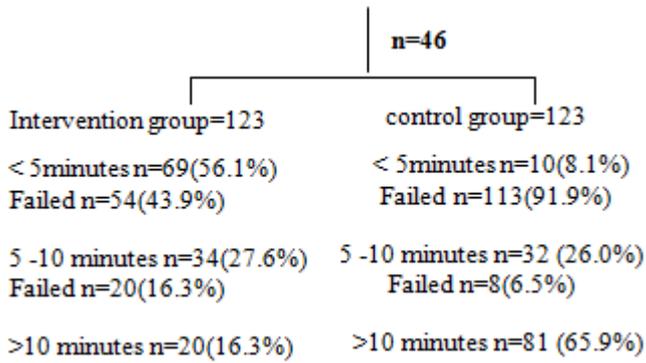


Figure 4.5: Details of time of cannulae insertion in the intervention and control groups in Khartoum state pediatric hospitals 2012

The figure shows total time consumed for successful cannulae insertion in the intervention group 69(87.3%) were success in less than 5 minutes, 34(51.5%) were success between 5-10 minutes, and 20 (19.8 %) were success after more than 10 minutes. While in the control group 10(12.7%) were success in less than 5 minutes, 32(48.5%) were success between 5-10 minutes, and 81 (80.2%) were success after more than 10 minutes.

4.2.5 Hypothesis 3:

Transillumination of peripheral veins will reduce the cost of cannulae insertion procedure in health facilities.

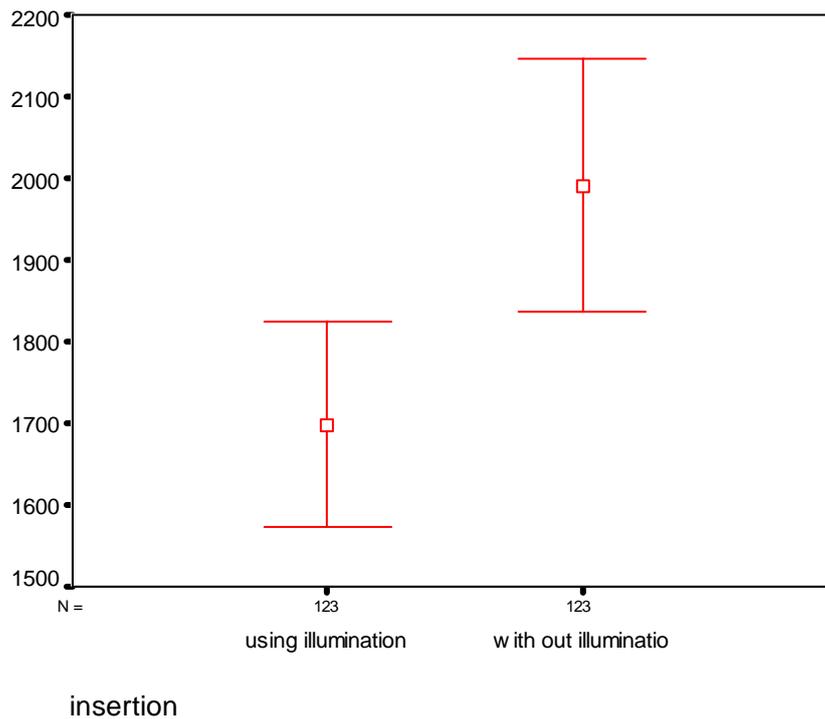


Figure 4.6: Total procedure cost in intervention and control groups using error bar in Khartoum state pediatric hospitals 2012

Figure 4.6. shows An independent - Samples t- Test was conducted to evaluate the hypothesis that Transillumination of peripheral venous will reduce the cost of cannulae insertion procedure in Khartoum state pediatric hospitals. With the number of participants 123 intervention and 123 control, the test was significant $t(246) = (-2.90)$ $p.value = (0.004)$ the result was support the research hypothesis that an intervention group mean (1698.57) ,SD (702.99) lower the cost of procedure. in control group mean(1991.32), SD (866.99) the 95% Confidence interval for the difference in means was from -490.99 to -94.52 the eta square index indicated that 3.4% of the variance procedure cost was accounted for by a whether a participant was assigned to intervention or control groups. More details were found below to explain how the total cost of all supplies was calculated.

Table 4.3: Cost of cannulae for cannulae insertion procedure intervention group & control groups in Khartoum state pediatric hospitals 2012.(n=246)

Groups No. of cannulae used	UI	NI	Per unit cost	Cost(SDG)	
				UI	NI
One	78	59	1.200	93.6	70.8
Two	78	96	1.200	93.6	112.8
Three	18	42	1.200	21.6	54
Four	0	8	1.200	0	9.6
TOTAL(SDG)				208.8	247.2

This table shows the cost of cannulae used in all attempts. in intervention group only three attempts were done, thus the maximum number used was three cannulae. in the 1st and 2nd attempt inserter used were 78cannulae , when these number multiply by cost/unit it equal 93.6SDG.in the 3rd attempt number of cannulae used were 18 cannulae, when multiply by cost/unit it equal 21.6SDG and the total cost of cannulae used in the intervention group was 208.8SDG. While in control group in the 1st attempt number of cannulae used was 59 cannulae, when multiply by cost/unit it equal

70.8SDG. in the 1st attempt number of cannulae used was 59 cannulae, when multiply by cost/unit it equal 70.8SDG. in the 2nd attempt number of cannulae used was 96 cannulae, when multiply by cost/unit it equal 115.2SDG. in the 3rd attempt number of cannulae used was 42 cannulae, when multiply by cost/unit it equal 50.4SDG, and in the 4th attempt number of cannulae used was 8 cannulae, when multiply by cost/unit it equal 9.6SDG. total cost of cannulae used in control group was 246SDG.

4.2.51 Number of alcohol swab used

Table 4.4 Frequency and percentage distribution of number of swab used to complete the successful cannulae insertion in the intervention and control groups in Khartoum state pediatric hospitals 2012.(n=246)

Groups No. of alcohol Swab	UI (intervention)		NI (control)	
	F	P	F	P
One	71	57.7%	43	35.0%
Two	29	23.6%	51	41.5%
Three	15	12.2%	23	18.7%
>three	8	6.5%	6	4.9%
Total	123	100%	123	100%

in the intervention group patients who used one swab were 71 (57.7%), patients who used two swab were 29(23.6%), patients who used three swab were 15(12.2%) and patients who used more than three swab were 8(6.5%).while in the control group patients who are used one swab were 43(35.0 %), patients who used two swab were 51(41.5%), patients who used three swab were 23(18.7%) patients who used more than three swab were 6(4.9%)

Table 4.5: Cost of alcohol swab for cannulae insertion procedure in intervention group & control groups in Khartoum state pediatric hospitals 2012.(n=246)

No. of alcohol swab used/ attempts	Groups		Per unit cost	Cost (SDG)	
	UI	NI		UI	NI
One	71	43	0.15	10.65	6.45
Two	58	102	0.15	8.7	15.3
Three	45	69	0.15	6.75	10.35
Four	32	24	0.15	4.8	3.6
TOTAL				30.9 (SDG)	35.7 (SDG)

This table shows the cost of alcohol swab used in all attempts. in intervention group inserter used 71 alcohol swab one time , when these number multiply by cost/unit it equal 10.65SDG. 58 alcohol swab used two time, when multiply by cost/unit it equal 8.7 SDG. 45 alcohol swab used three time, when multiply by cost/unit it equal 6.75 SDG. 32 alcohol swab used four time, when multiply by cost/unit it equal 4.8 SDG total cost of alcohol swab used in intervention group was 30.9SDG.While in control group inserter used 43 alcohol swab one time , when these number multiply by cost/unit it equal 6.45SDG. 102 alcohol swab used two time, when multiply by cost/unit it equal 15.3SDG. 69 alcohol swab used three time, when multiply by cost/unit it equal 10.35SDG. 24 alcohol swab used four time, when multiply by cost/unit it equal 6.3 SDG total cost of alcohol swab used in intervention group was 35.7SDG

4.2.5.2 Number of syringes used

Table 4.6: Frequency and percentage distribution of number of syringes used to complete the successful cannulae insertion in the intervention and control groups in Khartoum state pediatric hospitals 2012.(n=246)

Groups No. of syringes	Using illumination (intervention)		Without illumination (control)	
	Frequency	Percentage	Frequency	Percentage
One	121	98.40%	117	95.1%
Two	2	1.60%	5	4.1%
Three	0	0%	1	0.8%
Total	123	100%	123	100%

in the intervention group patients who used one syringe were 121 (98.4%), patients who used two syringe were 2(1.6%), and patients who used three syringe were 0(0%).while in the control group patients who used one syringe were 117(95.1%), patients who used two syringe were 5(4.1%), and patients who used three syringe were 1(.8%)

Table 4.7: Cost of syringes for cannulae insertion procedure in intervention group & control groups in Khartoum state pediatric hospitals 2012.(n=246)

Attempts	Number syringes used		Per unit cost	Cost (SDG)	
	Using illumination	Without illumination		Using illumination	Without illumination
1 st	121	117	0.75	90.75	87.75
2 nd	4	10	0.75	3	7.5
3 rd	0	3	0.75	0	2.25
4 th	0	0	0.75	0	0
TOTAL				93.75(SDG)	97.5(SDG)

This table shows the cost of syringes used in all attempts. in intervention group 121syringe used in the 1st attempts total cost were 90.75SDG. in the 2nd attempt 4syringes used with the total cost equal 3SDG. In control group 117 syringes was used in the 1st attempts with the total cost equal 87.75SDG. 10 syringe in the 2nd attempt with the total cost equal 7.50 SDG. And 3 syringes were used in 3rd attempt with the total cost equal 2.25 SDG.

Table 4.8: Total Cost of cannulae insertion procedure in intervention group & control groups in Khartoum state pediatric hospitals 2012.(n=246)

Group of insertion	some supplies used for cannulae insertion			Total (SDG)
	Cannulae cost	Swab cost	Syringes cost	
Using illumination	208.8	30.9	93.75	333.5
without illumination	247.2	35.7	97.5	380.4
Total difference				46.9 SDG

This table shows the total cost of procedure in the study groups. In intervention group total cost of cannulae used (208.8 SDG) added to total cost of alcohol swab used (30.9SDG) added to total cost of syringes used (93.75SDG) the total cost were 333.6SDG.

In control group total cost of cannulae used (247.2SDG) added to total cost of alcohol swab used (35.7SDG) added to total cost of syringes used (97. 5SDG) the total cost were 380.4 SDG. Total difference was (46.9SDG)

4.2.6 Hypothesis 4:

There is significant association between age and Peripheral venous access in intervention and control group.

4.2.61 Association between age of children and attempts of cannulae insertion in intervention and control groups:(n=246)

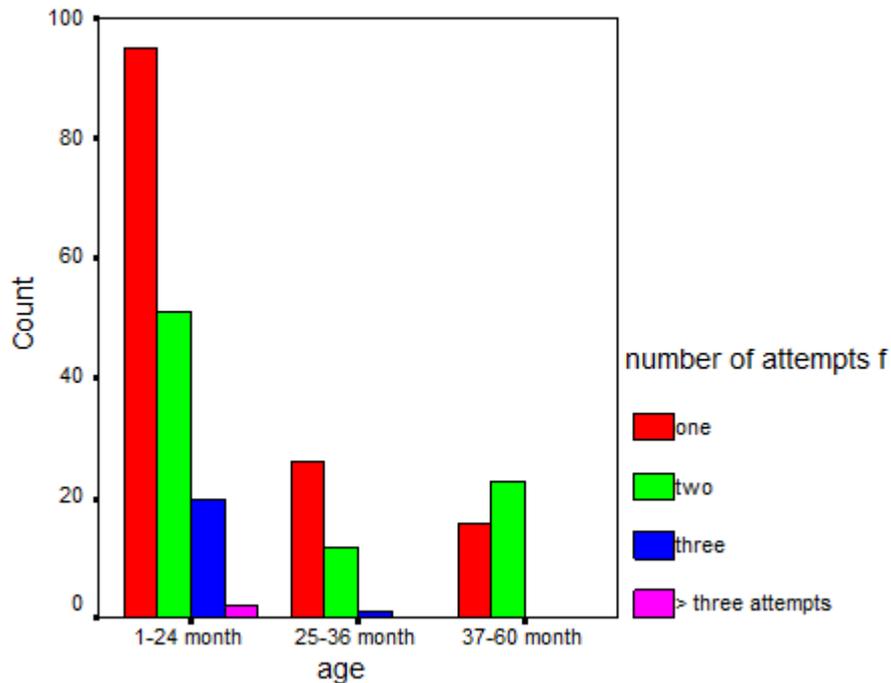


Figure 4.7: Association between age and number of attempts for cannulae insertion in intervention group and control groups in Khartoum state pediatric hospitals 2012.

A two-way contingency table analysis was conducted to evaluate whether there is a significant association between age and cannulae insertion success rate. The two variables were group with two categories (intervention and control) and age was ordered with three, (1-24) month (25-36) month (37-60) month. Number of attempts and age were found highly significant related. Pearson chi-square (6, 246) = 18.14. p.value = 0 .006.

In the intervention and control group out of 246 of participants 168, 39, 39 ages were from (1-24), (25-36), (37-60) respectively. Inserter’s were successful in the 1st attempts of cannulae insertion in 95 (38.6%) of participants from age 1-24 month. Inserter’s were successful in the 2nd attempts of cannulae insertion in 51(20.7%) of participants, Inserter’s were successful in the 3rd attempts of cannulae insertion in 20(8.1%) of children and Inserter’s were

successful in the more than three attempts of cannulae insertion in 2(0.8%) of children. In age 25-36 month maximum numbers of attempts were three. Inserter’s were successful in the 1st attempts of cannulae insertion in 26 (10.6%) of children, and were successful in the 2nd attempts of cannulae insertion in 12(4.9%) of children. Inserter’s were successful in the 3rd attempts of cannulae insertion in 1(0.4%) of children. In age 37-60 month maximum numbers of attempts were two. Inserter’s were successful in the 1st attempts of cannulae insertion in 16 (6.5 %) of children, and were successful in the 2nd attempts of cannulae insertion in 23(9.3%) of children. (All these results were summarized in figure 4.7)

4.2.62 Association between gender of children and attempts of cannulae insertion in intervention and control groups (n=246)

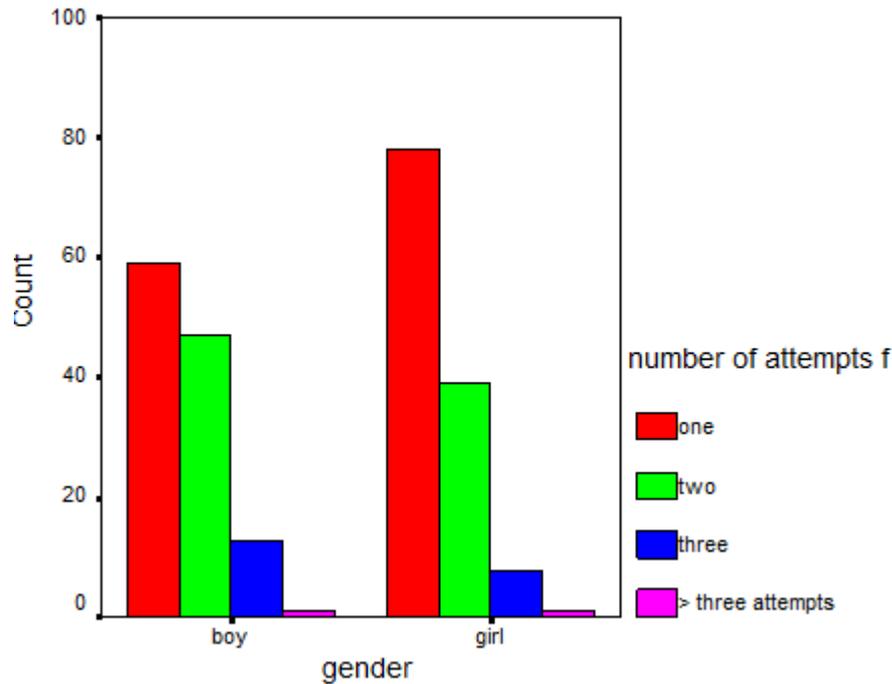


Figure 4.8: Association between gender and number of attempts for cannulae insertion in intervention group and control groups in Khartoum state pediatric hospitals 2012

A two-way contingency table analysis was conducted to evaluate whether there is a significant association between gender and cannulae insertion success rate. The two variables were group with two categories (intervention and control) and gender was categorized with two (boy and girls). There were no significant relation between number of attempts and gender. Pearson chi-square (3, 246) = 4.43. p.value = 0.219

In the intervention and control group out of 246 of participants, 120 were boys and 126 were girls. Regarding boys, Inserter's were successful to insert cannulae from the 1st attempt to 59 (24.0%) of boys, Inserter's were successful to insert cannulae in the 2nd attempt to 47 (19.1%) of boys,

Inserter's were successful to insert cannulae from the 3rd attempt to 13 (5.3%) of boys, Inserter's were successful to insert cannulae in more than three attempts to 1 (0.4%) of boys. Regarding girls, Inserter's were successful to insert cannulae from the 1st attempt to 78 (31.7%) of girls, Inserter's were successful to insert cannulae in the 2nd attempt to 39 (15.9%) of girls, and Inserter's were successful to insert cannulae from the 3rd attempt to 8 (3.3%) of girls and Inserter's were successful to insert cannulae in more than three attempts to 1 (0.4%) of girls.(All these results were summarized in figure 4.8)

4.2.6.3 Association between skin color of children and attempts of cannulae insertion in intervention and control groups:

Table 4.9: Association between skin color and number of attempts for cannulae insertion in intervention group and control group in Khartoum state hospitals 2012

	Number of attempts of cannulae insertion				Total	X ²	p.value
	One	Two	Three	>Three			
White	24(9.8%)	22(8.9%)	3(1.2%)	0(0%)	49(19.9%)	(6,246)= 9.35	0.155
Fair	83(33.7%)	43(17.5%)	17(6.9%)	1(0.4%)	144(58.5%)		
Black	30(12.2%)	21(8.5%)	1(0.4%)	1(0.4%)	53(21.5%)		

A two-way contingency table analysis was conducted to evaluate whether there is a significant association between skin color and cannulae insertion success rate. The two variables were group with two categories (intervention and control) and age was categorized with three (white, fair, and black skin). There were no significant relation between number of attempts and skin color. Pearson chi-square (6, 246) = 9.35. p.value = 0.155.

In the intervention and control group out of 246 of participants, 49, 144, 53 were white, fair, and black skin color respectively. Inserter was success in the 1st attempt to24 (9.8%) of white skin color, Inserter was success in the 2nd attempt to 22(8.9%) of white skin color, Inserter was success in the 3rd attempt to3 (1.2%) of white skin color.

Inserter was success in the 1st attempt to83 (33.7%) of fair skin color, Inserter was success in the 2nd attempt to 43 (17.5%) of white skin color, Inserter was success in the 3rd attempt to 17 (6.9%) of fair skin color. Inserter was success in the more than three attempt to1 (0.4%) of fair skin color For the same group regarding the black skin color Inserter was success in the 1st attempt to30 (12.2%) and success in the 2nd attempt to21 (8.5%) Inserter was success in the 3rd attempt to1 (0.4%) of black skin color Inserter was success in more than three attempt to1 (0.4%) of black skin color (All these results were summarized in table 4.9.)

4.2.6.4 Association between diagnoses of children and control groups: attempts of cannulae insertion in intervention and

Table 4.10: Association between diagnosis and number of attempts for cannulae insertion in intervention group and control group in Khartoum state hospitals 2012

	Number of attempts of cannulae insertion				Total	X ²	p.value
	One	Two	Three	>Three			
Dehydration	47(19.1%)	25(10.2%)	10(4.1%)	1(0.4%)	83(33.7%)	(12,246)= 21.40	0.04
Infection	67(27.2%)	38(15.4%)	6(2.6%)	1(0.4%)	112(45.4%)		
Anemia	16(6.5%)	6(2.4%)	0(0%)	0(0%)	23(9.3%)		
Convulsions	6(2.4%)	9(3.7%)	20.8%)	0(0%)	17(6.9%)		
CHD	1(0.4%)	7(2.8%)	3(1.2%)	0(0%)	11(4.5%)		

A two-way contingency table analysis was conducted to evaluate whether there is a significant association between diagnosis and cannulae insertion success rate. The two variables were group with two categories (intervention and control) and diagnoses were categorized with five (dehydration, infection, anemia, convulsions, and CHD). Number of attempts and diagnoses were found significantly related. Pearson chi-square (12, 246) = 21.40 p.value = 0.04.

In the intervention and control group out of 246 of participants, 83, 112, 23, 17, 11 were having dehydration, infection, anemia, convulsions, and CHD respectively. Inserter was success in the 1st attempt to 47 (19.1%) dehydrated patients, Inserter was success in the 2nd attempt to 25 (10.2%) dehydrated patients, Inserter was success in the 3rd attempt to 10 (4.1%) dehydrated patients and Inserter was success in more than three attempts to 1 (0.4%) dehydrated patients. Inserter was success in the 1st attempt to 67 (27.2%) of infection patients, Inserter was success in the 2nd attempt to 38(15.4%) of infection patients, Inserter was success in the 3rd attempt to 6 (2.4%) of infection patients and Inserter was success in more than three attempts to 1 (0.4%) of infection patients, regarding patients with anemia Inserter was success in the 1st attempt to 16(6.5%) and success in the 2nd attempt to 6 (2.4%). regarding patients with convulsions 6(2.4%), 9(3.7%), 2(0.8%) inserters were success in the 1st and 2nd and three attempts respectively. And patients with CHD 1(0.4%), 7(2.8%), 3(1.2%) (0%) inserters were success in the 1st and 2nd and three attempts respectively (All these results were summarized in table 4-10.)

4.3 Discussion

The present study was designed to evaluate the effectiveness of light source device on peripheral venous catheter for patients age from 1 to 60 months admitted to pediatric hospitals in Khartoum state, conducted over four months. Data were collected from 246 patients 123 who were selected as control group from Omdurman pediatric hospital (Mohamed Alamin Hamid), Aalbulk pediatric hospital and Alseweedi charity pediatric hospital, other 123 were selected as intervention group from Jaafar Ibn Oaf hospital, Ahmed Gasim hospital and Abo Sea'd hospitals. In this study the data collection instruments were demographic questionnaire to collect the demographic data, and observational checklist to collect data about:

- Procedure of cannulae insertion.
- Time consumed to complete the procedure.
- Cost of procedure of cannulae insertion

The next part of this chapter stated the discussion of results addressed in part one.

Regarding the demographic data, the results of this study demonstrated that there were no statistically significant differences in some demographic (age, gender, skin color) variables between the two groups (p value > 0.05) using chi-square test. The only significant difference was stated in diagnoses (p value < 0.05)

Research question one: What was the effect of using Transillumination of peripheral veins on the cannulae insertion success rates?

Hypothesis one: Success rate of cannulae insertion in peripheral veins in children is higher when using Transillumination compares to control group.

The study results showed that a cold light device, such as the portable head light, can improve vascular access success in pediatric patients. First-attempt access success rate was significantly higher in intervention group compared to control group (56.9% vs. 43.1%) (p = 0.03). The maximum number of attempts was three in intervention group compared to more than three attempts in control group. Two attempts were required in 45.3% of patients in the intervention group and in 54.7% of the control group; three attempts were needed in 28.6% in intervention group and 71.4% in the control group, there was no more than three attempts in intervention group, but there was 1.6% in control group, thus the findings showed that the success rate was higher in intervention group who were using the light source device, and hence the first research hypothesis was accepted.

Although, the findings of this study in first attempt success rate increased from 48% to 63.4% (the different 15.4%) but this was lower than findings by Hess(2004) who conducted study to investigate A biomedical device to improve pediatric vascular access success rate. The objective of that study was to evaluate the effectiveness of a vein-viewing device on the success of venipuncture performed by staff nurses on a pediatric surgical unit. This study design non-randomized study which examined pediatric inpatients from the age of newborn to 17 years. The sample required vascular access at a tertiary care center in Northeast Florida. The number of first-attempt success rate increased from 49.3% to 80.2%, (the different 30.9%) (Experimental group, n = 91). These data were compared to baseline data (control group, n = 150) previously collected on the same unit without using the device. Results were statistically significant between the two groups. The difference between

the two studies may be of age this recent study age were between 1 to 60 months, while Hess's study age from newborn to 17 years old. Another reason for the difference in the recent study was different operators to insert the cannulae (registrars, house officer, and nurses) whereas; in the Hess's study all the operators were staff nurses on a pediatric surgical unit (who suggest were skillful).

Although, the findings of this study in first attempt success rate increased from 48% to 63.4% (the different 15.4%) and failure rate in the first attempts decreased from 52.0% to 36.6% (the different 15.4%) but this was higher than the findings of Natascha J Cuper, et al who were conducted study aimed to evaluate the first time of visualizing veins by a prototype of a near-infrared (NIR) vascular imaging system for venipuncture in children. Children (0-6 years) attending the clinical laboratory of a pediatric university hospital during a period of 2 months control group (n = 80) and subsequently during a period of 1 month with a prototype of an NIR vascular imaging system (n = 45). Failure rate (i.e., more than 1 puncture) decreased from 10/80 to 1/45 (the different 10.3%) (P =0.05) study showed promising results on the value of an NIR vascular imaging system in facilitating venipuncture in children.

The different between the two studies may be of devices used, this recent study used simple light source device, while Natascha J Cuper, et al study used near-infrared (NIR) vascular imaging system to visualize the veins, this study used the device in facilitated the venipuncture in children, but the recent study was used the device to facilitated the venous access for cannulae insertion (although there no big different between the venous access and venipuncture)

Research question 2:

What was the effect of using Transillumination of peripheral venous on time of peripheral intravenous (IV) cannulae insertion?

Hypothesis 2:

Time of procedure of cannulae insertion on peripheral veins in children is shorter when using Transillumination compares to control group.

The study result showed that a cold light device can shorten the time of peripheral intravenous (IV) cannulae insertion in pediatric patients. The percentage of procedures completed within less than 5 minutes increased when nurses used the transillumination light device compared to not using the device, (P =0.00). Thus the findings showed that the time was shorter in study group who were using the illumination device, and hence the 2nd research hypothesis was accepted. this finding is important as time factor is sometimes very important to child management in emergency situations like convulsions and cardiac pulmonary resuscitation, it also minimize the child stress and family anxiety.

Although one study in the literature found that the average time requirement for peripheral IV Cannulation was reported at 2.5 to 13 minutes, (Leidel et al., 2009) but this study revealed that 87.3% of venous access in less than 5 minutes. The finding of this study was supported by Hess who conducted study investigating a biomedical device to improve pediatric vascular access success. Time required to establish successful vascular access using a vein-viewing

device were self-reported by nursing staff (experimental group, n = 91). These data were compared to baseline data (control group, n = 150) previously collected on the same unit without using the device. The percentage of procedures completed in 15 minutes or less increased from 52.8% to 86.7% (difference 33.9%). Results were statistically significant between the two groups and uses of a vein-viewing device significantly decrease procedure time for the study population. the recent study revealed that the percentage of procedures completed in less than 5 minutes was increased from 8.1% to 56.1% (difference 48%). The different between the two studies may be related to age this recent study age were between 1 to 60 months, while Hess's study age from newborn to 17 years old. Another reason for the different in the recent study was different operators to insert the cannulae (registrars, house officer, and nurses) whereas; in the Hess's study all the operators were staff nurses on a pediatric surgical unit (who suggest were skillful).

Another study conducted by K. HOSOKAWA: Transillumination by light-emitting diode facilitates peripheral venous cannulation in infants and small children, the study was supported the 1st two hypotheses, and was in conformity with this current study. It was randomly assigned 136 infants and children weighing <15 kg, undergoing general anesthesia, to red LED-powered Transillumination (intervention, n=67) vs. the usual method (control, n=69) of peripheral venous cannulation. The primary and secondary study variables were the rate of successful cannulation at initial attempt, and the duration of insertion attempts, respectively. The success rates at first attempt were 75% and 61% respectively (P=0.03). And mean \pm SD times to successful venous access were 47 \pm 34 and 68 \pm 66 s (NS) in the two groups, respectively. The cannulation procedures were completed significantly earlier in the intervention group than in the UM group P=0.03). Study concluded that LED-powered Transillumination devices facilitated peripheral venous cannulation in small infants and children. (Wiley 2010)

Research question 3:

What was the effect of using Transillumination of peripheral veins in the cost of cannulae insertion in health facilities?

Hypothesis 3: Transillumination of peripheral veins will reduce the cost of cannulae insertion procedure in children.

Although this study showed that there was reducing in cost of peripheral veins catheter in children after light source device was used, but the researcher found no similar enough studies for data comparison, which impaired the realization of this research. The study result showed that a cold light device, such as the portable head light, can lower the cost of cannulae insertion procedure in pediatric patients.

Costings used in our study indicate that using of transillumination in peripheral cannulae insertion in children would reduce the cost by nearly half (46.9%). Cost savings would be much higher if this technique were to be adopted in the pediatric hospital. The estimation were very

conservative, derived from the cost of a basic facilities used (cannulae, swab, and syringes) and not including the cost of any other like gloves, saline and manpower) The result of cost calculation was significant difference (total difference in direct cost =46.9SDG) p.value= (0.004) thus, the result was supported the research hypothesis that Transillumination of peripheral venous will reduce the cost of cannulae insertion procedure in children, and hence the 3rd research hypothesis was accepted.

One study stated that, repeated attempts to achieve successful vascular access are costly both in supplies and labor expenses. Costs are multiplied by increased procedure time and the use of additional staff members needed to restrain children.

Research question 4:

Was there association between some demographic variables and peripheral venous success in intervention and control group?

Hypothesis 4: There was significant association between some demographic variables and peripheral venous access success rate in intervention and control group.

Association between some demographic variables and peripheral venous access success in intervention and control group showed that there was highly significant association between the age and number of attempts for peripheral venous access in children ($P = 0.00$). Although the cannulae insertion was difficult in small age group but one attempt of (PIC) was higher in less than two years old and multiple attempts were increased in other age groups, this may consider due to transparency of skin tissues in small children to light.

Highly significant association between the diagnosis and number of attempts for peripheral venous access in children. ($P = 0.04$).

This was supported by the findings of (Perry et al. 2011).who stated that nursing staff felt the device was beneficial for 90% for those patients who had difficult IV access. Further, 70 % of the nurses surveyed found the device helpful for dehydrated patients and 80% in the chronically ill population.

There was no significant association between the gender, and number of attempts for peripheral venous access in children. ($P = 0.22$), no significant association between the skin color and number of attempts for peripheral venous access in children. ($P = 0.15$).

Another Prospective study in hospitalized children younger than 19 years conducted in general inpatient wards by J Routt Reigart (), to determine parameters of pediatric PIV placement, including factors associated with success, observation of PIV placement by trained research staff. Successful placement was achieved in 95.8 % (567/592) cases with a median time of 9 minutes. Children younger than 2 years were less likely to have success on the first attempt (38.9% vs 53.5%) and have longer time to success (11 minutes). Children younger than 2 years experienced

lower first-attempt successful PIV placement and took longer. The overall success rate was similar to prior reports.

Study Limitations

This study has several limitations but the most important limitation that the study did not attempt to identify reasons why an access attempt failed. Although the participating professional health had specialized pediatric skills, the study did not measure or control for issues related to experience. Additionally, the study could not control for potential reporting bias related to anticipated venipuncture difficulty, another limitation are

- 1) Not true randomized clinical study.
- 2) Health professional participated in the study was not calibrated or no special criteria was identified for them, factors may potentially affect an operator's ability to cannulate a vein.(like visual acuity)
- 3) Dissimilar in patient demographics may observe different outcome.
- 4) No Procedure room in 50% of hospitals, most of cannulae insertion done in the wards, we did not control for ambient lighting in the wards, which could have affected vein visibility.
- 5) All the studies done regarding transillumination of peripheral veins were from the developed countries, no studies found from the developing countries supporting or rejecting the result of recent study.

Implications

The light source device is inexpensive. Thus, having multiple devices can become not costly. The benefits of the device must be weighed by significantly improved vascular access success rates, highly significant improvement in clinical outcomes, reduced labor and supply costs. Clinical benefits of improved first-attempt vascular access success in children include that it could reduced anxiety, and stress, in addition, improving the vascular access process and caregivers and nursing satisfaction, also it could be reduce the potential infection in children hospitals and more researches is needed for this area. In some hospitals used vein viewer, patients who were re-hospitalized, often asked for the device to be used on the first attempt.

5. Conclusions & Recommendations

5.1. Conclusions

On the basis of the findings of the present study: the effectiveness of light source device on peripheral venous Cannulation (PVC) in children - Khartoum state hospitals. Use of a simple light source device facilitates the insertion of peripheral venous cannulae in children.

The following conclusions were made

- 1) Significantly increased first-attempt Venipuncture success rate and decreased the number of attempts per patient
- 2) Significant decreased procedure time for the study population that used the device.
- 3) Total cost of procedure by Sudanese pound was significantly reduced.

- 4) Statistically significant association between age, diagnoses of children and success rate, and insignificant between gender, skin color and success rate.

In addition this study concluded that the device was safe, a cheap and it was well received by nurses inserted the cannulae for pediatric patients.

The overall experience of conduction of the research was really enriching for the researcher, it was a new learning experience to conduct this type of research also showed that there is a great need to educate the nurses on new technology which help in insertion of peripheral venous cannulae in children.

5.2. Recommendations

Study recommended that:

- 1) Studies are needed on transillumination with different design (RCT, longitudinal) with different sample size and location especially in country like Sudan for the evidence based practice. to introduce transillumination in all paediatric hospitals.
- 2) Transillumination should be known by health providers in pediatric care setting because of the benefits achieved.
- 3) Because Transillumination was found to be beneficial for pediatric patients with difficult IV access, dehydration or a chronic illness, cost effective and reduce time of cannulae insertion procedure, it should be introduced as a training skill for doctors, nurses and other health personnel.

5.3 Dedication

I dedicate this work to:

- My parents who wish me always progress.
- The children everywhere from who I have learned.
- My family who prays for me every time for success
- Nurses who took part in this study, who are doing good work despite difficult circumstances.

5.4 Acknowledgement

First, I wish to thank God for giving me power to complete this thesis, then I would like to thank the following persons for their respective contribution to this Dissertation:

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his busy schedule, Prof.Hassan always finds the time to discuss anything with me; from him I get a solid base in attitudes and knowledge in the field of nursing for children, he is my idol in pediatric medicine and nursing. I wish for him health and wellness.

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Appendixes
University Of Medical Sciences & Technology Faculty Of Nursing Sciences Graduate College

Title: the Effectiveness of light source device on peripheral venous Cannulation (PVC) in children - Khartoum state hospitals

Data Collection Flowchart Assessment (DCFA)

Thank you for taking the time to complete this (DCFA) on the usefulness of the trans-illumination in peripheral venous cannulation. The purpose of this non-invasive device is to facilitate venous cannulation in children.

Serial no:

Hospital:.....

Name of personnel fill the (DCFA)

Section one: Demographic Data of Children

- 1) Age: month
- 2) Gender: Boy Girl
- 3) Diagnosis:
- 4) Skin color:
White fair skin color black
- 5) Title of health professional who will insert the cannulae:
Registrar Senior House Officer Nurse

Section two: Regarding peripheral Cannulae Insertion

- 1) Insertion of cannulae:
Using illumination without illumination
- 2) Number of attempts for cannulae insertion:
1 2 3 > 3 attempts
- 3) Number of cannulae used:
1 2 3 > 3 cannulae
- 4) Number of alcohol swab used:
1 2 3 3 swab
- 5) Number of syringes used:
1 2 3 3 syringes
- 6) Time of successful cannulae insertion in minutes:
 < 5 min. 5-10 min. 10 min.

Annexes (1)

Information for participants (pre-test, control group and intervention group)

Information to participants (pilot study)

Title of the study: the effectiveness of light source device on peripheral venous catheter (PVC) insertion procedure in children. 2012

Chief investigator: Amal Abd Elgadir Ali Mohamed.

Address: Sudan-Khartoum-University of Medical Sciences and Technology-Faculty of Nursing Sciences.

E-mail address: amel.abdelgader@umst-edu.sd

Phone: 0912554716

This study is the basis of a dissertation in a Doctor of Philosophy qualification at University of Medical Sciences and Technology (UMST).

Supervisor: Prof. Hassan Mohamed Ahmed –consultant pediatrician

Co-supervisor: Dr.Djenta Saha –researcher

Description of the study:

This study will be done to evaluate the effectiveness of light source device on peripheral venous catheter (PVC) insertion procedure in children. Usually insertion of peripheral intravenous access is the common and stressful procedure not only for patients but for caregivers and health care provider Therefore, techniques that optimize peripheral line placement are essential. We will use Transillumination light source to facilitate the visualization of peripheral veins for your child. The introduction of this technology in the pediatric hospitals will improve and make cannulae insertion for children is easy in the future.

Expected outcomes

- 1)Number of trials or attempts that are done usually to the child by the health care providers will be reduced and makes administering an IV easier for the nurse and more comfortable for the child.
- 2)Minimize the time of insertion when peripheral intravenous access was decided.
- 3)It will be cost effective by reducing the total number of facilities used in the pediatric hospitals for cannulae insertion (swab, syringes and cannulae).

Risks:

According to literature there is minimal risks to your child was identified, the child feel pain on cannulae insertion.

Confidentiality of the data:

All information you supply for the program will be treated in confidential manner. All confidential records will be kept in a locked filling cabinet. Any information stored in the computer files is protected by password (know only to the researcher). Only the researcher has access to the computer database. Aggregate data only will be published and no individual participants will be identified.

Voluntary participation:

Your participation in this intervention is entirely voluntary. Your consent will be needed to use the Illumination device for cannulae insertion. You are free to withdraw from the study at anytime and your child data will be destroyed

Your involvement in the study will include giving acceptant for:

- 1) Weighing and measuring height for your child
- 2) Performing the illumination procedure
- 3) Observing the procedure of illumination in respect to time, number of trials, calculate the facilities used during the procedure and documentation of observations

Questions or concerns/complaints:

All participants in this study are welcome to contact Amal Abd Elgadir Ali (chief investigator) regarding any questions, concerns or complaints you may have about this study.

Thank you for considering participation in this study, your participation is greatly appreciated.

Annexes (2)

Information for participants (pre-test, control group and intervention group)

Information for participants (Intervention group)

Title of the study: the effectiveness of light source device on peripheral venous catheter (PVC) insertion procedure in children. 2012

Chief investigator: Amal Abd Elgadir Ali Mohamed.

Address: Sudan-Khartoum-University of Medical Sciences and Technology-Faculty of Nursing Sciences.

E-mail address: amel.abdelgader@umst-edu.sd **Phone:** 00249912554716

This study is the basis of a dissertation in a Doctor of Philosophy qualification at University of Medical Sciences and Technology (UMST).

Supervisor: Prof. Hassan Mohamed Ahmed –consultant pediatrician

Co-supervisor: Dr.Djenta Saha –researcher

Description of the study:

This study will be done to evaluate the effect of illumination on peripheral venous catheter (pvc) insertion procedure in children. usually insertion of peripheral intravenous access is the common and stressful procedure not only for patients but for caregivers and health care provider Therefore, techniques that optimize peripheral line placement are essential. We will use Transillumination light source to facilitate the visualization of peripheral veins for your child. The introduction of this technology in the pediatric hospitals will improve and make cannulae insertion for children is easy in the future.

Expected outcomes:

- 1) Number of trials or attempts that are done usually to the child by the health care providers will be reduced and makes administering an IV easier for the nurse and more comfortable for the child.
- 2) Minimize the time of insertion when peripheral intravenous access was decided.
- 3) It will be cost effective by reducing the total number of facilities used in the pediatric hospitals for cannulae insertion (swab, syringes and cannulae).

Risks:

According to literature there is minimal risks to your child was identified, the child feel pain on cannulae insertion.

Confidentiality of the data:

All information you supply for the program will be treated in confidential manner. All confidential records will be kept in a locked filling cabinet. Any information stored in the computer files is protected by password (know only to the researcher). Only the researcher has access to the computer database. Aggregate data only will be published and no individual participants will be identified.

Voluntary participation:

Your participation in this intervention is entirely voluntary. Your consent will be needed to use the Illumination device for cannulae insertion. You are free to withdraw from the study at anytime and your child data will be destroyed

Your involvement in the study will include giving acceptant for:

- 1) Weighing and measuring height for your child
- 2) Performing the illumination procedure
- 3) Observing the procedure of illumination in respect to time, number of trials, calculate the facilities used during the procedure and documentation of observations

Questions or concerns/complaints:

All participants in this study are welcome to contact Amal Abd Elgadir Ali (chief investigator) regarding any questions, concerns or complaints you may have about this study.

Thank you for considering participation in this study, your participation is greatly appreciated.

Annex 3:

Information for participants (control group)

Title of the study: the effectiveness of light source device on peripheral venous catheter (PVC) insertion procedure in children. 2012.

Chief investigator: Amal Abd Elgadir Ali Mohamed.

Address: Sudan-Khartoum-University of Medical Sciences and Technology-Faculty of Nursing Sciences.

E-mail address: dramel_2012@ymail.com

Phone: 0912554716

This study is the basis of a dissertation in a Doctor of Philosophy qualification at University of Medical Sciences and Technology (UMST).

Supervisor: Prof. Hassan Mohamed Ahmed

Co-supervisor: Prof. Dr.Djenta Saha

Description of the study:

Usually insertion of peripheral intravenous access is the common and stressful procedure not only for patients but for caregivers and health care provider this study was conducted to assess the success rate of cannulae insertion, time consumed for insertion cannulae for your child and the number and swab consumed for this procedure.

Your involvement in the study will include:

Verbal acceptance will be needed for the researcher to:

- 1) Weighing and measuring height for your child
- 2) Observe the process of cannulae insertion and fill the data collection flowchart sheet.

Expected benefit for you:

Your participation in this study may improve the insertion of cannulae in children in the future

Risks:

Minimal pain to the child during cannulae insertion.

Confidentiality of the data:

All information's you supply for the program will be treated in confidential manner. All confidential records will be kept in a locked filling cabinet. Any information stored in the computer files is protected by password (know only to the researcher). Only the researcher has access to the computer database. Aggregate data only will be published and no individual participants will be identified.

Voluntary participation:

Your participation in the program is entirely voluntary and you are free to withdraw from the study at anytime and your data will be destroyed.

Questions or concerns/complaints:

All participants in this study are welcome to contact Amal Abd Elgadir Ali (chief investigator) regarding any questions, concerns or complaints you may have about this study.

Thank you for considering participation in this study, your participation is greatly appreciated

Annexes (4)

Consent form (English and Arabic)

Chief investigator: Amal Abd Elgadir Ali Mohamed

Supervisor: Prof: Hassan Mohammed Ahmed – pediatrician

Participant's name: _____

My signature below indicates:

1. I have read the Participant Information Sheet/ have been read to me
2. I understand the nature and purpose of the study.
3. I have been given the opportunity to ask questions regarding the research study.
4. I understand that the confidentiality of all information I provide will be safeguarded.
5. I understand that participation is voluntary, and I am free to withdraw from the study at any time.
6. I consent to participate in this study.

Sig (fingerprint): _____

Date: _____

I have explained the nature and purpose of this study to the above participant and have answered their questions. (Researcher)

Researcher: _____ Date: _____



Transillumination of veins by using light source device .



Transillumination of veins by using light source device



Light source device used to illuminate the peripheral veins.

