بسم الله الرحمن الرحيم

Shendi University

Faculty of Graduate Studies and Scientific Research

Research about:

Assessment of Nurses competency Regarding Intravenous Drugs Administration, Safety and Errors in Elmak Nimer University Hospital 2016.

A thesis submitted in requirements of partial fulfill for The master's degree in medical surgical nursing.

Submitted by:

Safa Hashim Mohammed Alhassan

B.Sc. Nursing science- University of Shendi

Supervised:

Dr: Mariam Mohamed Alnageeb

B.Sc, M.Sc, Phd Pediatric Nursing- Shendi university

December 2016

الآيـــــة

قال تعالى:

﴿ وَنَادَى أَصْحَابُ الْجَنَّةِ أَصْحَابَ النَّارِ أَن قَدْ وَجَدْنَا مَا وَعَدَنَا رَبُّنَا حَقّاً فَهَلْ وَجَدتُّم مَّا وَعَدَ رَبُّكُمْ حَقّاً قَالُواْ نَعَمْ فَأَذَّنَ مُؤَذِّنٌ بَيْنَهُمْ أَن لَّعْنَةُ اللّهِ عَلَى الظَّالِمِينَ ﴾

صَدَقَ الله العلي ُالعَظِيم

الأعراف - آية (44)

Dedication

I dedicate this work to my soul mate

Abdellagader,

My parent, my family,

My best friend to for all people whom

I love and respect and people whom love

me and for you.

Acknowledgement

I would like to phrase my deep gratitude

to my supervisor

Dr: Mariam Mohmed Alnageeb

&

For this continuous support and guidance

I would like to phrase my thanks to the

staff of Shendi University Faculty of Nursing

Science & my deep grating to:

Dr: Hagazi Mohmed AHmed

I would like to record my thanks to everybody

who helped me complete this work.

List of abbreviation

Abbreviation	Meaning
ADEs	Adverse drug events
AMDSs	Automated medication dispensing systems
ANA	American Nurses Association
APRN	Advanced practice nurse
IV	Intravenous
IVPB	Intravenous piggyback
MA	Medication administration
MAE	Medication administration error
MAR	Medication administration record
MATS	Medication Administration Time Study
MRSA	Methicillin-resistant Staphylococcus aureus
PICC	Peripherally inserted central catheter
T.I.D	3times a day

ملخص الدراسة

أجريت هذه الدراسة الوصفية في مدينه شندي في مستشفي الملك نمر الجامعي بغرض التعرف علي معرفه الممرضين بطريقه إعطاء الأدوية الوردية وأداءهم فيها وقياس معرفه ومهارة الممرضين بطريقه تجهيز الأدوية الوردية ومعرفة الممرضين بالطرق الآمنة لإعطاء الأدوية الوردية ومعرفتهم بالأخطاء التي تحدث أثناء إعطاءها تمت الدراسه في الفتره ما بين (أغسطس إلى ديسمبر 2016م) .

شملت الدراسة 70 ممرضا وممرضة تم اختيار جميع العاملين ف المستشفي، وجمعت البيانات عن طريق الاستبيان وقائمه التحقق وحللت البيانات بواسطة طريقتين هما: برنامج الحزم الإحصائية للعلوم الاجتماعية النسخة 22 وعن طريق التحليل اليدوي البسيط وبينت البيانات عن طريق الأشكال والجداول.

خلصت هذه الدراسة أن معرفة الممرضين بطرق تجهيز الأدوية الوردية ضعيفة بنسبه (42.8%) ولكن معرفتهم بطرق تجهيز المحاليل الوردية جيده بنسبة (40%) أما بالنسبة لمعرفتهم بالطرق الآمنة للإعطاء فكانت جيده بنسبه(67.1%) وأيضا معرفتهم بالأخطاء التي تحدث أثناء الإعطاء فهي جيده بنسبة (96.5%) من ناحية أخري فقد كان الأداء في ما قبل الإعطاء جيدا بنسبة (48.5%) أما في إعطاء المحاليل الوردية متوسط الجودة بنسبة (54.4%) أما الأداء في إعطاء الأدوية الوردية فكان جيداً بنسبة (41.5%).

أوصت الدراسة بالاتي: تطبيق استراتجيات قياسية للطرق الآمنة لإعطاء الأدوية، وهيكل تطبيقي لي الإبلاغ عن الأخطاء التي تحدث، وتطبيق استراتجيات في نظام العمل للتقليل من الأخطاء بواسطة مرؤوسي المستشفيات، بالإضافة لبرامج التعليم والتدريب المستمر للممرضين في طرق إعطاء الأدوية والاستعانة باختصاصين وخبراء في الأدوية مثل الصيادلة في برامج تدريب الممرضين التي تقام بواسطة رؤساء التمريض.

Abstract

This study was descriptive study done in, Al-Mek Nimer university hospital the aim of study was done to know nursing knowledge and performance about intravenous drug administration, & assess nursing knowledge about intravenous drug preparation, identify performance of administration, assess nurses knowledge about safety and errors, during period extended from (August to December 2016).

Sample includes 70 of nurses was selected, all nurses was enroll, data collect through structured questionnaire and check list, analysis by simple manually analysis and software program statistical package of social science(SSPS version 22) was used , Represent in table and figure.

The result of study found that Nursing knowledge about prepare IV medication was poor (42.8%), but their knowledge about prepare infusion therapy was good (40%) nursing knowledge about IV drug safety was good (67.1%) and nursing knowledge regarding medication errors was good (96.5%) on the other hand nurse's performance pre procedure was good (48.5%), regarding IV infusion was fair (54.4%) and performance about IV push procedure was good. (41.5%)

Present study recommended the following: apply a standardized strategies assessment of safe medication administration, incident reporting forms, systems strategies to reduce the number of systems errors hospital director & by the head nurses: continuous training, courses & education programmers for nurses and involvement of medication experts such as pharmacists in nursing training programmers.

List of contents

List of tables

List of figures

Chapter one

- ***Introduction***
- ***Justification***
- ***Objectives***

1.1 Introduction

Medications are substances prescribed by the client's health care practitioner to help in the treatment, relief, or cure of the cause of the client's health alteration or in the prevention of an alteration, [1].

A drug is a chemical substance intended for use in the diagnosis, treatment, cure, mitigation, or prevention of a disease. When a drug is given to a client, there is an intended specific effect. An assumption made by nurses before administration of any medication is that the drug will be safe for the client to consume if the dose, frequency, and route are within the therapeutic range for that drug, [1].

Medication management requires the collaborative efforts of many health care providers. Medications may be prescribed by a physician, dentist, or other authorized prescriber, [1].

Nurses play an essential role in the administration of intravenous medications And responsible for educating the client about his or her medications and its possible side effects as well as for evaluating the outcome of the prescribed therapy in restoring and maintaining the client's health, [1].

Intravenous Medication administration requires specialized knowledge, judgment, and nursing skill based on the principles of pharmacology. The nursing process is used to direct nursing decisions relative to safe intravenous drug administration and to ensure compliance with standards of practice, [1].

Intravenous medications pose particular risks because of their greater complexity and the multiple steps required in their preparation, administration and monitoring, [1].

Patients with acute or chronic health problems restore or maintain their health using a variety of strategies. One of these strategies is medication, a substance used in the diagnosis, treatment, cure, relief, or prevention of health problems. No matter where they receive their health care—hospitals, clinics, or home, [2].

Nurses play an essential role in safe intravenous medication preparation, administration, and evaluation of medication effects. In all settings, nurses are responsible for evaluating the effects of intravenous medications on the patient's ongoing health status, teaching them about their intravenous medications and side effects, ensuring adherence to the intravenous medication regimen, [2].

Intravenous (IV) therapy is considered an essential component of current healthcare delivery, with over 90% of hospitalized patients receiving some form of infusion therapy. Errors involving IV medications can occur in all phases of the medication use process and can be particularly dangerous based on the drug's properties and the complexity of its therapeutic action, [3].

IV medications are clinically advantageous due to their immediate therapeutic effect and ability to support plasma drug levels that reach an early target effect. At the same time, harm can easily result from IV drug administration due to the immediate bioavailability of intravenously administered drugs, the narrow therapeutic dose range of many IV medications, as well as the limitations in reversing systemic effects after IV administration The significant risk for patient injury and death related to IV medication errors is well known., In their 2001 study of pediatric inpatients, Kaushal et al. demonstrated that IV medications are associated with 54% of potential adverse drug events (ADEs). IV medications were also associated with 56% of preventable ADEs in a five-year retrospective review of medication errors in a United Kingdom pediatric teaching hospital; 59% of these errors occurred during drug administration by nurses, with dosing and concentration mistakes being the most prevalent. In addition to these studies, over the last several decades ,there was many published numerous IV push-related error reports involving patient injury, which were obtained through its National Medication Errors Reporting Program, [4] .

1.2 Rational

Intravenous drug administration is one of the highest risk areas of nursing practice and a matter of considerable concern for both managers and practitioners Nurses are administer numerous intravenous drugs daily, the nurses should administer intravenous drugs in a safe and efficient manner accord with nursing standards of practice and agency policy.

1.3 Objectives

1.3.1 General objective:

To assess nurses knowledge and practice regarding intravenous drugs administration.

1.3.2 Specific objectives:

- To assess nursing knowledge regarding intravenous drug preparation.
- To evaluate nursing practice about intravenous drug administration methods.
- To determine nurses knowledge regarding intravenous drug safety.
- To assess nurses knowledge about intravenous medication error.

Chapter two

- ***Literature review***

2. Literature Review

2.1 Intravenous therapy:

(IV therapy or IV therapy in short) is the infusion of liquid substances directly into a vein. Intravenous simply means "within vein". Therapies administered intravenously are often included in the designation of specialty drugs. Intravenous infusions are commonly referred to as drips because many systems of administration employ a drip chamber, which prevents air from entering the blood stream (air embolism), and allows an estimation of flow rate, [3].

Intravenous therapy may be used to correct electrolyte imbalances, to deliver medications, for blood transfusion or as fluid replacement to correct, for example, dehydration. Intravenous therapy could also be used for chemotherapy.

Compared with other routes of administration, the intravenous route is the fastest way to deliver fluids and medications throughout the body. The bioavailability of the medication is 100% in IV therapy, [3].

Administering intravenous medications safely requires an understanding of legal aspects of health care, pharmacology, pharmacokinetics, the life sciences, pathophysiology, human anatomy, and mathematics , [2].

2.1.1 Study background:

1/ a study conducted on nursing staff performance of medication administration: Medication Administration Time Study (MATS)

done By Elganzouri ES1, Standish CA, Androwich I. orthwestern Memorial Hospital, Chicago USA 2009 May.

The aim of this study was to develop and test a method for assessing nursing effort and workflow in the medication administration process.

A descriptive observation study of 151 nurses during 980 unique medication observations in medical-surgical units at a rural hospital, an urban community hospital, and an academic medical center was conducted.

Result reveal that: Nurses averaged more than 15 minutes on each medication pass and were at risk of an interruption or distraction with every medication pass.

Results conclude that: System challenges faced by nurses during the medication administration process lead to threats to patient safety, work-arounds, workflow inefficiencies, and distractions during a time when focus is most needed to prevent error, [5].

2/a study conducted on into the factors underlying the occurrence and reporting of drug errors in a district general hospital done by Jill Gladstone BA MSc RGN Royal Devon and Exeter Hospital Barrack Road England in Feb 2010 to identify any common themes that underlie the occurrence and reporting of drug administration errors Data were collected from a variety of sources drug error reports, questionnaires to nurses and nurse managers, and interviews with nurses who had been involved in drug errors Several areas of particular concern emerged, including the nurses' confusion regarding the definition of drug errors and the appropriate actions to take when they occurred, their fear of disciplinary action, their loss of clinical confidence, the variation in managerial response, and a possible lack of nurses' mathematical skills.

Results revealed: it was likely that many drug errors were not reported, for a variety of reasons It is recommended that all of these issues are addressed as a matter of urgency, for the sake of both patients and nurse practitioners, [6].

3/ A study conducted on Errors in the administration of intravenous medications in hospital and the role of correct procedures and nurse experience done by Johanna, Westbrook, Marilyn I Rob, Amanda Woods, Dave Parry Australian Institute of Health Innovation, University of New South Wales, Sydney, Australia Accepted 26 May 2011 Published Online First 20 June 2011.

Prospective observational study of 107 nurses preparing and administering 568 intravenous medications on six wards across two teaching hospitals. Procedural

failures (eg, checking patient identification) and clinical intravenous errors (eg, wrong intravenous administration rate) were identified and categorized by severity. Results revealed that: 568 intravenous administrations, 69.7% (n=396; 95% CI 65.9 to 73.5) had at least one clinical error and 25.5% (95% CI 21.2 to 29.8) of these were serious. Four error types (wrong intravenous rate, mixture, volume, and drug incompatibility) accounted for 91.7% of errors. Wrong rate was the most frequent and accounted for 95 of 101 serious errors. Error rates and severity decreased with clinical experience. Each year of experience, up to 6 years, reduced the risk of error by 10.9% and serious error by 18.5%. Administration by bolus was associated with a 312% increased risk of error. Patient identification was only checked in 47.9% of administrations but was associated with a 56% reduction in intravenous error risk.

Results conclude that: Intravenous administrations have a higher risk and severity of error than other medication administrations. A significant proportion of errors suggest skill and knowledge deficiencies, with errors and severity reducing as clinical experience increases. A proportion of errors are also associated with routine violations which are likely to be learnt workplace behaviors. Both areas suggest specific targets for intervention, [7].

4/ A study conducted on multinational prospective study To assess a Errors in administration of parenteral drugs in intensive care units: frequency, characteristics, contributing factors, and preventive measures done by Andreas Valentin, Maurizia Capuzzo, Bertrand Guidet , Rui Moreno, Barbara Metnitz,Accepted 5 December 2008 ,Published 13 March 2009 in Europe.

Observational, prospective, 24 hour cross sectional study with self-reporting by staff, Setting 113 intensive care units in 27 countries, Participants 1328 adults in intensive care.

Main outcome measures Number of errors; impact of errors; distribution of error characteristics; distribution of contributing and preventive factors.

Results revealed that: 861 errors affecting 441 patients were reported: 74.5 (95% confidence interval 69.5 to 79.4) events per 100 patient days. Three quarters of the errors were classified as errors of omission. Twelve patients (0.9% of the study population) experienced permanent harm or died because of medication errors at the administration stage. In a multiple logistic regression with patients as the unit of analysis, odds ratios for the occurrence of at least one parenteral medication error were raised for number of organ failures 1.19, 95% confidence interval 1.05 to 1.34.

Results conclude that parenteral medication errors at the administration stage are common and a serious safety problem in intensive care units. With the increasing complexity of care in critically ill patients, organizational factors such as error reporting systems and routine checks can reduce the risk for such errors, [8].

2.2 Routes of Administration:

The route prescribed for administering a medication depends on the properties and desired effect of the medication and the patient's physical and mental condition

2.2.1 Parenteral Routes. Parenteral administration involves injecting a medication into body tissues. The following are the four major sites of injection:

1. **Intradermal (ID):** Injection into the dermis just under the epidermis
2. **Subcutaneous**: Injection into tissues just below the dermis of the skin
3. **Intramuscular (IM):** Injection into a muscle
4. **Intravenous (IV):** Injection into a vein, the nurse administers medications intravenously by the following methods:

1. as mixtures within large volumes of IV fluids**.**
2. by injection of a bolus or small volume of medication through an existing IV infusion line or intermittent venous access (heparin or saline lock)
3. By "piggyback" infusion of a solution containing the prescribed medication and a small volume of IV fluid through an existing IV line all three methods the patient

has either an existing IV infusion running continuously or an IV access site for intermittent infusions, [2].

When using any method of IV medication administration, observe patients closely for symptoms of adverse reactions. After a medication enters the bloodstream, it begins to act immediately, and there is no way to stop its action. Thus take special care to avoid errors in dose calculation and preparation. Carefully follow the six rights of safe medication administration, double-check medication calculations with another nurse, and know the desired action and side effects of every medication you give. If the medication has an antidote, make sure that it is available during administration. When administering potent medications, assess vital signs before, during, and after infusion, [2].

Administering medications by the IV route has advantages. Often the nurse uses this route in emergencies when a fast-acting medication must be delivered quickly. The IV route is also best when it is necessary to give medications to establish constant therapeutic blood level. Because IV medications are immediately available to the bloodstream once they are administered, verify the prescribed rate of administration with a medication reference or a pharmacist before giving them to ensure that the medication is given safely over the appropriate amount of time. Patients experience severe adverse reactions if IV medications are administered too quickly, [2].

1. Large-Volume Infusions. Of the three methods of administering IV medications, mixing them in large volumes of fluids is the safest and easiest. Because the medication is not in a concentrated form, the risk of side effects or fatal reactions is minimal when infused over the prescribed time frame. Medications are diluted in large volumes (500 or 1000 mL) of compatible IV fluids such as normal saline or lactated Ringer's solution, There is a danger with continuous infusion: if the IV fluid is infused too rapidly, the patient is at risk for medication overdose and circulatory fluid overload, [2].

Many patient safety risks such as incorrect calculation, non-aseptic preparation, and incorrect labeling occur when nurses have to prepare medications in IV containers. Check with a pharmacist before mixing a medication in an IV container. If the pharmacist confirms that you need to prepare the medication, ask another nurse to verify your medication calculations and have that nurse watch you during the entire procedure to ensure that you prepare the medication safely. First ensure that the IV fluid and medication are compatible. Then prepare the medication in a syringe using strict aseptic technique. Clean the injection port of the IV bag with an alcohol swab, remove the cap from the needle, and stick the needle into the IV fluid. Push the medication into the IV fluid and mix the solution by turning the IV bag gently end to end. Finally attach a medication label. , [2].

Administer the medication to the patient at the prescribed rate. Do not add medications to IV bags that are already hanging because there is no way to tell the exact concentration of the medication. Add medications only to new IV bags. When administering medications in large IV infusions, regulate the IV rate according to the health care provider's order. Monitor patients closely for adverse reactions to the medication and fluid volume overload. Also check the site frequently for infiltration and phlebitis, [2].

2. IV bolus: involve introducing of a concentrated dose of a medication directly into the systemic circulation because a bolus requires only a small amount of fluid to deliver the medication, it is an advantage when the amount of fluid that the patient can take is restricted. The IV bolus, or "push," is the most dangerous method for administering medications because there is no time to correct errors. In addition, a bolus may cause direct irritation to the lining of blood vessels. Before administering a bolus confirm placement of the IV line, Never give a medication intravenously if the insertion site appears puffy or edematous or the IV fluid cannot flow at the proper rate, Accidental injection of a medication into the tissues around

a vein causes pain, sloughing of tissues, and abscesses, depending on the composition of the medication, [2].

3. Volume-Controlled Infusions*:* Another way of administering IV medications is through small amounts (50 to 100 mL) of compatible IV fluids. The fluid is within a secondary fluid container separate from the primary fluid bag. The container connects directly to the primary IV line or to separate tubing that inserts into the primary line, three types of containers are volume-control administration sets (piggyback sets, and mini-infusers. Using volume-controlled infusions has several advantages: It reduces risk of rapid-dose infusion by IV push, Medications are diluted and infused over longer time intervals (e.g., 30 to 60 minutes), It allows for administration of medications (e.g., antibiotics) that are stable for a limited time in solution, It allows for control of IV fluid intake, [2].

A. Piggyback: A piggyback is a small (25 to 250 mL) IV bag or bottle connected to a short tubing line that connects to the upper Y-port of a primary infusion line or to an intermittent venous access, The piggyback tubing is a micro drip or macro drip system, The set is called a piggyback because the small bag or bottle is higher than the primary infusion bag or bottle. In the piggyback setup the main line does not infuse when the piggybacked medication is infusing, [2].

B. Volume-Control Administration: Volume-control administration sets are small (150-mL) containers that attach just below the primary infusion bag or bottle. The set is attached and filled in a manner similar to that used with a regular IV infusion, [2].

C .Mini-Infusion Pump: The mini-infusion pump is battery operated and allows medications to be given in very small amounts of fluid (5 to 60 mL) within controlled infusion times using standard Intermittent Venous Access**.** An intermittent venous access (commonly called a saline lock) is an IV catheter capped off on the end with a small chamber covered by a rubber diaphragm or a specially designed cap. Special rubber-seal injection caps usually accept needle safety

devices Advantages to intermittent venous access include the following: Cost savings, Effectiveness of nurse's time enhanced by eliminating constant monitoring of flow rates, increased mobility, safety, and comfort for the patient .

After the medication has been administered through an intermittent venous access, the access must be flushed with a solution to keep it patent. Generally normal saline is an effective flush solution for peripheral catheters. Some agencies require the use of heparin, [2].

2.3. Medical uses:

Substances that may be infused intravenously include volume expanders, blood-based products, blood substitutes, medications and nutrition, [3].

2.3.1 Volume expanders:

There are two main types of volume expander: crystalloids and colloids. Crystalloids are aqueous solutions of mineral salts or other water-soluble molecules. Colloids contain larger insoluble molecules, such as gelatin. Blood is a colloid. Colloids preserve a high colloid osmotic pressure in the blood, while, on the other hand, this parameter is decreased by crystalloids due to hemodilution. There does not appear to be a benefit of using colloids over crystalloids. Crystalloids generally are much cheaper than colloids (blood, albumin, plasma, etc.) The most commonly used crystalloid fluid is normal saline, a solution of sodium chloride at 0.9% concentration, which is close to the concentration in the blood (isotonic). Lactated Ringer's (also known as Ringer's lactate) and the closely related Ringer's acetate, are mildly hypotonic solutions often used in those who have significant burns,Volume expanders may either be isotonic, hypotonic, or hypertonic, [3].

2.3.2Blood-based products:

A blood product (or blood-based product) is any component of blood which is collected from a donor for use in a blood transfusion. Blood transfusions can be life-saving in some situations, such as massive blood loss due to trauma, or can be

used to replace blood lost during surgery. Blood transfusions may also be used to treat a severe anemia or thrombocytopenia caused by a blood disease ,Early blood transfusions consisted of whole blood, but modern medical practice commonly uses only components of the blood, such as fresh frozen plasma or cryoprecipitate, [3].

2.3.3 Blood substitutes:

Blood substitutes (also called artificial blood or blood surrogates) are artificial substances aiming to provide an alternative to blood-based products acquired from donors. The main blood substitutes used today are volume expanders such as crystalloids and colloids mentioned above. Also, oxygen-carrying substitutes are emerging, [3].

2.3.4Buffer solutions:

Buffer solutions are used to correct acidosis or alkalosis. Lactated Ringer's solution also has some buffering effect. A solution more specifically used for buffering purpose is intravenous sodium bicarbonate, [3].

2.3.5Other medication:

Medications may be mixed into the fluids mentioned above. Certain types of medications can only be given intravenously, such as when there is insufficient uptake by other routes of administration such as enterally. Examples include intravenous immunoglobulin and propofol.

Other Parenteral nutrition is feeding a person intravenously, bypassing the usual process of eating and digestion. The person receives nutritional formulas containing salts, glucose, amino acids, lipids and added vitamins, [3].

2.4 Adverse effects:

2.4.1. Pain:

An injection inherently causes pain and is medically invasive. In cases in which a choice between intravenous therapy and oral treatment may be made to achieve the same outcome, such as in the case of mild or moderate dehydration

treatment (assuming oral rehydration therapy is an option), then one should avoid using intravenous therapy in place of the less invasive oral option , [3].

2.4.2. Infection:

Any break in the skin carries a risk of infection. Although IV insertion is an aseptic procedure, skin-dwelling organisms such as Coagulase-negative staphylococcus or Candida albicans may enter through the insertion site around the catheter, or bacteria may be accidentally introduced inside the catheter from contaminated equipment. Moisture introduced to unprotected IV sites through washing or bathing substantially increases the infection risks.

Infection of IV sites is usually local, causing easily visible swelling, redness, and fever. If bacteria do not remain in one area but spread through the bloodstream, the infection is called septicemia and can be rapid and life-threatening. An infected central IV poses a higher risk of septicemia, as it can deliver bacteria directly into the central circulation, [3].

2.4.3. Phlebitis:

Phlebitis is inflammation of a vein that may be caused by infection, the mere presence of a foreign body (the IV catheter) or the fluids or medication being given. Symptoms are warmth, swelling, pain, and redness around the vein. The IV device must be removed and if necessary re-inserted into another extremity.

Due to frequent injections and recurring phlebitis, scar tissue can build up along the vein. The peripheral veins of intravenous drug addicts, and of cancer patients undergoing chemotherapy, become sclerotic and difficult to access over time, sometimes forming a hard, painful “venous cord”, [3].

2.4.4. Infiltration / extravasation:

Infiltration occurs when an IV fluid or medication accidentally enters the surrounding tissue rather than the vein. It may occur when the vein itself ruptures (the elderly are particularly prone to fragile veins due to a paucity of supporting tissues), when the vein is damaged during insertion of the intravascular access

device, when the device is not sited correctly or when the entry point of the device into the vein becomes the path of least resistance , Infiltration is an inadvertent administration of a non-vesicant solution/drug into the tissue, which happens so often when the tourniquet isn't removed in a timely fashion. Infiltration is characterized by coolness and pallor to the skin as well as localized swelling or edema. It is treated by removing the intravenous access device and elevating the affected limb so that the collected fluids can drain away, [3].

2.4.5. Fluid overload:

This occurs when fluids are given at a higher rate or in a larger volume than the system can absorb or excrete. Possible consequences include hypertension, heart failure, and pulmonary edema, [3].

2.4.6. Hypothermia:

The human body is at risk of accidentally induced hypothermia when large amounts of cold fluids are infused. Rapid temperature changes in the heart may precipitate ventricular fibrillation, [3].

2.4.7. Electrolyte imbalance:

Administering a too-dilute or too-concentrated solution can disrupt the patient's balance of sodium, potassium, magnesium, and other electrolytes, [3].

2.4.8. Embolism:

A blood clot or other solid mass, as well as an air bubble, can be delivered into the circulation through an IV and end up blocking a vessel; this is called embolism. It is nearly impossible to inject air through a peripheral IV at a dangerous rate. The risk is greater with a central Line

Air bubbles of less than 30 microliters are thought to dissolve into the circulation harmlessly. A larger amount of air, if delivered all at once, can cause life-threatening damage, or, if extremely large (3-8 milliliters per kilogram of body weight), can stop the heart, [3].

One reason veins are preferred over arteries for intravascular administration is because the flow will pass through the lungs before passing through the body. Air bubbles can leave the blood through the lungs, [3].

2.5 Intravenous access devices:

These can be used to obtain blood (e.g. for testing), also known as phlebotomy, as well as for the administration of medication and fluids, [3].

2.5.1Hypodermic needle:

The simplest form of intravenous access is by passing a hollow needle through the skin directly into the vein. This needle can be connected directly to a syringe (used either to withdraw blood or deliver its contents into the bloodstream) or may be connected to a length of tubing and thence whichever collection or infusion system is desired, [3].

2.5.2. Peripheral cannula:

A peripheral cannula is the most common intravenous access method utilized in both hospitals and pre-hospital services. A peripheral IV line consists of a short catheter (a few centimeters long) inserted through the skin into a peripheral vein (any vein not situated in the chest or abdomen). This is usually in the form of a cannula-over-needle device, in which a flexible plastic cannula comes mounted over a metal trocar. Once the tip of the needle and cannula are introduced into the vein via venipuncture, the cannula is advanced inside the vein over the trocar to the appropriate position and secured, the trocar is then withdrawn and discarded. Blood samples may be drawn directly after the initial IV cannula insertion

Any accessible vein can be used although arm and hand veins are used most commonly, with leg and foot veins used to a much lesser extent. In infants the scalp veins are sometimes used, [3].

The caliber of cannula is commonly indicated in gauge, with 14 being a very large cannula (used in resuscitation settings) and 24-26 the smallest. The most common sizes are 16-gauge (midsize line used for blood donation and transfusion),

18- and 20-gauge (all-purpose line for infusions and blood draws), and 22-gauge (all-purpose pediatric line). 12- and 14-gauge peripheral lines are capable of delivering large volumes of fluid very fast, accounting for their popularity in emergency medicine. These lines are frequently called "large bores" or "trauma lines", [3].

The part of the catheter that remains outside the skin is called the connecting hub; it can be connected to a syringe or an intravenous infusion line, or capped with a heplock or saline lock, a needleless connection filled with a small amount of heparin or saline solution to prevent clotting, between uses of the catheter. Ported cannula have an injection port on the top that is often used to administer medicine In cases of shock, a central venous catheter, a peripherally inserted central catheter, venous cut down or intraosseous infusion may be necessary, [3].

2.6 Complications:

If the cannula is not sited correctly, or the vein is particularly fragile and ruptures, blood may extravasate into the surrounding tissues, this situation is known as a "tissuing" or a "blown vein". Using this cannula to administer medications causes extravasation of the drug which can lead to edema, causing pain and tissue damage, and even necrosis depending on the medication. The person attempting to obtain the access must find a new access site proximal to the "blown" area to prevent extravasation of medications through the damaged vein.

A peripheral IV cannot be left in the vein indefinitely, because of the risk of insertion-site infection leading to phlebitis, cellulitis and sepsis. The US Centers for Disease Control and Prevention updated their guidelines and now advise the cannula need to be replaced every 96 hours. This was based on studies organize to identify causes of Methicillin-resistant Staphylococcus aureus (MRSA) infection in hospitals. In the United Kingdom, the UK Department of health published their finding about risk factors associated with increased MRSA infection, now include

intravenous cannula, central venous catheters and urinary catheters as the main factors increasing the risk of spreading antibiotic resistant strain bacteria, [3].

2.7. Central lines:

Central IV lines flow through a catheter with its tip within a large vein, usually the superior vena cava or inferior vena cava, or within the right atrium of the heart, [3].

This has several advantages over a peripheral IV:

It can deliver fluids and medications that would be overly irritating to peripheral veins because of their concentration or chemical composition. These include some chemotherapy drugs and total parenteral nutrition, Medications reach the heart immediately, and are quickly distributed to the rest of the body.

Caregivers can measure central venous pressure and other physiological variables through the line.

Central IV lines carry risks of bleeding, infection, gangrene, thromboembolism and gas embolism .They are often more difficult to insert correctly as the veins are not usually palpable and rely on an experienced clinician knowing the appropriate landmarks and/or using an ultrasound probe to safely locate and enter the vein. Surrounding structures, such as the pleura and carotid artery are also at risk of damage with the potential for pneumothorax or even cannulation of the artery.

There are several types of central IVs, depending on the route that the catheter takes from the outside of the body to the vein, [3].

2.7.1Peripherally inserted central catheter:

PICC lines are used when intravenous access is required over a prolonged period of time or when the material to be infused would cause quick damage and early failure of a peripheral IV and when a conventional central line may be too dangerous to attempt. Typical uses for a PICC include: long chemotherapy regimens, extended antibiotic therapy, or total parenteral nutrition.

The PICC line is inserted through a sheath into a peripheral vein sometimes using the Seldinger technique or modified Seldinger technique, under ultrasound guidance, usually in the arm, and then carefully advanced upward until the catheter is in the superior vena cava or the right atrium. An X-ray must be used to verify that the tip is in the right place when fluoroscopy was not used during the insertion. The insertion site requires better protection than that of a peripheral IV, due to the higher risk of serious infection. However, a PICC poses less of a systemic infection risk than other central IVs, because the insertion site is usually cooler and dryer than the sites typically used for other central lines, [3].

2.7.2.Central venous lines:

There are several types of catheters that take a more direct route into central veins. These are collectively called central venous lines.

In the simplest type of central venous access, a catheter is inserted into a subclavian, internal jugular, or (less commonly) a femoral vein and advanced toward the heart until it reaches the superior vena cava or right atrium.

Because all of these veins are larger than peripheral veins there is greater blood flow past the tip of the catheter meaning irritant drugs are more rapidly diluted with less chance of extravasation. It is commonly believed that fluid can be pushed faster through a central venous catheter but as they are often divided into multiple lumens then the internal diameter is less than that of a large-bore peripheral cannula, [3].

2.7.3 Tunnelled lines:

Another type of central line, called a Hickman line or Broviac catheter, is inserted into the target vein and then "tunneled" under the skin to emerge a short distance away. This reduces the risk of infection, since bacteria from the skin surface are not able to travel directly into the vein; these catheters are also made of materials that resist infection and clotting, [3].

2.7.4.Implantable ports:

A port (often referred to by brand names such as Port-a-Cath or MediPort) is a central venous line that does not have an external connector; instead, it has a small reservoir that is covered with silicone rubber and is implanted under the skin. Medication is administered intermittently by placing a small needle through the skin, piercing the silicone, into the reservoir. When the needle is withdrawn the reservoir cover reseals itself. The cover can accept hundreds of needle sticks during its lifetime. It is possible to leave the ports in the patient's body for years; if this is done however, the port must be accessed monthly and flushed with an anti-coagulant, or the patient risks it getting plugged up. If it is plugged it becomes a hazard as a thrombus will eventually form with an accompanying risk of embolization. Removal of a port is usually a simple outpatient procedure; however, installation is more complex and a good implant is fairly dependent on the skill of the radiologist, [3].

2.8. Principles of Drug Administration:

To provide safe drug administration, the nurse should practice the "rights" of drug administration. They are:

The right client, the right drug, the right dose, the right time and the right route

Experience indicates that five additional rights are essential to professional nursing practice

The right assessment, the right documentation, the client's right to education, the right evaluation and the client's right to refuse. The right client needs to be ensured by checking the wrist band, and by checking a second piece of identification. This could be a picture on the chart, or a case number that is both on his chart and wristband. This must be done before any medication is administrated.

The right drug means that the client receives the drug that was prescribed by a physician (MD), dentist (DDS), podiatrist (DPM), or an advanced practice nurse with the license to write prescriptions (APRN).

The use of computerized systems to record medications has helped to decrease medication errors, because nurses are not trying to read written forms of the prescriptions. Dr.'s can electronically add a new medication order to a pt. chart from any location.

If there is a phone order or verbal order it must be cosigned by the prescribing physician within 24 hours, [9].

The components of a drug order are as follows:

Date and time the order is written, Drug name (generic is preferred), Drug dosage, Route of administration, Frequency and duration of administration (e.g., x 7 days, x 3 doses).

Any special instructions for withholding or adjusting dosage based on nursing assessment, drug effectiveness, or laboratory results.

To avoid error, the nurse must check the bottle against the order for the medication three different times. At the time of contact with bottle or container, before pouring the drug, and after pouring the drug.

Drugs given for the first dose, one-time or PRN medication should always be checked against the original order, [9].

The following are the four categories of drug orders:

1. standing orders 2. One-time (single dose)
3. PRN 4. STAT (at once)

The nursing implications include the following:

Check that medication order is complete and legible, Know why the client is receiving the medication, Check the drug label three times before administration, Know the start date that the drug was ordered and the ending date, Calculate the

drug dose correctly, Administer drugs at the specified times, Administer drugs that are affected by foods, before meals, Administer drugs that can irritate the stomach (gastric mucosa) with food, [9].

The drug administration schedule can sometimes be flexible in order to accommodate the client's activities for the day or preference, it's the nurse's responsibility to be aware of tests or procedures that are taking place that may affect the medication administration. Check the expiration date on medications and return to pharmacy if expire, Antibiotics need to be given evenly over 24 hours as opposed to T.I.D , [9].

2.9. Intravenous (IV) medications methods

IV bolus (push), as a secondary or "piggyback" intermittent infusion, or by continuous infusion in a large volume of solution. With each of these methods, potent drugs are rapidly absorbed and distributed throughout the circulatory system to arrive at target tissues and organs, initiating desired responses as well as the potential for adverse reactions, [10].

Nursing responsibilities for IV medication administration include:

Supporting positive outcomes, reducing the risk of adverse events and integrating medication administration into the patient's plan of care, [10].

Basic intravenous medication safety:

Nursing responsibilities for the safe and effective administration of intravenous (IV) medications begin with the standards of practice common to all routes:

Know and perform the six rights of medication administration – right patient, right drug, right dose, right route, right time, and right documentation, Check the medication at least three times against the medication administration record (MAR) prior to administration – as you remove the drug from the storage area, as you prepare the drug, and at the patient's bedside just before you administer the drug. Only administer medications you have prepared or those that have been prepared

by a licensed pharmacist only, administer medications that have been labeled appropriately, Perform accurate dosage calculations.

Remember that, once you have administered an IV medication, it enters the bloodstream immediately and begins to affect target tissues and organs. Take diligent care to avoid errors in dosage calculations, preparation, and administration. It is also crucial to know the desired action and side effects of each medication prior to administration and the antidote if one is available , [10].

IV medications and the plan of care:

When an IV medication is prescribed, your patient might have unique physical or emotional needs that make the IV route preferable or necessary. The nursing process provides a framework for assessing need, planning and implementing delivery, and evaluating the patient's response to IV medications, [10].

2.10. Indications for IV medications include:

- A patient who is unwilling or unable to swallow, or A drug whose action is adversely affected by digestive secretions ,A drug that would irritate the gastrointestinal tract if given orally, A drug used for anesthesia or procedural sedation A medication that is only effective or available in IV form , The need to determine a precise, accurate dose (because intravenous absorption is more complete and predictable than that of other routes) A drug that requires monitoring and maintaining therapeutic blood levels An emergency situation when a drug must act rapidly, [10].
- As with all medications, IV drugs are prescribed and dosed to treat specific conditions, with additional consideration for the patient's medication "profile," which includes genetics, age, gender, current medications, and medical history. Become familiar with your patient's medication profile. It provides information essential for planning and implementing effective IV medication therapy, [10].

1. ***Genetics:*** Genetic-based differences in drug metabolism are possible and should be considered when patients have unexpected responses to medication

dosing. Often, these genetic-based differences are shared by members of the same ethnic group, so these differences are often categorized that way, This variation is due to genetic alterations in specific drug-metabolizing enzymes and becomes apparent in an individual's response to the medication, [10].

2. ***Age:*** Remember that the liver inactivates and metabolizes most drugs, while the kidneys eliminate the byproducts (metabolites) of the drugs from the body. This is important to consider when providing IV medication to the very young or very old. Young children lack fully developed hepatic and renal function. They metabolize and excrete drugs inefficiently, making children more susceptible to toxic effects. Likewise, diminishing hepatic and renal function prolongs drug action in older adults, who are also more likely to have other conditions affecting drug response such as altered cardiac, pulmonary, and immune function. Older adults are also likely to experience drug-drug interactions due to the treatment of multiple health problems, [10].
3. ***Gender:*** In general, men and women can respond in different ways to the same medication. For example, women tend to have a higher percentage of body fat while men have a higher percentage of body fluid, thus women might accumulate fat-soluble drugs over time. Other considerations for women are the ability of some drugs to cross the placenta and that of some drugs to be found in breast milk. When providing any medications to women who are pregnant or may become pregnant or who are breastfeeding, be knowledgeable about safe use during pregnancy and lactation, [10].
4. ***Physical characteristics and health status:*** Body surface area, height, and weight are used to calculate many drug doses, especially for children. Overweight and underweight adults might also require dose adjustments. Problems that can affect IV dose requirements include renal and hepatic impairment and cardiac and pulmonary dysfunction. Knowing your patient's

medical history, including current medications, allergies, and intolerances, helps you assess appropriate responses and alerts you to possible adverse effects.[10] Study conduct by Kelly Gonzales University of Iowa may2011 the purpose of this work was to address medication errors and safe medication administration practices in relation to practicing nurses and nursing students, [10].

These different approaches will be presented as three separate papers but interrelated themes. The approach used in the first paper was a systematic literature search of medication Administration errors and the pediatric population; five themes emerged including the Incidence rate of medication administration errors, specific medications involved in Medication administration errors and classification of the errors, why medication Administration errors occur, medication error reporting, and interventions to reduce Medication errors. The approach used in the second paper included a systematic Literature review and implementation of a survey, both focusing on the assessment Strategies for safe medication administration with practicing nurses and nursing students. Results of both the review and the survey indicated a lack of a comprehensive assessment of safe medication administration. The approach used in the third paper was a research Study to conduct a psychometric evaluation of the Safe Medication Administration (SAM) Scale with baccalaureate nursing students, Results provided evidence of the Validity and reliability of the SAM Scale. This body of work exposed a gap in nursing and demonstrates the importance of having a standardized assessment of safe medication Administration with evidence of validity and reliability to demonstrate competency in this area, [11].

Patient teaching:

Prior to initiating IV medication therapy, assess your patient's prior knowledge and ability to participate in education sessions. Explain or reinforce the indications and expected response of each medication. Instruct the patient about

reportable symptoms, such as pain, burning, itching, or swelling at the IV site, as well as other potential reactions specific to the medication, [10].

2.11.Medication Errors:

A medication error can cause or lead to inappropriate medication use or patient harm. MAE defines it as ‘mistakes associated with drugs and intravenous solutions that are made during the prescription, transcription, dispensing, and administration phases of drug preparation and distribution, [2].

Medication errors include inaccurate prescribing, administering the wrong medication, giving the medication using the wrong route or time interval, and administering extra doses or failing to administer a medication. Preventing medication errors is essential. The process of administering medications has many steps and involves many members of the health care team. Because nurses play an essential role in preparing and administering medications, they need to be vigilant in preventing errors Advances in technology have helped to decrease the occurrence of medication errors. Medication errors are related to practice patterns, health care product design, or procedures and systems such as product labeling and distribution. When an error occurs, the patient’s safety and well-being become the top priority. The nurse first assesses and examines the patient’s condition and notifies the health care provider of the incident as soon as possible. Once the patient is stable, the nurse reports the incident to the appropriate person in the institution (e.g., manager or supervisor). The nurse is responsible for preparing a written occurrence or incident report that usually needs to be filed within 24 hours of the error. The report includes patient identification information; the location and time of the incident; an accurate, factual description of what occurred and what was done; and the signature of the nurse involved. Report all medication errors, including those that do not cause obvious or immediate harm or near misses, [2].

Steps taken to prevent medication errors:

- Prepare medications for one person at a time, Follow the six rights of medication administration, Be sure to read labels at least three times (comparing medication administration record [MAR]with label) before administering the medication Use at least two patient identifiers and review the patient's allergies whenever administering a medication, Do not allow any other activity to interrupt administration of medication to a patient (e.g., phone call, pager, and discussion with other staff),Double-check all calculations and other high-risk medication administration processes (e.g., patient-controlled analgesia) and verify with another nurse. Do not interpret illegible handwriting; clarify with prescriber, Question unusually large or small doses, Document all medications as soon as they are given, [2].
- When you have made an error, reflect on what went wrong and ask how you could have prevented the error, evaluate the context or which a medication error occurred this helps to determine if nurses have the necessary resources for safe medication administration. Attend in-service programs that focus on the medications commonly administered. Ensure that you are well rested when caring for patients. Nurses make more errors when they are fatigued, [2].
- Involve and educate the patient when administering medications. Address patients' concerns about medications before administering them (e.g., concerns about their appearance or side effects),Follow established policies and procedures when using technology to administer medications (e.g., automated medication dispensing systems [AMDSs] and bar-code scanning) Medication errors occur when nurses "work around" the technology (e.g., override alerts without thinking about them), [2].
- A Paper surveys current literature related to medication administration errors, the role of nurses in such errors, and current initiatives that are underway within

New Zealand to address this aspect of patient safety, done by Karen McBride-Henry and Maralyn Foureur in 2006, [12].

- The literature review focused on research that primarily addresses the issues related to medications that arise in tertiary care facilities.
- Medication administration errors are reported to occur in one in five medication dosages. Such events have long been scrutinized, with the primary focus being the practice of nurses and their role in medication error. Analysis of such events frequently identifies the nurse as the deliverer of unsafe practice. However, over the past few years a shift in how medication errors are understood has led to the identification of systems-related issues that contribute to medication errors. However, observations of practice are considered to be the most accurate way of measuring the occurrence of MAE (medication administration error),[12].
- Two such observational studies found that MAE rates in the acute-care setting varied between 14.9% and 32.4%, The medication error rate for intravenous medications is significantly higher than other types of medications, with researchers observing preparation error rates of 26% and administration error rates of 34% The total of all observed medication errors indicates that errors occur in almost one out of every five doses, [12].

Researchers return to standard categories for describing the various ways in which errors occur. These factors cover errors such as wrong administration rates, calculation errors, and wrong dose. Research suggests that the number one occurring error is inaccurate IV push rates, with 88 in 100 doses being improperly administered. Other frequently observed errors included wrong administration rates, which ranged between five to 21.6 in 100 doses and the omission of dosages, which ranged between (8.1 to50 in100 doses) the least frequently observed error was an allergy related error, which occurred between 1.3 and 1.8 times in 100 doses. It has been reported that the overall incidence of adverse events occurring within the hospital system in New Zealand is 6.3% concluded that errors occur on

both a systems and personal level, however nurses have developed significant expertise in MA and have considerable knowledge of associated systems. This knowledge needs to be accessed and utilized within quality initiatives tackling the issue of Medication Administration, [12].

Chapter three

- ***Methodology and material***

3.Methodology

3.1 Study approach:

The approach of this study is quantitative.

3.2Study design:

This study was descriptive cross sectional done in Almak Nimer university hospital during period extended from (August to December 2016) to assess nurses knowledge and practice about intravenous medication administration, safety and errors.

3.3 Study area:

The research was done in Sudan in Shendi, Shendi locality is one of the localities of the River Nile State. It is bounded by Khartoum state to the south, Elddamer locality to the north, River Nile to the west and Gadarif state to the east. The total area of the locality is about 14596 Km2. Geographically it lies between line 36 east to 31 west longitudinal and line 19 north to line 15 south latitudinal in the arid zone of Sudan with an annual rainfall ranging' between 0 and 119ml per year. It is situated on the main River Nile, which provides the water for the agricultural land. The main plants are cash crops such as white beans, onions, wheat and sorghum, goats and camels are practiced both by the few nomadic 'Rashaida' and the settled farmers.

Culturally the population of Shendi is a mixture of the various cultures that occur in Sudan though the Northern tribes, particularly ElGaalien, are predominant Shendi has three hospital, Shendi teaching hospital, military hospital and Almak Nimer hospital

3.4 Study setting:

Almak Nimer hospital is establish in July 2002, it is biggest hospital which have different department and provide good health service for population Shendi area, there is medicine department, surgery, pediatric, obstetrical, ENT,

ophthalmic, dental unit, which compose of tow ward male and female with at least 40 beds, thirteen nurses are working in this unit. There are also major and minor theater, emergency room and CCU, ICU, and dialysis room. Emergency room, oncology, and dialysis unit, there is also blood bank and pharmacy and laboratory. The hospitals have more than 200beds, and the nursing staff rotated among the units routinely, they were about 125nurse.

3.5 Study population:

All nurses who work in Almak Nimer university hospital during the period of study.

- **Inclusion criteria:**

The Inclusion criteria were nurses working in the wards and units regardless of status or shift these wards include medical, surgical, obstetrics and gyncology, pediatric, coronary care unit (CCU) and intensive care units (ICUs).

- **Exclusion criteria:**

The exclusion criteria were nurses who working in outpatient care clinics, nurses who work in hemodialysis unit, nurse's work as national service and nurses on annual or maternity leave during the study period.

3.6 Sampling and sample size:

All nurses on hospital was enroll, and (70)nurses work during all shift were participated in the study.

3.7 Date collection tools:

Two tool has been used which is check list has been developed by researcher from available literature review adopted by, [1]. And grated by done and not done. It composed from (23) Steps. Structured questionnaire has been developed by researcher and Data were collected using close ending interview questionnaire consist of (1-20) questions from (1-5) about personal data, from (6-9) about knowledge regarding IV drug preparation, question from (10-13).

About IV therapy method, (14-16) question about knowledge regarding IV drug safety, (17-20) question about assessment knowledge about IV drug errors.

3.7.1 Scoring system for check list:

Pre procedure scale composed of 9 steps:

- Good skills → 7-9steps.
- Satisfied → 6_4steps.
- Poor →< 4 steps.

- Iv push procedure composed of 7 steps:

- Good skills → 7_5 steps.
- Satisfied → 4_3 steps.
- Poor →<3 steps.

- IV infusion procedure scale composed of 7 steps:

- Good skills → 7_5 steps.
- Satisfied → 4_3 steps.
- Poor →<3 steps.

3.7.2 Scoring system for knowledge:

Scoring system was developed by the researcher which the data distributed in many categories to measure the level of nurses knowledge about IV drug administration first category was 4 options if the respondent response to (4-3) choice it consider good knowledge, (2) choice consider fair knowledge ,(1-0) choice it consider poor knowledge, second category was 5 options if the respondent response to (5-4) choice consider good knowledge,(3) choice consider fair knowledge,(2-1) choice consider poor knowledge ,third category was 6 options if the respondent response to(6-4) choice it consider good knowledge,(3) choice consider fair knowledge, (2-1) choice it consider poor knowledge, four category was 8 options if the respondent response to(8-6) choice it consider good knowledge,(5-4) choice consider fair knowledge(3-1) choice it consider poor knowledge .

3.8 Data collection technique:

Data was collected during the three shifts for three weeks. Every participate was observe during the procedure, any questionnaire was filled by participation it take about 15 minute there No missing in questionnaire

3.9 Ethical considerations:

The Research was approved by faculty of community research. The original director of the hospital and administer staff permit to conduct study. Purpose of study was explain verbally to each participate and there were accept to participate, they have chance to continue or stop any time they wish.

3.10 Data analysis technique:

The data was coded and analyzed manually by simple statistical technique and else by using software program (SPSS-version 22) presented in form of figures and tables. Deferent measures were used (frequency - percentage.)

Chapter four

Results

4. Results

Table NO (4.1): Distribution of study group according to knowledge about preparation on timing of medication.

Nurses knowledge	*Frequency*	*Percentage*
Good	24	34.3%
Fair	22	31.4%
Poor	24	34.3%
Total	70	100%

Table (4.1) showed that, nurse's knowledge about preparation on timing of medication were good as presented by 34.3%, fair by %31.4 and poor knowledge by 34.3%.

Table NO (4.2): Distribution of study group knowledge about prepare IV medication:

Nurses knowledge	**Frequency**	**Percentage**
Good	20	28.6%
Fair	20	28.6%
Poor	30	42.8%
Total	70	100%

Table (4.2) showed that nurse's knowledge about preparation of IV medication were good as presented by 28.6%, fair by 28.6% and poor knowledge by 42.8%.

Table NO (4.3) Distribution of study group knowledge about prepare infusion therapy:

Nurses knowledge	Frequency	Percentage
Good	28	40%
Fair	19	27%
Poor	23	33%
Total	70	100%

Table (4.3) showed that, nurse's knowledge about preparation of infusion therapy were good as presented by 40%, fair by %27 and poor knowledge by %33.

Table NO (4.4) Distribution of study group about knowledge about indication of IV medication:

Nurses knowledge	*Frequency*	*Percentage*
Good	31	44.3%
Fair	11	15.7%
Poor	28	40%
Total	70	100%

Table (4.4) showed that, nurse's knowledge about indication of IV medication were good as presented by 44.3%, fair by %15.7 and poor knowledge by 40%.

Table NO (4.5) Distribution of study group knowledge about IV medication method:

Nurses knowledge	Frequency	Percentage
Good	21	30%
Fair	21	30%
Poor	28	40%
Total	70	100%

Table (4.5) showed that, nurse's knowledge about IV medication method were good as presented by 30%, fair by %30 and poor knowledge by %40.

Table NO (4.6) Distribution of study group knowledge about intravenous access device:

Nurses knowledge	*Frequency*	*Percentage*
Good	25	35.7%
Fair	15	21.3%
Poor	30	43%
Total	70	100%

Table (4.6) showed that, nurse's knowledge about IV access device were good as presented by 35.7%, fair by %21.3 and poor knowledge by %43.

Table NO (4.7) Distribution of study group knowledge about possible complication of intravenous therapy:

Nurses knowledge	Frequency	Percentage
Good	34	48.5%
Fair	22	31.5%
Poor	14	20%
Total	70	100%

Table (4.7) showed that, nurse's knowledge about possible complication of IV medication were good as presented by 48.5%, fair by %31.5 and poor knowledge by %20.

Table NO (4.8) Distribution of study group knowledge about nursing responsibilities for the safe administration of IV medication:

Nurses knowledge	Frequency	Percentage
Good	29	41.4%
Fair	17	24.3%
Poor	24	34.3%
Total	70	100%

Table (4.8) showed that, nurse's knowledge about nursing responsibilities for the safe administration of IV medication were good as presented by 41.4%, fair by %24.4 and poor knowledge by %34.2.

Table NO (4.9) Distribution of study group knowledge about factor increase the risk of IV medication errors:

Nurses knowledge	Frequency	Percentage
Good	36	51.4%
Fair	15	21.4%
Poor	19	27.2%
Total	70	100%

Table (4.9) showed that, nurse's knowledge about factor increase the risk of IV medication errors were good as presented by 51.4%, fair by 21.4% and poor knowledge by 27.2%.

Table NO (4.10) Distribution of study group knowledge about type of IV medication errors:

Nurses knowledge	Frequency	Percentage
Good	30	42.9%
Fair	15	21.4%
Poor	25	35.7%
Total	70	100%

Table (4.10) showed that, nurse's knowledge about type of IV medication errors were good as presented by 42.7%, fair by %21.5 and poor knowledge by %35.8.

Table NO (4.11) Distribution of study group knowledge about organizational factor that contribute to medication errors:

Nurses knowledge	Frequency	Percentage
Good	28	40%
Fair	18	25.7%
Poor	24	34.3%
Total	70	100%

Table (4.11) showed that, nurse's knowledge about organizational factor that contribute to IV medication errors were good as presented by 40%, fair by %25.8 and poor knowledge by %34.2.

Table NO (4.12) Distribution of study group knowledge about personnel factor that contribute to medication errors:

Nurses knowledge	Frequency	Percentage
Good	29	41.4%
Fair	20	28.6%
Poor	21	30%
Total	70	100%

Table (4.12) showed that, nurse's knowledge about personnel factor that contribute to medication errors were good as presented by 41.5%, fair by %28.5 and poor knowledge by 30%.

Table NO (4.13) Distribution of study group knowledge about nursing assessment during IV therapy:

Nurses knowledge	*Frequency*	*Percentage*
Good	19	27%
Fair	22	31.5%
Poor	29	41.5%
Total	70	100%

Table (4.13)showed that, nurse's knowledge about nursing assessment during IV therapy were good as presented by 27%, fair by %31.5 and poor knowledge by %41.5.

Table NO (4.14): Represent pre procedure nurses performance about intravenous drug administration

N= 70

Nurses performance	Frequency	Percent
Good	34	48.5%
Fair	11	15.8%
Poor	25	35.7%
Total	70	100%

Table (4.14) showed that, nurse's performance about pre procedure were good as presented by 48.5%, fair by %15.8 and poor skills by %35.7.

Table NO (4.15): Represent during procedure nurses performance about IV Push drug administration

N=70

Nurses performance	Frequency	Percent
Good	29	%41.5
Fair	14	20%
Poor	27	%38.5
Total	70	%100

Table (4.15) showed that, nurse's performance during IV Push administration were good as presented by % 41.5, fair by %20and poor skills by%38.5.

Table NO (4.16): Represent during procedure nurses performance about IV infusion drug administration

N=70

Nurses performance	Frequency	Percent
Good	15	%21.4
Fair	38	%54.4
Poor	17	%24.2
Total	70	%100

Table (4.16) showed that, nurses performance during procedure were good as presented by %21.4, fair by %54.4 and poor skills by %24.2.

Table No (4.17) Correlation between education level and nurses knowledge regarding safety:

Education	Nursing responsibilities for the safe administration of IV medication			Total	Asymp. Sig. (2-sided)
	Good	Fair	Poor		
Diploma	9	0	0	9	.*000
	12.9%	0.0%	0.0%	12.9%	
Bachelor	20	17	7	44	.*000
	28.6%	24.3%	10.0%	62.9%	
Post graduate	0	0	17	17	.*000
	0.0%	0.0%	24.3%	24.3%	

Correlation is significant if the p-value less than 0.05, highly significant if the p-value at 0.00 and not significant if the p-value more than 0.05, the relation between education level and nursing responsibilities for safe IV Drug administration was highly significant (p-value=.000).

Table No (4.18) Correlation between education level and factor that increase the risk of IV medication errors:

Education	Factor that increase the risk of IV medication errors			Total	Asymp. Sig. (2-sided)
	Good	Fair	Poor		
Diploma	9	0	0	9	.*000
	12.9%	0.0%	0.0%	12.9%	
Bachelor	27	15	2	44	.*000
	38.6%	21.4%	2.9%	62.9%	
Post graduate	0	0	17	17	.*000
	0.0%	0.0%	24.3%	24.3%	

The relation between education level and knowledge about factor that increase the risk of IV Drug errors was highly significant (p-value=.000).

Table No (4.19) Correlation between education level and nurses knowledge regarding safe practice guide line:

Education	Knowledge about safe practice guideline					Asymp. Sig. (2-sided)
	Competency Assessment	Error Reporting	Labeling	Aseptic Technique	Total	
Diploma	9	0	0	0	9	.*000
	12.9%	0.0%	0.0%	0.0%	12.9%	
Bachelor	3	13	28	0	44	.*000
	4.3%	18.6%	40.0%	0.0%	62.9%	
Post graduate	0	0	1	16	17	.*000
	0.0%	0.0%	1.4%	22.9%	24.3%	

The relation between education level and knowledge about safe practice guideline was highly significant (p-value=.000)

Table No (4.20) Correlation between nurse experience and knowledge about medication errors:

Nursing experience	Type of IV medication errors			Total	Asymp. Sig. (2-sided)
	Good	Fair	Poor		
< 2	20	0	0	20	.009
	28.6%	0.0%	0.0%	28.6%	
> 2-5 years	10	15	0	25	.023
	14.3%	21.4%	0.0%	35.7%	
> 5-10 years	0	0	15	15	.020
	0.0%	0.0%	21.4%	21.4%	
>10 years	0	0	10	10	
	0.0%	0.0%	14.3%	14.3%	

The relation between nursing experience level and knowledge about type of IV medication errors was not significant (p-value=.009)

Table No (4.21) Correlation between nursing experience & organizational factor that contribute to medication errors:

Nursing experience	Organizational factor that contribute to medication errors			Total	Asymp. Sig. (2-sided)
	Good	Fair	Poor		
< 2	20	0	0	20	.007
	28.6%	0.0%	0.0%	28.6%	
> 2-5 years	8	17	0	25	.012
	11.4%	24.3%	0.0%	35.7%	
> 5-10 years	0	1	14	15	.022
	0.0%	1.4%	20.0%	21.4%	
>10 years	0	0	10	10	
	0.0%	0.0%	14.3%	14.3%	

The relation between nursing experience level and knowledge about organizational factor that contribute to medication errors was not significant (p-value=.007)

Table No (4.22) Correlation between nursing experience& personnel factor that contribute to medication errors:

Nursing experience	Personnel factor that contribute to medication errors			Total	Asymp. Sig. (2-sided)
	Good	Fair	Poor		
< 2	20	0	0	20	.005
	28.6%	0.0%	0.0%	28.6%	
> 2-5 years	9	16	0	25	.012
	12.9%	22.9%	0.0%	35.7%	
> 5-10 years	0	4	11	15	.011
	0.0%	5.7%	15.7%	21.4%	
>10 years	0	0	10	10	
	0.0%	0.0%	14.3%	14.3%	

The relation between nursing experience level and knowledge about personnel factor that contribute to medication errors was significant (p-value=.005)

Figures

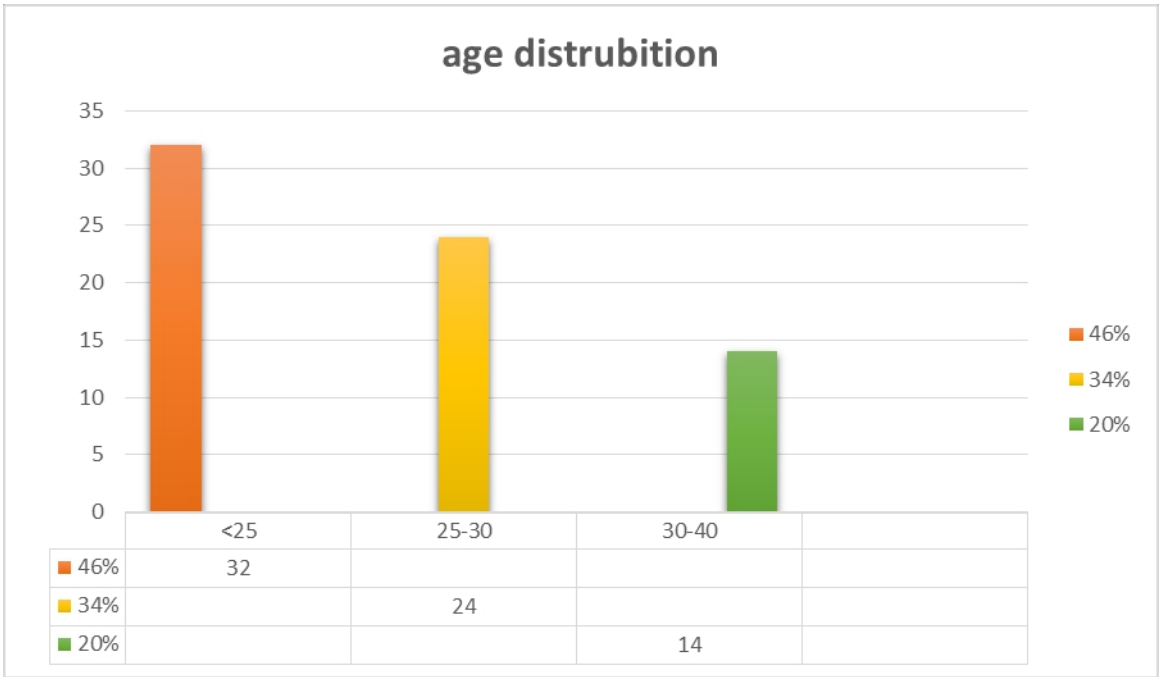

Figure (4.1) Age of nurses:

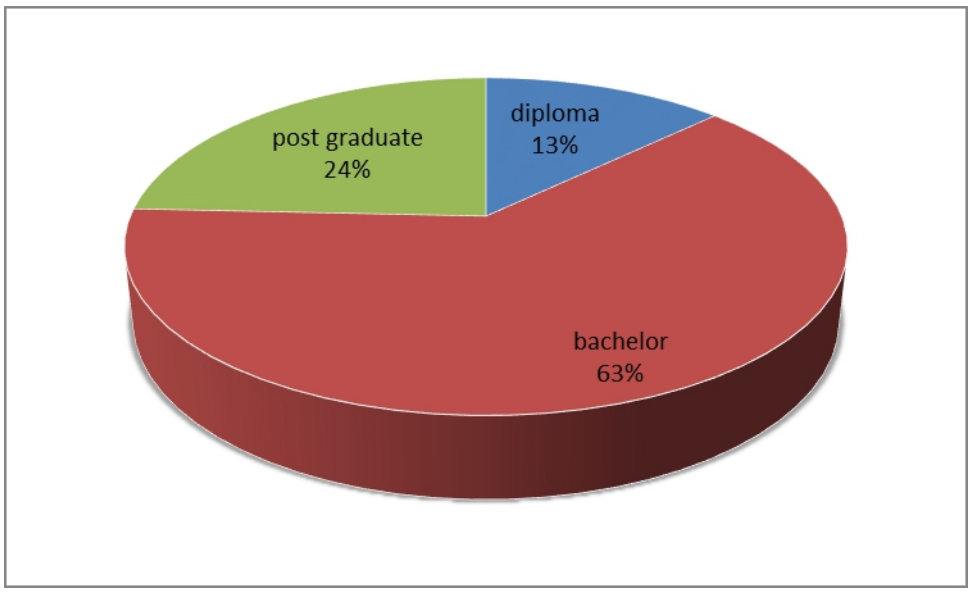

Figure (4.2) Education level of nurses:

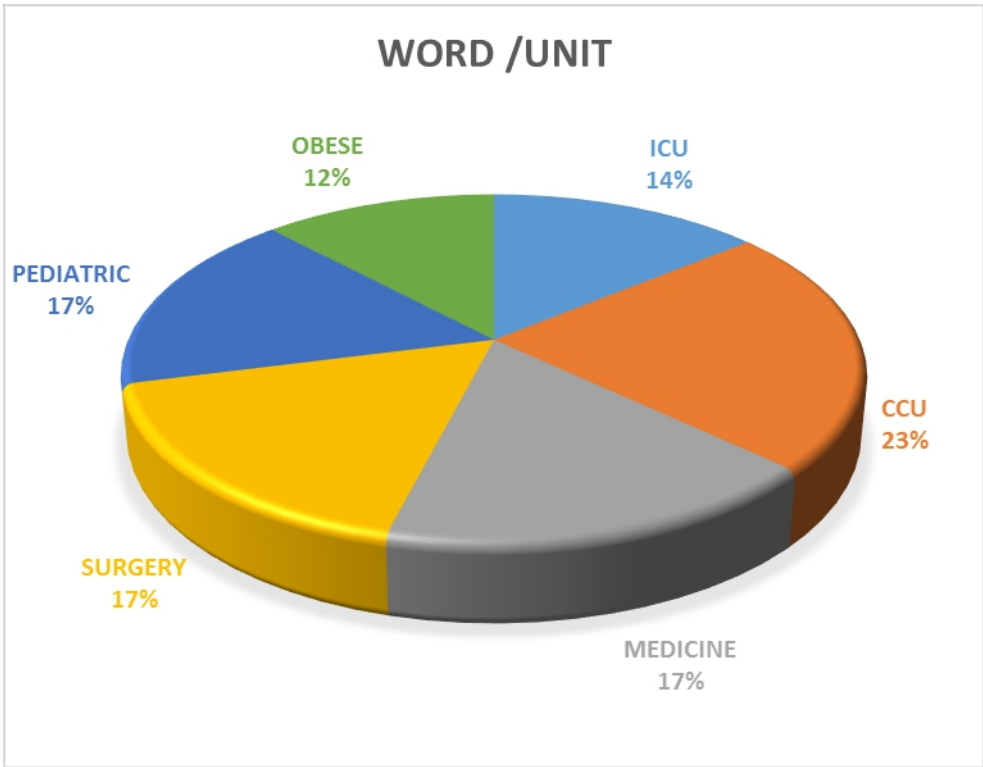

Figure (4.3) Nursing work unit or /ward:

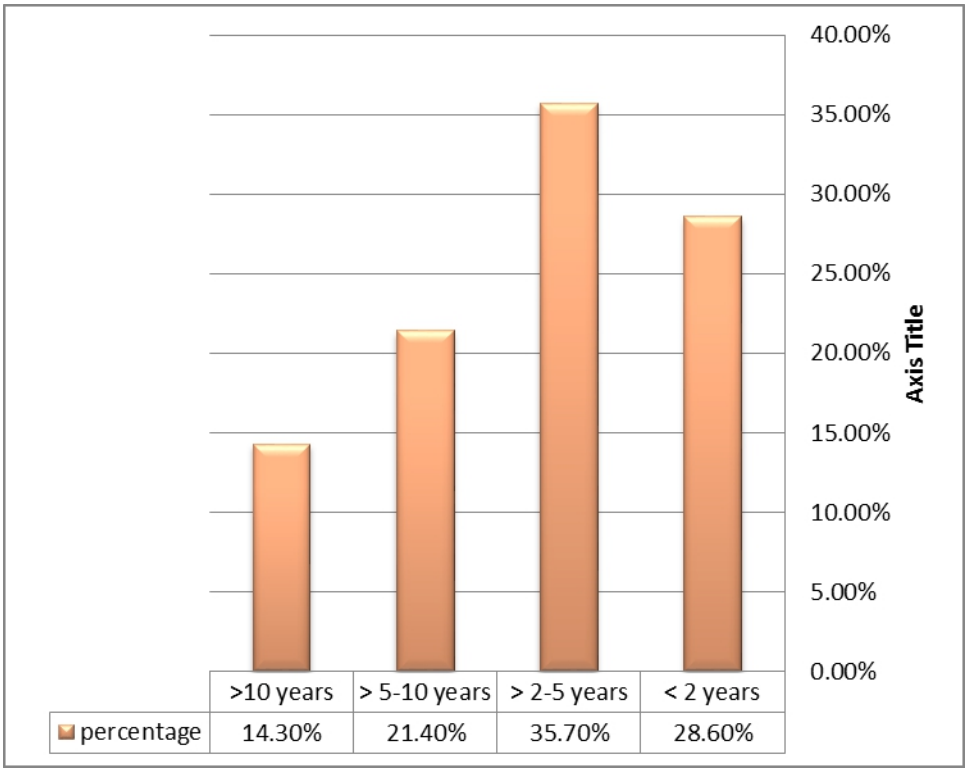

Figure (4.4) Nursing experience

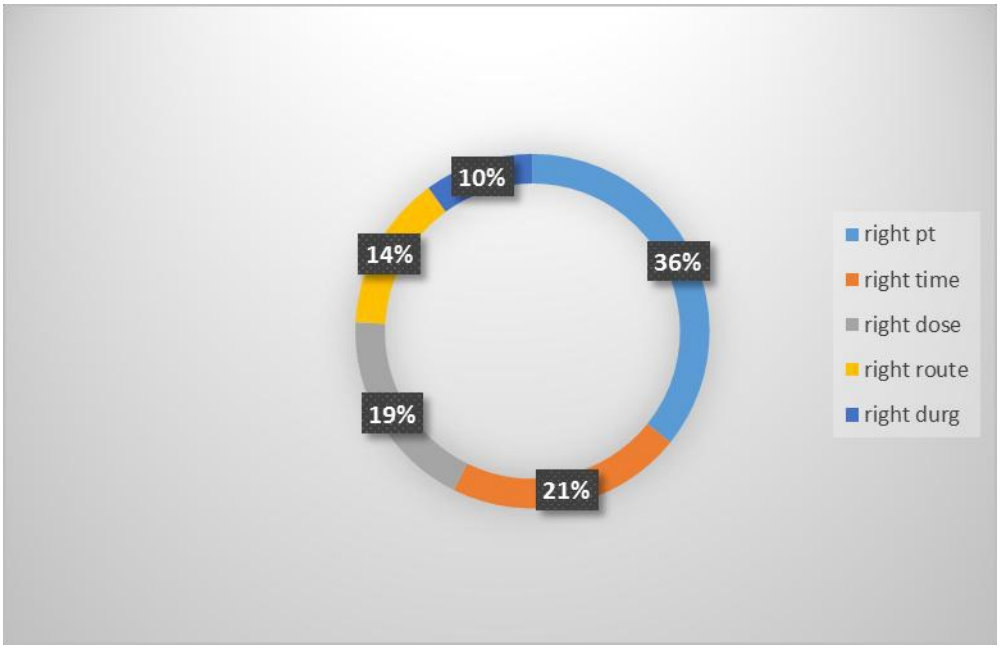

Figure (4.5) Nursing knowledge about checkup the ten rights:

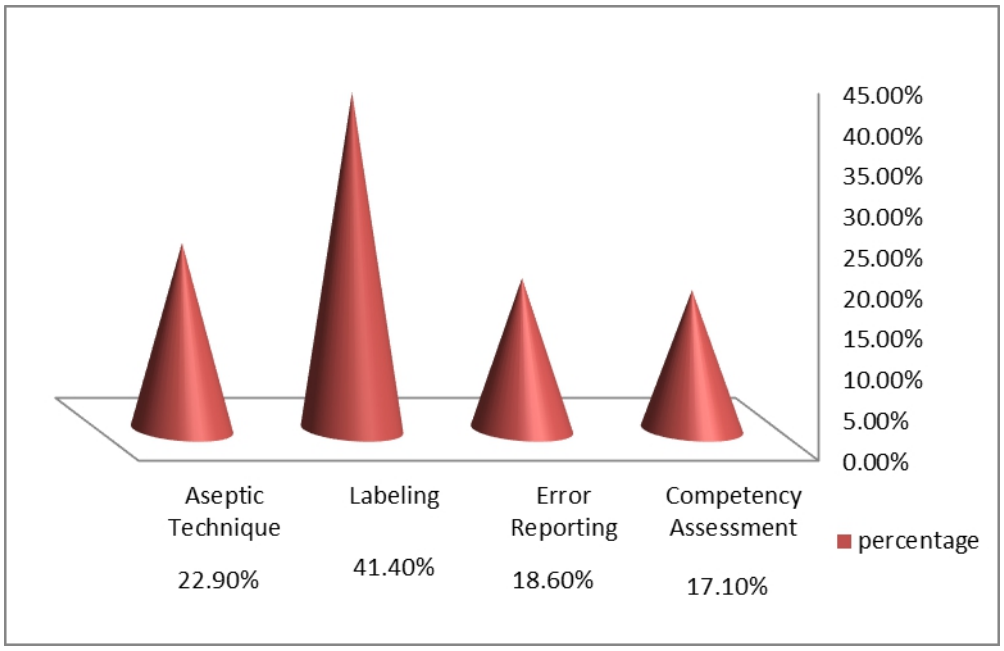

Figure (4.6) Nursing knowledge about safe practice guidelines:

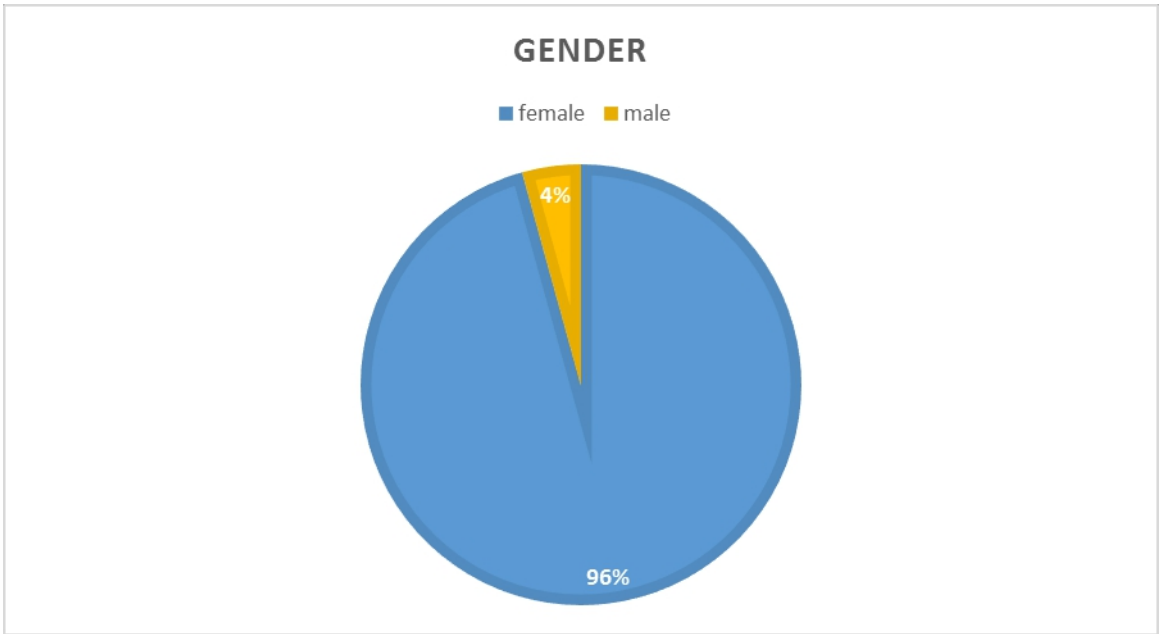

Figure (4.7) Gender of nurse:

Chapter five

- ***Discussion***
- ***Conclusion***
- ***Recommendations***

5.1 Discussion

Intravenous (IV) therapy is considered an essential component of current healthcare delivery, with over 90% of hospitalized patients receiving some form of infusion therapy, Errors involving IV medications can occur in all phases of the medication use process and can be particularly dangerous based on the drug's properties and the complexity of its therapeutic action [14]

Findings of this study showed that nurses from the selected wards had an average level of knowledge in the preparation and administration of IV medications the study include 70 nurses: Gender profiles of respondents were 95.7% females age of nurses range as following less than 25 are 46% , most of them are young and their experience revealed that 35.7% had 2-5 years of experience, the majority of the respondents (63%) were bachelors holders. The respondent work unit and ward was medicine ward 17%, surgery ward 17% obstetric ward 12%, pediatric ward 17%, ICU unit 14%, CCU 23%.

About respondents knowledge regarding preparation on timing of medication, 34.3% was good knowledge .about check the six rights before administration was good 49.3%,nurse knowledge about IV preparation was poor 42.8% may be due to of work flow and lack of staff while nurse's knowledge about preparation infusion therapy was good 40% because they thought it is contain high alert medication.

In addition nurse's knowledge about indication of IV medication was good 44.3% while the knowledge about IV medication method was poor 40%, on the other hand knowledge about intravenous access device was poor 43% may be due to lack of facilities Lack of financial resources, human resources, insufficient staff education and training about new IV infusion device.

Furthermore Nurses' knowledge about possible complication of intravenous therapy was good 48.5% nurses' knowledge about nursing responsibilities for the safe and effective administration of IV medication was good 41.4% nurses'

knowledge about factor increase the risk of IV medication errors was good more than a half (51.4%)this agree with study [13] It has been estimated that between 44,000 to 98,000 people die each year due to medical errors that could have been prevented.

In regard to nursing knowledge about safe practice guidelines this study showed that less than half (41.4%) though labeling was high percent, this agree with the study [8] Medications or solutions in unlabeled syringes or bottles are unidentifiable and have been mistaken for different medications or solutions and administered to the wrong patient, in the wrong dose, and/or by the wrong route. with this study Many errors associated with unlabeled containers have resulted in serious patient harm or death.

In addition to that, nurses knowledge about type of IV medication errors, organizational factor and personnel factor contribute to medication errors was good (42.9%, 40%, 41.4%), respectively this stated with [13]The medication error rate for intravenous medications is significantly higher than other types of medications the total of all observed medication errors indicates that errors occur in almost one out of every five doses.

Nurses' knowledge about nursing assessment during IV therapy was unfortunately poor 41.5%.

The study showed that about half of nurses (48.5%)had good performance in pre procedure preparation to IV drug administration so 80% of them check the accuracy of medication, 78%was check the six rights, 100% was gather equipment, 73% check patency of infusion site, 88%check medication for expiration date, 100%was prepare their medications, on the other hand weak point were 55% assess the patient for contraindication 36%wash their hands,53%explain the procedure to the client.

In addition to that ,the study reveal that almost all nurses had a good skill in performing IV pushing procedure all step was perfectly good except , 74% clean iv

port with antiseptic swab , 44% dispose uncapped needles and syringes due to lack of safety boxes.

Finally, the study represented that nurses skills about IV infusion drug administration more than a half was fair skills 54.4% so they 78% inject appropriate medication into appropriate solution, 95% was document the procedure but only less than a half did not check the client for allergy, did not else check the drug compatibility chart, moreover did not observe client for adverse reactions this indicate that either nurses have not trained well, work overload, or due to job dissatisfaction.

There was highly and directly statistical significant relationship between study group education level and their knowledge regarding safety about IV medication administration (*p=.000)*, which may reflect that Patient safety is also a concern in nursing education. It is a basic assumption that the baccalaureate graduate is prepared to promote safe, quality patient care, in spite of that there was no statistical significant relationship between the experience and knowledge about IV medication errors types (*p=.009*),else there was no statistical significant relationship between the experience and knowledge about organizational factor that contribute to medication errors (p=.007) ,on the other hand there was statistical significant relationship between the experience and knowledge about personal factor that contribute to medication errors (p=.005).

Limitations:

There were a few limitations to this study. The results may not necessarily reflect all nurses working in Elmk Nimer Hospital University.

The number of statements or queries measuring knowledge (i.e. only20 statements posed in the questionnaire) was too small and did not cover other aspects of IV medications such as drug interactions and compatibility issues.

Another limitation was that the questionnaire was in the English language. English is not the native language for most of the nurses and language barrier dispositions may occur in this survey when respondents found it difficult to understand the questionnaire especially diploma holder responders.

5.2 Conclusion

The study concluded the following:

Nursing knowledge about prepare IV medication less than a half was poor, and knowledge about prepare infusion therapy half of them was good ,nursing knowledge about IV drug safety was good almost of them and nursing knowledge regarding medication errors was majority of them had been good.

Most of nurses' have good performance in pre procedure preparation. In spite of that they were didn't assess for any contraindication ,check the client for allergies, check the drug compatibility and use of aseptic technique and infection control measures.

Finally, the nurse's performance regarding IV infusion was satisfied and performance about IV push procedure was good.

5.3 Recommendations

Based on the finding of the present study it recommended the following

By the hospital director have to provide:

- Demonstrates the need for a standardized strategies assessment of safe medication administration in order to verify that nurses and nursing students are prepared to give safe, quality care.
- Reported that the overall incidence of adverse events occurring within the hospital system.
- Incident reporting forms require individuals to identify themselves and, if directly involved, accept responsibility for the error, regardless of the circumstances.
- Organizations have to put systems strategies in place to reduce the number of systems errors

By the Head nurse have to provide:

- Nurses have to make continuous training and courses about IV access device and method by using charts, real object, and media.
- Nursing training programmers should provide more hours for calculation and understanding of IV medications. Continuous education programmers on aspects of IV medications and related safety issues for nurses are also important
- The involvement of medication experts such as pharmacists in nursing training programmers would be beneficial in addressing issues relating to IV medications

Appendix

- ***References.***
- ***Questionnaire***
- ***Checklist***

References

1. Sue C. Delaune Patricia k.Ladner fundmentals of nursing standards &practice 2002 Printed by Delmar publisher, second edition, page: 725-732.

2. Potter & Perry . Fundamental of nursing 2013 by Mosby, an imprint of Elsevier Inc Printed in Canada ,eighth edition, page: 565_ 635.

3.https://en.wikipedia.org/wiki/Intravenous_therapy, access on 13/10/2016 at 7:00pm

4.http://www.ismp.org/Tools/guidelines/ivsummitpush/ivpushmedguidelines.pdf access on 13/10/2016 at 6:10 pm

5. http://www.bmj.com/content/338/bmj.b814 (icu durg adminstration error) access on 2/10/2016 at 8:18 pm

6.http://onlinelibrary.wiley.com/doi/10.1046/j.1365-2648.1995.22040628.x/full access on 25/9/2016 at 9:30pm

7. Phillips J, Beam S, Brinker A. Retrospective analysis of mortalities associated with medication errors. Am J Health Syst Pharm 2001;58:1835– 41. access on 27/9/2016 at 11:12am.

8.https://www.nursingtimes.net/roles/nurse-educators/preventing-and-reporting-drug-administration-errors/203718.article access on 30/9/2016 at 7:23pm

9.https://sites.google.com/site/pharmacology1site/week-1/drug-actions-principles-of-drug-administration---group-2/principles-of-drug-administration, access on 13l10/2016 at 8:30 pm.

10.http://www.atitesting.com/ati_next_gen/skillsmodules/content/medication-administration-4/equipment/nursing-responsibilities.html access on 13/10 at 5:00 pm

11.www.bbraun.it/documents/RCN-Guidlines-for-IV-therapy.pdf, access on 13/10/2016 at 6:49 pm

12.https://www.nuh.nhs.uk/handlers/downloads.ashx?id=63421 access on 13/10/2016 at 6:25 pm.

13. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3228265/access on 1/12/2016 at 12:26 pm

14.http://www.sciencedirect.com/science/article/pii/S187704281203884access on 2/2/2016 at 7:35pm

Shendi University

Faculty Of post graduate study

Master of Nursing science

Questionnaire About nursing knowledge and practice regarding intravenous drug administration

No ( )

Part one Demographic data

1. **Age (years)** : (a) <25( ) (b) 25–30 ( ) (c) >30–40( )

2. **Education**: (a) diploma ( ) (b) bachelor ( ) (c) post graduate ( )

3. Gender: (a)male ( ) (b)female ( )

4. **Wards/Units**: (a) ICUs ( ) (b) Medical ( ) (c) Surgical ( ) (d) Obstetrics & Gynaecological ( ) (e) CCU ( ) (f) Pediatric ( )

5. Nursing experience (years) : (a) <2 ( )(b) 2–5 ( )(c) >5–10( ) (d) >10( )

Part two Knowledge about IV drug preparation

6. When Timing of medicine preparation you should:

(a) A venous access device must be in place before an injectable is prepared ( )

(b)Administration must be commenced as soon as possible after preparation ( )

(c) Prepare for one patient at a time ( )

(d)Discard any prepared products if clinical need ceases ( )

7. Check the patient's prescription for:

(a)The right patient ( ) (b)The right drug chart ( )(c)The right date/ day/ time ( ) (d)Right Route ( ) (e)Right drug, preparation, dose and indication ( )

8. When prepare IV medication you should do the following:

(a) Patient assessment about identifying the most suitable vein ( )

(b)Positive patient identification ( ) (C) Check patency of cannula ( )

(d) Check all Aseptic technique infection control measures to prevent pathogenic micro-organisms ( ) (e) Check Allergy status of patient ( )

9. **Preparing of IV infusion therapy you should do the following:**

(a)Assessment of patients' vascular access needs, nature and duration of therapy ()

(b) Set rate on pump if applicable ( ) (c) documentation ( )

(*d*) Monitoring and care of the site ( ) (e) infection control issues ( )

Part there knowledge about IV therapy method:

10. Indications for IV medications include:

(a) A patient who is unwilling or unable to swallow ( )

(b)A drug whose action is adversely affected by digestive secretions ( )

(c)A drug that would irritate the gastrointestinal tract if given orally ( )

(d)A drug used for anesthesia or procedural sedation ( )

(e)A medication that is only effective or available in IV form ( )

11. IV mediation methods include:

(a) IV push ( ) (b) Intermittent venous access device ( )

(c) Intermittent infusion (or piggyback) ( ) (d) Continuous infusion ( )

(e) Electronic pumps and controllers ( ) (f) Patient-controlled analgesia ( )

12. Intravenous access devices are:

(a) Peripheral catheter ( ) (b) Peripherally inserted central catheter PICC ( )

(c) Central line ( ) (d) Subcutaneous injection port ( )

13. **Possible complications of intravenous therapy are:**

(a) Infiltration / extravasation ( ) (b) Fluid overload ( ) (c) Embolism ( )

(d) Phlebitis ( ) (e) Infection ( )

Part four nursing knowledge about IV drug safety:

14. Nursing responsibilities for the safe and effective administration of intravenous (IV) medications are:

(a) Know and perform the six rights of medication administration ( )

(b) Check the medication at least three times against the medication administration record (MAR) ( )

(c) Only administer medications you have prepared ( )

(d) Only administer medications that have been labeled appropriately ( )

(e) Perform accurate dosage calculations ( )

15. Factors that Increase the Risk of IV Medication Errors are the following:

(a) Lack of Drug Information ( ) (b) Lack of Patient Information ( )

(c) Risks Associated with Environment, Staffing, and Workflow ( )

(D) Risks Associated with Device Use ( )

(e) Risks Associated with Staff Education and Competency ( )

16. Safe Practice Guidelines include the following

(a)Competency Assessment ( ) (B) Error Reporting ( ) (c) Labeling ( )

(d)Aseptic Technique ( )

Part five nursing knowledge about IV drug errors

17. Types of IV medication administration errors?

(a) Wrong administration rates ( ) (b) Wrong IV push rate ( )

(c) Wrong dose Calculation ( ) (d) Wrong drug ( ) (e) Wrong patient ( )

(f) Dose delayed > 1 hour ( ) (j) Wrong route ( ) (k)Allergy related error( )

18. Organizational Factors that contribute to medication errors?

(a) Lack of adequate staffing ( ) (b) Patient acuity level ( )

(c) Physical environment: lighting, drug preparation facilities ( )

(d) Inadequate access to policy and medication information ( )

19. Personnel factor that contribute to medication errors

(a)Understanding of how errors occur ( ) (b) Number of hours on shift ( )

(c)Distractions ( ) (d) Lack of knowledge about medication ( )

(e) Dosage calculating ( )

20.nursing assessment observations during IV therapy include:

(a) Close monitoring of weight gain/loss ( ) (b) Accurate I and O ( )

(c) Assessing for signs of edema ( ) (D) Assessing lung sounds ( )

IV administration check list

1) Check the accuracy of the medication order.	***done***	***Not done***
2) Assess for any contraindications to client receiving medications (hypotension, heart rate, allergies, labs)		
3) Perform the 6 rights of medication administration		
4) Gather prepared equipment (medication labeled with the client's name, and time tape for fluids to infuse per hour).		
5)Wash hands		
6) Explain the procedure to the client.		
7) Check patency of infusion site.		
8) Check medication expiration date		
9) Prepare meds		
(10)IV push (existing line): Select injection port of IV tubing closest to patient.		
11)Clean injection port with antiseptic swab		
12) Connect syringe to port of IV line.		
13)inject medication within amount of time recommended		
14)After administering bolus, withdraw syringe		
15) Clean injection port of lock with antiseptic swab		
16) Dispose of uncapped needles and syringes in puncture-proof and leak-proof container.		
17) Prepare IVPB: Inject appropriate medication into appropriate solution		
18)Attach IV tubing and prime without losing medication and expelling air		
19) Check the client's chart for allergies, and check the drug		

compatibility chart.		
20) Attach IVPB Open clamp of secondary tubing and adjust drip rate to desired infusion rate.		
21) Observe client for any signs of adverse reactions		
22) When secondary bag and drip chamber are empty, close the clamp ,and remove the secondary system		
23) Record medication infusion on the MAR		