T.C.
HACETTEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCE
FACULTY OF NURSING

THE IMPACT OF MEDICATION SAFETY EDUCATION ON PERCEPTION OF MEDICATION ERRORS, KNOWLEDGE AND INTRAVENOUS MEDICATION PRACTICE AMONG PALESTINIAN CRITICAL CARE NURSES

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APPROVAL
This dissertation has been approved by the committee above in conformity to the regulation and bylaws of Hacettepe university graduate programs and has been accepted by the board of directors of the Institute of Health Science.

Prof. Ersin FADILLIOĞLU, MD, PhD
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ABSTRACT

Abukhader, Imad. **The Impact of Medication Safety Education on Perception of Medication Errors, Knowledge, and Intravenous Medication Practice among Palestinian Critical Care Nurses , Hacettepe University , Graduate School of Health Science , Surgical Nursing Program, PhD Dissertation, Ankara, 2014.** This study was carried out as quasi experimental one group pretest posttest study to measure the impact of medication safety educational program on perception of medication errors, knowledge, and intravenous medication practices among Palestinian critical care nurses. The study population was selected among the nurses who are working at the Palestine Medical Complex /Ramallah/ Palestine. Sample of the study consisted of 52 nurses who were working at the general Intensive Care Unit, Surgical Intensive care unit and the Coronary Care Unit. The study was conducted between April 27 and August 10, 2014. The Gladstone survey, knowledge determination form and Practical Observation Form were both utilized as data collection tools to measure nurses' knowledge, and perception of safety medication administration. Nurses were educated parallel to the booklet on safe medication administration developed by researcher. Nurses were evaluated by data collection forms prior and after the educational session. Data was analyzed using SPSS Inc., version 18 software package. Descriptive statistics, McNemar's test, and chi squared tests were used to evaluate the data. Research findings revealed that there were significant improvements in knowledge and practices of nurses on the intravenous medication administration; while perceptions of nurses on medication errors were not changed as result of the education program. Based on the results of the study, implementation and dissemination of comprehensive, systematic, and continuous educational programs in order to enhance the knowledge, practices and perceptions of nurse's on intravenous medication administration practices was recommended.

Key words: Medication Errors, Nursing, Intravenous Medication Safety, Patient Safety.

ÖZET

Abukhader, Imad. **İlaç Güvenliği Eğitiminin Filistin'de Yoğun Bakım Hemşirelerinin İntravenöz İlaç Uygulamasına İlişkin Bilgilerine, Uygulamalarına ve İlaç Hataları Algılarına Etkisi, Hacettepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Cerrahi Hastalıkları Hemşireliği Programı, Doktora Tezi, Ankara, 2014.** Bu çalışma ilaç güvenliği eğitiminin Filistin'de yoğun bakım hemşirelerinin intravenöz ilaç uygulamasına ilişkin bilgilerine, uygulamalarına ve ilaç hataları algılarına etkisini belirlemek amacıyla yarı deneysel, tek grup ön test-son test çalışması olarak yürütülmüştür. Çalışmanın örneklemi Filistin/ Ramallah şehrindeki Filistin Tıp Merkezinde çalışan hemşirelerin arasından seçilmiştir. Tıbbi, Cerrahi Yoğun Bakım Üniteleri ve Koroner Bakım Ünitesinde çalışan 52 hemşire araştırmanın örneklemini oluşturmuştur. Çalışma 27 Nisan ve 10 Ağustos 2014 tarihleri arasında gerçekleştirilmiştir. Hemşirelerinin intravenöz ilaç uygulamasına ilişkin bilgilerine, uygulamalarına ve ilaç hataları algılarına etkisini belirlemek anmacıyla Gladstone Survey, Bilgi Belirleme Formu ve Gözlem Formu veri toplama aracı olarak kullanılmıştır. Güvenli intravenöz ilaç ugulamasına ilişkin araştırmacı tarafından geliştirilen kitapçık doğrultusunda hemşirelere eğitim verilmiştir. Hemşireler hem eğitim öncesinde ve sonrasında veri toplama araçları kullanılarak değerlendirilmiştir. Veriler SPSS 18 yazılım paketi kullanılarak analiz edilmiştir. Verilerin değerlendirilmesinde betimleyici istatistikler, McNemar testi ve ki kare testi kullanılmıştır. Sonuç olarak, eğitim programı sonucunda hemşirelerin intravenöz ilaç bilgi ve uygulamalarında önemli gelişme olurken, intravenöz ilaç hatalarına ilişkin algılarında istatistiksel olarak anlamlı bir gelişme olmadığı saptanmıştır. Araştırmadan elde edilen bulgular doğrultusunda, hemşirelerin intravenöz ilaç uygulamasına ilişkin bilgi ve uygulamalarının geliştirilmesi amacıyla kapsamlı, sistematik ve sürekli eğitim programlarının uygulanması ve yaygınlaştırılması önerilmiştir.

Anahtar Kelimeler: İlaç Hataları, Hemşirelik, İntravenöz İlaç Güvenliği, Hasta Güvenliği.

CONTENTS

SYMBOLS AND ABBREVIATIONS

ADE	: Adverse Drug Event
ADR	: Adverse Drug Reaction
CCU	: Coronary Care Unit
FDA	: Food & Drug Administration
HCPC	: Health & Care Professional Council
ICU	: Intensive Care Unit
IOM	: Institute of Medicine
IV	: Intravenous
MAEs	: Medication Administration Errors
NPSGs	: National Patient Safety Goals
TJCI	: The Joint Commission International
USA	: United States of America
WHO	: World Health Organization

GRAPHS

TABLES

1. INTRODUCTION

1.1. Definition of the Problem

Health care is constantly developing, progressing, evolving and advancing as the needs of the population change. Knowledge and techniques in health care are rapidly expanding and even the health care environment is becoming increasingly complex. This point is emphasized by the USA Health & Care Professions Council (HCPC-2010), which states that recipients of care trust health professionals to provide care that is safe, efficient, effective, timely, patient-centered, and equitable. Patient safety is considered as the iceberg of global public health issue. In recent years, countries have increasingly recognized the importance of improving patient safety. Globally, numerous organizations have concerns about patient safety and error. In 2002, World Health Organization (WHO) Member States agreed on a World Health Assembly resolution on patient safety.

Within the United States, the Institute of Medicine (IOM) has addressed this major public health concern by explicitly identifying and prioritizing patient safety as one of the areas that must be improved in the 21st century healthcare system. IOM defined safety as "freedom from accidental injury". The IOM (1999) report, *To Err is Human,* was the first report of its kind to expose the significance of preventable medical errors. This report caught the attention of healthcare providers, advocates, policy makers, and patients, each of whom demanded improvements in the delivery and safety of healthcare. Despite the IOM's candid report published over a decade ago, little change has been made in the healthcare industry to decrease medical errors (Landrig, et al, 2010).

WHO and The Joint Comission International (JCI) are important organizations, which study on patient safety. In 2002, Joint Comission established its National Patient Safety Goals (NPSGs) program. The NPSGs were established to help accredited organizations address specific areas of concern in regards to patient safety. A panel of widely recognized patient safety experts adviced JCI on the development and updating of NPSGs. The purpose of the National Patient Safety Goals is to improve patient safety with the goals focusing on problems in health care safety and how to solve them. JCI notes that quality will become one of the primary determinants

of reimbursement levels. Improved and consistent quality will also reduce costs at hospitals by eliminating variability and risk to patients. JCI 2014 Hospital Patient Safety Goals include;

- Identify patients correctly.
- Improve staff communication.
- Use medicines safely.
- Use alarms safely
- Prevent infection.
- Identify patient safety risks.
- Prevent mistakes in surgery.

Since medication errors are considered the most common medical error, "use of medicines safely" is important among the JCI Patient Safety Goals (The Joint Commission, 2008).

The IOM also identified medication errors as a major source of error in healthcare which may negatively impact patient safety. While almost one-fifth of all medical errors in hospital settings were deemed to be drug-related, over half of these were considered preventable.

As such, the IOM has placed medication error reduction as a priority area within the reports *To Err is Human* (2000), *Crossing the Quality Chasm* (2001), *Priority Areas for National Action* (2003), and *Patient Safety* (2004).

According to the US National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP 2001) medication error is "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health-care professional, patient or consumer". The characteristics of medication process (complexity of the procedures, multiplicity of professionals and services involved, rapid introduction of new drugs, diagnostic and therapeutic technologies, etc.) frequently provoke errors that jeopardize care security and quality, generating an increase in costs as well , Medication error is a potentially life-threatening problem that is relatively common in all hospitals around the world.(Pepper, 1995,Dean 1999, Greengold et al. 2003, Taxis & Barber 2003).

The morbidity and mortality associated with medication errors and other inappropriate use represents a large clinical and economic burden for patients,

providers, and society. Worldwide, there is a proliferation of studies about medication errors (Agency for Healthcare Research and Quality, 2007; Rothberg, Morsi, and Benjamin, 2008, Pekow, &Lindenauer, 2009). In recent studies, researchers report medication administration error rates of 16.7% to 27.6% (Berdot, 2012; DeYoung, Vanderkooi, & Barletta, 2009; Poon et al, 2010). In United States of America, the IOM reported that 7000 deaths occur yearly due to medication errors. IOM also reported that the cost of preventable adverse drug reactions (ADR's) is about 2.8 million dollars yearly for a 700 bed teaching hospital.

A 2006 study by the IOM estimated the preventable medication errors happen at least 1.5 million times per year in the United States. One study found that error occurring in an inpatient setting result in over $ 8000 of increased hospital cost per incident. IOM noted another study that examined medication errors in the over 65 Medicare population, finding that these errors cost nearly $900 million per year to treat. (Johnson and Bootman,1995) reported that the annual cost of drug-related morbidity and mortality was $76.6 billion in ambulatory care settings within the United States, while an update conducted by (Ernst and Grizzle,2003) noted a cost of $177.4 billion. Within nursing facilities, these costs were found to be $7.6 billion, which essentially equated to $1.33 billion spent on drug-related problems for every dollar used for medications.

In Britain, the cost of preventable adverse events is £ 1 billion per annum in lost bed days alone. The wider costs of lost working time, disability and further economic consequences are greater still (Anderson, 2010)

Research in Australia showed that total cost of medication errors represent 15.7% of total expenditure on direct hospital cost (Ehsani, Jackson, and Duckett, 2008). The Australian Institute of Health and Welfare reports costs relating to the inappropriate use of medicines are approximately $380 million annually. Factors that contribute to the financial burden as a result of medication error include additional resources consumed, increased hospital stay and bed occupancy. (Australian Institute of Health and Welfare. 2000).

(Hatcher et al. 2004) indicated that 61% of life threatening errors were associated with intravenous (IV) medications. Single site studies in the UK and US confirm that nurses made mistakes in preparing and administering IV medications in

13–84% of all cases. Undesirable variability in IV medication practices further increases the risk of harm.

A review of infusion safety system software data sets from more than 100 individual hospitals revealed huge variability in drug names, concentrations, dosing units, dose limits, maximum infusion rates, weight limits, volume limits, and other variables. (Bates, Vanderveen, Seger, et.al.2003) .Intravenous (IV) medications are frequently administered in critical care units. Critical care studies in high-alert IV medication administration found error rates of 34 % (Leape, Bates, Cullen, et al 1995). Medication errors account for 78% of serious medical errors in the Intensive Care Units (ICU). (Leape, Berwick, 2005). In the intensive care unit (ICU), on average, patients experience 1.7 errors per day and nearly all suffer a potentially life threatening error at some point during their stay.

The ICU brings together high-risk patients and interventions in a complex environment. Critically ill patients are prescribed twice as many medications as patients outside of the ICU. Most medications in the ICU are administered as weight-based infusions. These infusions require mathematical calculations and frequently are based on estimated weights increasing the risk of error (Pronovost, et al 2008). Multi centered studies by (Ridley and colleagues, 2009 and Calabrese and colleagues, 2010) identified potassium chloride, heparin, magnesium sulphate, vasoactive drugs, sedatives, and analgesics as the medications with the greatest risk of error.

Antibiotics frequently prescribed in the ICU and errors have potential implications both for individual patients and populations. Patients are prescribed these medications in an environment that is stressful, complex, changing, under the stewardship of multiple providers, and frequently managing patients in crisis (Kane-Gill, and Weber, 2006). Medication errors may be related to professional practice, health-care products, procedures and systems, including prescribing; order communication; product labelling, packaging and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use. It is commonly believed that medication errors occur as a result of either human error or a system flaw (AAP, 2003). The United States Food and Drug Administration (FDA) identified the most common types of fatal medication errors between 1993-1998 as

wrong dose (40.9% of errors), wrong medication (16% of errors) and wrong route of administration (9.5% of errors) (Phillips et al., 2001).

Many medication errors were found to be due to lack of pharmacological knowledge, proper attitude and skills in medication administration. (Gerry and Helen, 2003) have shown that 5.41% of the medication errors that occurred were due to failure in following the prescription and poor skills in administering drugs. The evidence of poor quality and errors in the preparation and administration of IV medications among health professionals points towards quality of care issues. Quality of this process is vital in providing safe patient care and attempts at quality improvement should be continually explored. In relation to safe IV medication use, health care providers are required to have adequate knowledge and skill (Anderson & Townsend, 2010).

A multidisciplinary team approach for medication management and the prevention of medication errors should be used. Nurses have many tasks, roles, and responsibilities, including the process of medication administration, which is considered the most critical responsibility since it is associated with high risks to health status that may occur with medication errors. The administration of medication is a fundamental role of a nurse and is the last step in the medication process preceded by the initiation and processing of the order (Agyemang and While, 2010).

Providing safe nursing care for patients has always been an important issue in health care setting. Nurses should adhere to the eight rights of medication administration (Right patient, Right medication, Right dose, Right route, Right time, Right documentation, Right reason, and Right response) to prevent medication errors. Since nurses are closely involved in the delivery of medications and are ultimately responsible during the medication administration phase, it is important for nursing to understand causes of medication administration errors (Anderson, and Townsend, 2010).

It has been estimated that 19% to 26% of a nurse's time is spent administering medications (Keohan, 2008; Westbrook, Duffield, and Creswick, 2011). In the medication use process, the nurse at the bedside is most vulnerable to errors. (Bates, Cullen, Laird, 1995) Compared with other steps in the process, the administration stage has the fewest safeguards and the fewest support mechanisms. (Leape, et al., 2010)

showed that 38 % of medication errors causing preventable Adverse Drug Events (ADEs) occurred during administration.

Of the non-intercepted potential ADEs and preventable ADEs, 51% occurred during the administration stage. Because administration occurs at the end of the medication use process, with no naturally occurring redundancies, opportunities to intercept errors at this stage are lessened. (Leape, Bates, Cullen, 1995). (Shane, 2009) stated that errors with IV medications were reported in the United States (US) even though the hospital pharmacy was responsible for the preparation of these medications. Nurses are now responsible for the preparation and administration of IV medications in most countries (, Hartley &Dhillon 1998; Ross et al. 2000 and Mathew 2007).

In nursing, continuing professional education is very important for continuous improvement of their performance to deliver the best patient care with the ultimate aim of improving patient outcomes. Continuing professional education keeps individuals current on trends, skills and techniques required for effective practice. (Gould, et al.2007). Education of nurses is important in improving medication safety also. Educational programs can raise nurses' awareness about medication errors and other medication-related safety issues (Elnour, et al. 2008). Proper understanding of causes of medication errors, investigating nurses' perception of these errors and outlining what barriers lay behind reporting these errors and performing educational programs to improve the practices could be the cutting edge between patients' safety and medication errors (Ulanimo, Leary-Kelley, Connolly, 2007). Understanding of medication errors can help healthcare professionals and managers to identify causes of medication errors and provide insight into how to make improvements to prevent or reduce those (Poon et al., 2010).

Little is known about the prevalence of medication errors in the Middle East, especially in Palestine, There is only one published study conducted in Jordan to describe Jordanian nurses perceptions about various issues related to medication errors, including rate, causes and reporting of medication errors.

This study will be the first one in the field of nursing which concern about the medication errors and safety practices of nurses working at the critical care units in Palestine and this will set a base line data for future studies in different departments, also findings of this study will help health care providers and health policy makers to

establish mechanisms to decrease medication errors, establish clear protocols that maximize patients' safety and improve quality of care provided for Palestinian patients.

1.2. Purpose of the Study

The purpose of this study is to evaluate the effect of medication administration safety practice education on the perception of medication errors, knowledge and practices among the critical care nurses in Palestine.

1.3. Hypothesis

H1: Knowledge of nurses on intravenous medication safety will be improved after planned education.

H2: Practices of nurses on intravenous medication safety will be improved after planned education.

H3: Perceptions of medication errors of nurses will be changed after planned education.

1.4. Theoretical Framework

Patient safety and quality health care are primary focus of health care. In 2002, WHO Member States agreed on a World Health Assembly resolution on patient safety. IOM has addressed this major public health concern by explicitly identifying and prioritizing patient safety as one of the areas that must be improved in the 21st century healthcare system. IOM defined safety as “freedom from accidental injury”. In 2002, Joint Commission established its National Patient Safety Goals (NPSGs) program. The purpose of the National Patient Safety Goals is to improve patient safety with the goals focusing on problems in health care safety and how to solve them. Joint Commission 2014 Hospital Patient Safety Goals include;

- Identify patients correctly.
- Improve staff communication.
- Use medicines safely.
- Use alarms safely
- Prevent infection.

- Identify patient safety risks.
- Prevent mistakes in surgery.

1.4.1. Medication Errors

Commonly used definition for a medication error is: Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. (IOM, 2008)

Proper medication administration is a critical for optimal medical treatment, but medication errors occur frequently. In an original investigation study conducted by (Barker, Flynn, Peppe, Bates, and Mikeal, 2002), direct observation was used as means to identify the specific types of medication errors that occur during the time of medication administration. The study concluded that of the 3,216 observed medications administrations, 605 (95% CI ±4.5%) medication errors were identified. The most frequent errors included wrong time (43%), medication omission (30%), wrong dose (30%) and unauthorized drug (4%).

Medication errors occur in all settings and may or may not cause an adverse drug event (ADE). Medications with complex dosing regimens and those given in specialty areas (e.g., intensive care units, emergency departments, and diagnostic and interventional areas) are associated with increased risk of ADEs. A study found that deaths the most severe ADE associated with medication errors involved central nervous system agents, anti - neoplastic, and cardiovascular drugs (Phillips and colleagues 2008). Administration of following medications may associate with errors:

- Medications with similar names or similar packaging
- Medications that are not commonly used or prescribed
- Commonly used medications to which many patients are allergic (e.g., antibiotics, opiates, and non-steroidal anti-inflammatory drugs)
- Medications that require testing to ensure proper (i.e., nontoxic) therapeutic levels are maintained (e.g., lithium, warfarin, theophylline, and digoxin)

1.4.2. Factors Associated With Medication Errors

There are association between working conditions/environment and medication errors. Medication errors may be caused from systems, process and human factors. Early research in this area found a relationship between characteristics of the work environment for nurses and medication errors. For example, a study found an association between the occurrence of medication errors and the inability to access information and failure to follow policies and guidelines (Leape and colleagues 2010).

Following the release of *To Err Is Human*, the focus on deaths caused by medication errors targeted system issues, such as high noise levels and excessive workloads, and system interventions, such as the need for computerized order entry, unit dose (e.g., single-dose packaging), and 24-hour pharmacy coverage. The IOM's report, *Crossing the Quality Chasm*, put forth the concept that poor designs set the workforce up to fail, regardless of how hard they try. Thus, if health care institutions want to ensure safer, higher-quality care, they will need to, among other things, redesign systems of care using information technology to support clinical and administrative processes.

1.4.2. a. Systems Factors

The system approach to safety emphasizes the human condition of fallibility and anticipates that errors will occur, even in the best organizations with the best people working in them. This approach focuses on identifying predisposing factors within the working environment or systems that lead to errors.

Systems factors that can influence medication administration include nurse staffing, workload, organizational climate/favourable working conditions, policies and procedures, and technologies enabling safety or contributing to medication administration errors.

1.4.2. b. Process Factors

There are five stages of the medication process: (a) ordering/prescribing, (b) transcribing and verifying, (c) dispensing and delivering, (d) administering, and (e) monitoring and reporting. Monitoring and reporting is a newly identified stage about

which there is little research. Some of the most noted and early work on medication safety found hospitalized patients suffer preventable injury or even death as a result of medication administration errors associated with errors made during the prescribing, dispensing, and administering of medications to patients. A few studies have indicated that one of every three medication errors could be attributed to either a lack of knowledge about the medication or a lack of knowledge about the patient. A review of the literature found 18 studies and 2 literature reviews that contained process factors and their association to medication errors by nurses.

Process factors that influence medication administration include latent failures that can instigate events resulting in errors, such as administrative processes, technological processes, clinical processes, and factors such as interruptions and distractions.

1.4.2. c. Human Factors

There are studies that assessed the association of human factors with medication administration errors. Fatigue, cognitive abilities, knowledge, experience, and skills are main human factors associated with medication administration errors. Nurses are primarily involved in the administration of medications across settings. Nurses can also be involved in both the dispensing and preparation of medications (in a similar role to pharmacists), such as crushing pills and drawing up a measured amount for injections. A study in the USA found that human factors like nurse's fatigue or exhaustion, incorrect rate calculations, high patient/nurse ratio, ICU patient condition that deteriorates quickly, distractions and interruptions during medication administration, nurse's lack of concentration, may lead to medication errors (Momtahan, Burns, and Gabriele, 2008).

1.4.3. Critical Care and Medication Errors

The ICU brings together high-risk patients and interventions in a complex environment. The single strongest predictor of an ADE is patient illness severity. Critically ill patients are prescribed twice as many medications as patients outside of the ICU. Most medications in the ICU are administered as weight-based infusions.

These infusions require mathematical calculations and frequently are based on estimated weights increasing the risk of error. Moreover, they are reliant on sophisticated technologies and equipment to deliver essential care and yet relatively little is known about medical equipment failures and the associated safety risks. (Momtahan, Burns, and Gabriele, 2008)

1.4.4. Precautions to Decrease Medication Errors and Improve Medication Administration Safety

TJC's2014 Hospital National Patient Safety Goals include following points related to "Using Medicines Safely":

- Before a procedure, label medicines that are not labelled. For example, medicines in syringes, cups and basins. Do this in the area where medicines and supplies are set up.
- Take extra care with patients who take medicines to thin their blood.
- Record and pass along correct information about a patient's medicines. Find out what medicines the patient is taking. Compare those medicines to new medicines given to the patient. Make sure the patient knows which medicines to take when they are at home. Tell the patient it is important to bring their up-to-date list of medicines every visit to a doctor.

1.4.5. General Precautions for Medication Administration Safety

The administration of medication is a cognitive and interactive aspect of nursing care and is more than just the psychomotor task of administering a medication to a client. It involves client assessment, making clinical decisions and planning care based on this assessment. Medication administration is performed in collaboration with the client and family. It is important that these principles of medication administration be known and followed by the nurse who is administering medications (JCI 2010)

- A multidisciplinary team approach for medication management and the prevention of medication errors should be used.

- Medications, chemicals, reagents, and related supplies should be procured and stored in a manner that facilitates safe and efficient delivery to the patient. Medications should be stored according to manufacturer's medication storage requirements.
- Expiration date of the medication should be controlled; if the expiration date has passed it should be discarded or returned to pharmacy.
- Health care organizations should periodically review a list of look-alike, sound-alike.
- Health care organizations should standardize medication delivery equipment
- Prescribing personnel should provide clear, unambiguous, and accurate medication orders. Verbal medication orders should be limited, especially with medications identified as high risk for sound-alike errors or as having commonly confused names. Nurses should confirm verbal medication orders by reading back the order to the prescriber digit by digit and spelling out the medication name if necessary. Nurses should immediately record verbal medication orders in the patient's record. Prescribers should review, validate, and sign the transcribed verbal medication order on the patient's record as close as possible to the time of the medication administration. When available, prescribers should use computerized provider order entry systems.
- Safe medication order transcribing processes should be implemented.
- Nurses must know the therapeutic use of the medicine to be administered, its normal dosage, side effects, precautions and contra-indications
- Nurses should collaborate with pharmacist
- Nurses should assess the patient and review the patient's record to confirm the patient's metric weight, medication history, and current medication orders before administering medications.
- Nurses should confirm that medications and herbal supplements were taken.
- Nurses should identify the client two or three ways before administering medications (Name, armband-depending on facility technology)

- Medication allergy and reaction information should be obtained from patients, family members, legal guardians, and previous medical records and should be documented clearly in the patients' records.
- Nurses who administer medications should not be interrupted or distracted when preparing and administering medications.
- When preparing medications for administration, the nurses should use safety devices.
- Medications should be prepared as close as possible to the time of use.
- The use of multi dose vials should be avoided.
- Nurses should follow the medication manufacturer's directions for use.
- Aseptic technique should be used in medication administration.
- Medications should be labelled that are not labelled. For example, medicines in syringes,
- Safe injection practices should be used (e.g. one syringe and one needle)
- Nurses should administer only medications they themselves or a pharmacist have prepared, except in an emergency.
- Technology should be integrated to decrease medication errors at specific steps in the medication administration process.
- The health care organization must have updated list of high-risk medications. Specific protocols should be developed for high-risk drugs, including independent verification and double check procedures.
- Patient should be monitored for therapeutic effect or adverse reactions to medications.
- Potential hazards and near misses, as well as actual medication errors should be detected and reported.
- Patients should be educated related to medication use.
- A comprehensive safety program should be developed to medication administration safety.
- Nurses should adhere to the eight rights of medication administration: Right patient, Right medication, Right dose, Right route, Right time, Right documentation, Right reason, and Right response.

Table 1.1. Rights of Medication Administration and Nursing Procedures

Rights of Medication Administration	**Nursing Procedures**
Right patient	Check the name on the order and the patient. Use 2 identifiers. Ask patient to identify himself/herself. When available, use technology (for example, bar-code system).
Right medication	Check the medication label. Check the order.
Right dose	Check the order. Confirm appropriateness of the dose using a current drug reference. If necessary, calculate the dose and have another nurse calculate the dose as well.
Right route	Again, check the order and appropriateness of the route ordered. Confirm that the patient can take or receive the medication by the ordered route.
Right time	Check the frequency of the ordered medication. Double-check that you are giving the ordered dose at the correct time. Confirm when the last dose was given.
Right documentation	Document administration AFTER giving the ordered medication. Chart the time, route, and any other specific information as necessary. For example, the site of an injection or any laboratory value or vital sign that needed to be checked before giving the drug.
Right reason	Confirm the rationale for the ordered medication. What is the patient's history? Why is he/she taking this medication? Revisit the reasons for long-term medication use.
Right response	Make sure that the drug led to the desired effect. If an antihypertensive was given, has his/her blood pressure improved? Does the patient verbalize improvement in depression while on an antidepressant? Be sure to document your monitoring of the patient and any other nursing interventions that are applicable.

1.4.6. Intravenous Medication Safety

In addition to above mentioned general strategies related to medication administration safety, following precautions are important in intravenous medication administrations (Taxis, Barber. 2003)

- Checking the information (Medicine, dosage and prescribed route, mathematical calculations, expiration dates, diluents)
- Properly using single-use medical devices (syringes, needles and infusion supplies)
- Using single-dose vials for one client only. Using single-dose vials and pre-filled syringes whenever possible.

- Preparing medicine, checking for any discoloration or cloudiness.
- Preparation of substances for injection in advance of their immediate use or administration of medication drawn into a syringe or container by another practitioner when not in their presence is not acceptable.
- Administering one drug at a time and do not mix drugs together in the same infusion.
- Checking patency of cannula and IV line. Checking cannula site for signs of infection, extravasations or phlebitis.
- Flushing between medications if appropriate to minimise the risk of drug interactions. A compatible flush should be administered before, between and after each medication.
- Administering medicine at the correct rate, in accordance with the monograph instructions, using the correct delivery systems including pumps lines and filters.
- Establishing if an electronically controlled infusion device is required and to be familiar with its use.
- Observing for adverse reactions, monitoring the patient as appropriate.
- Ensuring that all sharps and non-sharp waste are disposed of safely.

2. MATERIALS AND METHODS

2.1. Study Design

A quasi experimental, pretest/posttest study design was used to evaluate the effects of educational program on knowledge, practice and perception regarding intravenous medication safety of the nurses working at the Critical Care units in Palestine.

2.2. Setting

The study was conducted in intensive care units of four hospitals within Ramallah city in a region of west bank / Palestine. The four hospitals are integrated together under the name of Palestine Medical Complex, this complex is administered by the Palestinian Ministry of Health. One of these hospitals is general and has 127 beds and 86 nurses. The pediatric hospital has 47 beds and 40 nurses. The specialized surgical hospital with 42 beds and 38 nurses. And the emergency and trauma hospital and has 19 beds and 30 nurse. A total of 261 beds with 214 nurses worked in the four hospitals. Regarding the safety medication practice, there is no written protocol and no in service training related to prevention of medication errors, so the study is highly welcomed and appreciated, and it is considered to be part of the policy and protocol construction.

2.3. Population and Sample

Of the 214 nurses who worked in the four hospitals, 52 nurses are working in the general intensive care unit (ICU), coronary care unit (CCU) and surgical ICU were composed the sample of the study. All nurses (52 nurses) participated voluntarily in the study.

All registered nurses who are working in the critical care units (general and surgical ICU and CCU) of the Palestine Medical Complex and has not less than 6 months experience, were included in this study. These nurses were working either day or night duty in any of the three units.

2.4. Instruments

Study tools include:

No	Tool	Purpose
1.	Practice Observation Form	to determine nurses' practices on Intravenous Medication Safety based on eight rights (Appendix IV)
2.	Knowledge Determination Form	to determine nurses' knowledge on Intravenous Medication Safety (Appendix II)
3.	Gladstone Survey	to determine nurses' perception on Intravenous Medication Safety (Appendix III)

1. Practice Observation Form: This form was developed by researcher based on the literature to determine the adherence of **Intravenous Medication Safety** practices to the medication rights which are Right patient, Right medication, Right dose, Right route, Right time, Right documentation, Right reason, and Right response. Each nurse was observed 3 times during his / her practice while preparing and giving the medication. The researcher evaluate the adherence of the nurses to the medication rights through the scale of (performed, not performed or not observed).

2. Knowledge Determination Form: This form was developed by researcher based on the literature to measure the nurses' **knowledge on Intravenous Medication Safety.** The questionnaire consists 16 statements or queries to gauge their levels of knowledge regarding preparation (eight statements) and administration (eight statements) of IV medications. These statements were qualitative and quantitative in nature.

Qualitative-type statements assessed maintenance of quality in practice as well as clinical decision making skills. The quantitative-type statements tested on respondents' calculation and dosing skills. Each statement has *True, False* and *Don't Know* responses for the respondents to correctly choose.

3. Gladstone Survey: In 1993, Gladstone survey was initially developed in the United States by an experienced quality improvement clinician and a health services researcher. This survey was developed to assess and measure;

(1) nurse perceived causes of medication errors (10 items),

(2) percentage of drug errors reported to nurse managers (1 item),

(3) types of incidents that would be classified as

(a) medication errors,

(b) reportable to physicians,

(c) reportable using an incident report

(4) nurse views about reporting medication errors (6 items), and

(5) Nurses biographical data.

Pilot study was conducted to explore the relationships among measures of nurses' perceptions of organizational culture, continuous quality improvement implementation, and medication administration error reporting. The data from this pilot study support the criterion-related validity of the subscales. When the initial survey was designed, and subsequently refined, individual items were reviewed and assessed for face validity. After the subscales were initially created using exploratory factor analysis, they were also reviewed and assessed for face validity. After the subscales were finalized, confirmatory factor analysis was used to establish construct validity. Subscale reliability was assessed using Cronbach's Coefficient Alpha and the result was .078. Overall, the internal consistency for each subscale is within acceptable ranges.

Test-retest reliability was assessed for the subscales using a sample of registered nurses who were enrolled in a graduate-degree nursing program. The correlation (Pearson's *r*) of scores from Time 1 and Time 2 were used to assess test-retest reliability. Fifty-three participants completed surveys at both Time 1 and Time 2. The correlations for the subscales ranged from 0.53 to 0.78 Instrument content validity was determined acceptable by Osborne et al. (1999) and Goldstone (1995). In addition, Osborne et al, (1999) established reliability using the test-retest method (0.78) in their sample.

2.5. Educational Material

The educational material contained a training booklet, and a power point presentation for the participants. The materials prepared by the researcher based on the literature and focused on the following topics:

Definition of Medication Errors

Adverse Drug Events (ADE) and Adverse Drug Reactions (ADR)

Look-Alike/Sound-Alike Medications

High-Alert Medications

Impact of Working Conditions on Medication Errors

Aspect of Working Conditions in Relation to Medication Safety

Critical Care and Medication Errors

Precautions to Decrease Medication Errors and Improve

Medication Administration Safety

Rights of Medication Administration and Nursing Procedures

Intravenous Medication Safety

2.6. Pilot Study

A pilot study of the knowledge determination questionnaire was done for a period of one week from 8 April 2014 until 15 April 2014 at the specialized surgical hospital of Bethlehem Arab Rehabilitation Society. It was conducted prior to starting the actual data gathering and the aim was to assess the design and identify any methodological problem, to establish feasibility of recruitment and retention procedures, to determine time required to administer an instrument, and to assess preliminary data about readability, and applicability of an instrument .The pilot study was performed with five registered nurses (n=5), which is 10% of the target population, who were working in either the Surgical ICU, or CCU. Face validity was done and feedback had been obtained, which approved that no any modifications or suggestions were requested, so forms can be used in the main research study.

2.7. Implementation

Implementation of the study was performed between over a period of two months between April 2014 and August 2014 in following five phases.

Phase 1

The researcher observed the elements of the Intravenous Medication Safety before the educational session, using the observational form to evaluate the adherence to the eight rights of intravenous medication administration which are "right patient", "right medication", "right dose", "right route", "right time", "right documentation", "right reason", and "right response" between the dates of April 27 – May 26, 2014. Three obsevations for each nurses were done. And the duration of observation for each nurse was about one hour.

A list of the nurses in each unit was obtained from the head nurse of each unit with his or her time schedule(shift) during the above mentioned period, and regular and planned visits to each unit were organized 2 to 3 hours before and after the time of medication administration, also list of medications for each patient was obtained and the nurse incharge for medication administration each shift, on the time of medication administration, researcher started to observe each shot of medication administration and the adherance to the medication rights based on the practical observation form

Phase 2

In this phase pretest of the study was performed between the dates of June 11 – June 19,2014. Participants completed the Knowledge Form and Gladstone Survey before the educational sessions. The researcher distributed the questionnaires to the respondents (n=52) working on day and night duty. During the distribution of the questionnaires, the researcher briefly introduced himself to the registered nurses, explained the aim of the research study and the methods by which the questionnaires could be returned and offered an opportunity for any questions and answers, if needed. To ensure convenient return of questionnaires, the researcher

provided a sealed, identified box in each unit, the questionnaires were collected within 8 days.

Phase 3

In this phase educational sessions were organized and planned in cooperation with the nursing administration in the complex to be conducted in two sessions to ensure the attendance of all nurses working rotating shifts in the critical care units. This phase was performed between the dates of June 22 – June 29, 2014.

First Educational session at June 24, 2014: an educational session was conducted to explain and discuss the safe IV medication administration practice for nurses, the session had took place at the hospital library hall for one and a half hour. The training booklet was distributed for the nurses, and was elaborated through power point presentation, enough time for presentation and discussion was given

30 nurses attended the session and the discussion was rich with ideas and recommendations

Second Educational session at June 26, 2014: an educational session was conducted to explain and discuss the safe IV medication administration practice for nurses, the session had took place at the hospital library hall for one and a half hour. The training booklet was distributed for the nurses, and was elaborated through power point presentation, enough time for presentation and discussion was given

22 nurses attended the session and the discussion was rich with ideas and recommendations.

Phase 4

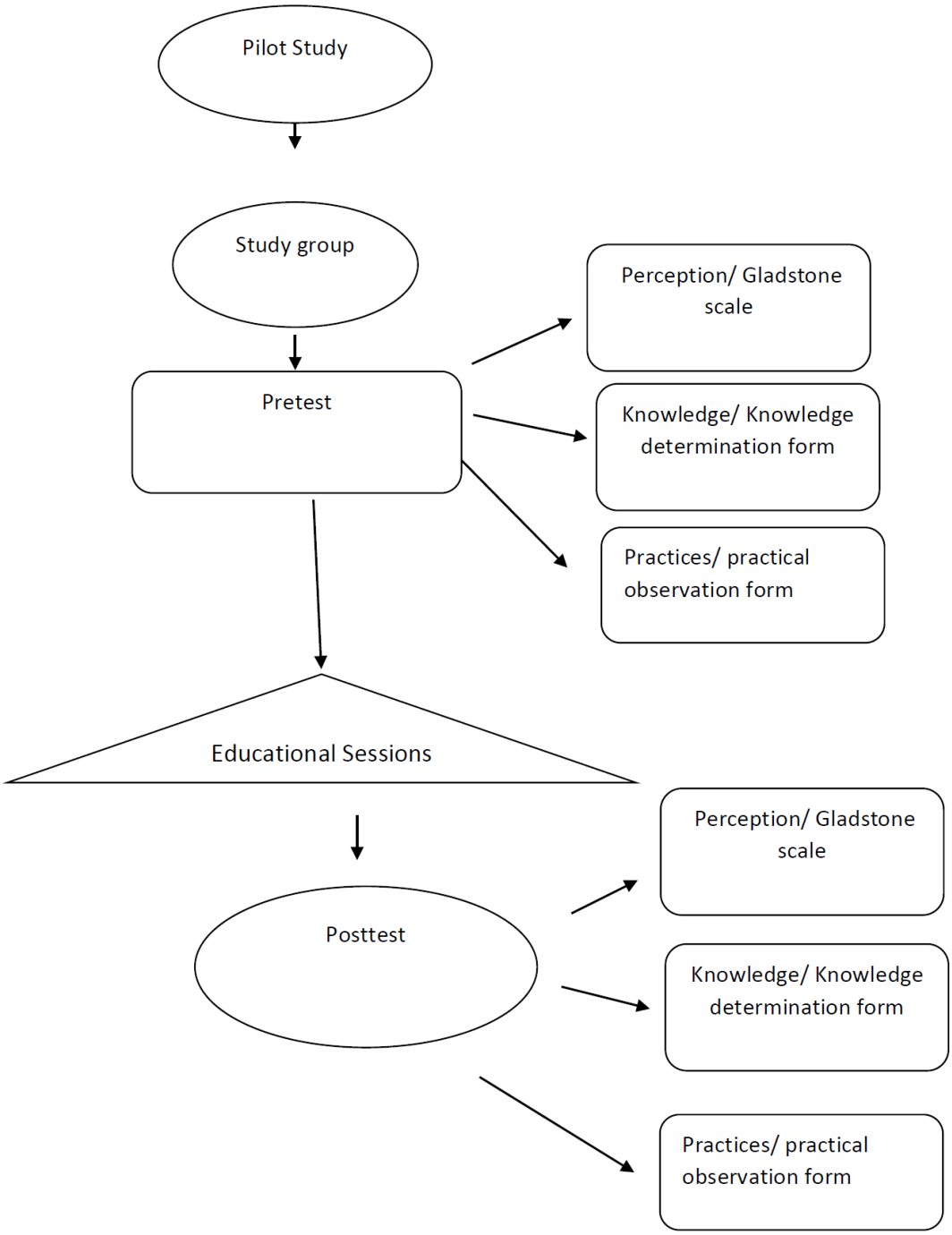
Posttest was performed in this phase. Participants completed the Knowledge Form and Gladstone Survey immediately after the educational sessions again. This phase was performed between the dates of July 2 – July 10, 2014.

Phase 5

Observations of the elements of the Intravenous Medication Safety to evaluate the adherence of the same group of nurses to the eight rights of medication administration in nursing practice repeated in this phase, three observations for each

nurses was done. This phase was performed between the dates of July 15 - August 10, 2014.

2.8. Flow Diagram of the Study



2.9. Ethical considerations

Official permission to conduct the study in the hospital was sought from the executive director of the Palestine Medical Complex (Appendix VI). Formal approval was obtained from the Research Ethical Committee at Hacettepe University (Appendix V). Nurses were informed about the study and written informed consents were obtained (Appendix I).

Permission was obtained for the use of Gladstone survey. An official permission from author obtained by sending an email to her asking to use her instrument, she gratefully replied by the approval. (Appendix VII)

2.10. Data Analysis

The characteristics that were examined in this study are nurses' Perception, Knowledge, and Practices of Intravenous Medication Safety and interventions to increase the awareness (dependent variable). The independent variable is the planned educational sessions on intravenous medication administration and demographic characteristics of nurses.

The data was evaluated using Statistical Package for the Social Sciences software version 18.0 (SPSS inc., Chicago, IL, USA). The results stated as mean ± SD and or percentage as appropriate at alpha level of $P<0.05$, inferential statistics were generated.

Mean vales were calculated for knowledge and practices of nurses and for reporting the rate of medication errors. McNemar's test, chi square and repeated measures ANOVA used to perform the comparisons.

Medication administration errors were identified by comparing medication administrations observed/found with what the prescribers ordered. Medication administration error was recorded when discrepancy was found between what was ordered and administered to the patient. The correct answers of the Knowledge Determination Form took place as Appendix II a.

3. FINDINGS

In this chapter, findings of the study conducted to determine the impact of intravenous medication safety education on knowledge, practices and perceptions of medication errors of critical care nurses in Palestine was given under following four sections:

1. Descriptive Characteristics of Nurses
2. Knowledge and Practices of Nurses on Eight Rights of Medication Administration Before and After Education
3. Perceptions of Nurses on Medication Errors Before and After Education

3.1. Descriptive Characteristics of Nurses

Table 3.1. Descriptive Characteristics of Nurses (N=52)

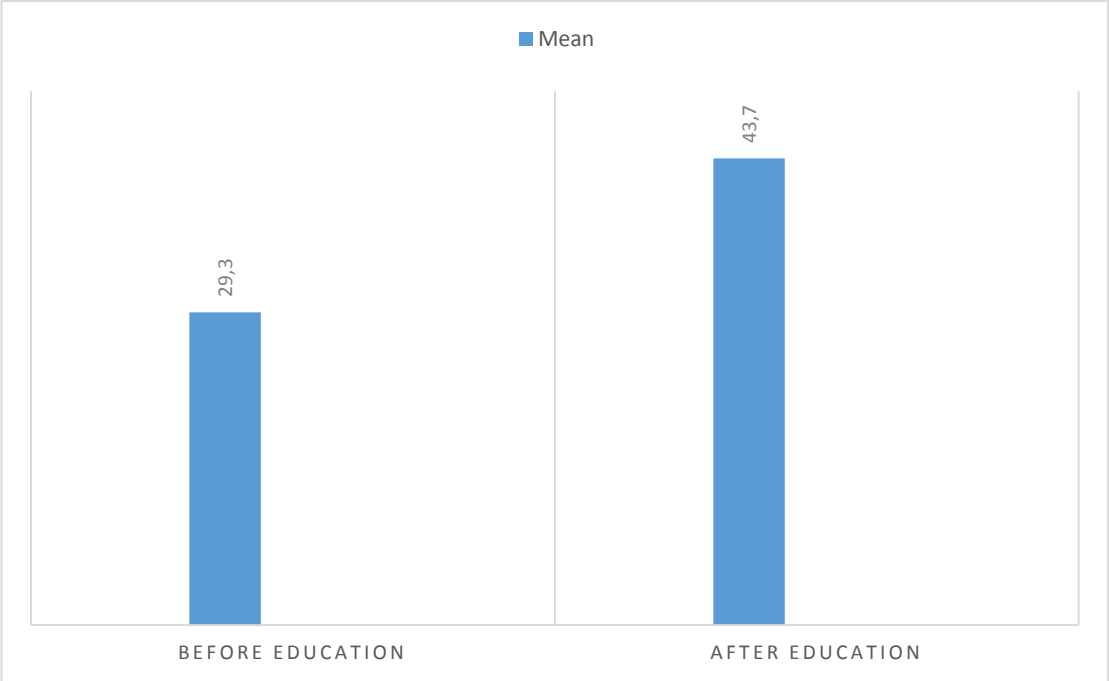
Descriptive Characteristics	**N**	**%**
Age		
< = 25	25	48.1
26 – 30	21	40.4
> =31	6	11.5
Educational Degree		
Bachelor	47	90.4
Maters	5	9.6
Gender		
Male	28	53.8
Female	24	46.2
Position		
Head Nurse	3	5.7
Staff Nurse	49	94.3
Units/wards		
Medical ICU	23	44.2
Surgical ICU	16	30.8
CCU	13	25
Years of Nursing Experience		
< = 5	35	67.3
6-10	12	23.1
> =11	5	9.6

The demographic characteristics of the respondents are shown in Table 3.1. Of the 52 respondents, 46.2% were female and 53.8% were males. The age of the nurses who are equals or less than 25 years was 48.1%, while nurses who are between 26-30 years was 40.4%, and nurses who are equals or more than 31 years was11.5%.The majority of the nurses (90.4%) held Bachelor degree in nursing, and the minority (9.6%) of the nurses held a master degree in Nursing. Three of the respondents were head nurses at the three units 5.7% while the others were staff nurses 94.3%. In regards to the units, 44.2% of the nurses was working at the medical ICU, and 30.8% was working at the surgical ICU and 25% of nurses was working at the CCU. The majority of nurse 67.3% of the nurse had nursing experience equals or less than 5 years, while 23.1% of the nurses had experience between 6 and 10 years and the minority of the nurses 9.6% had experience equals or more than 11 years.

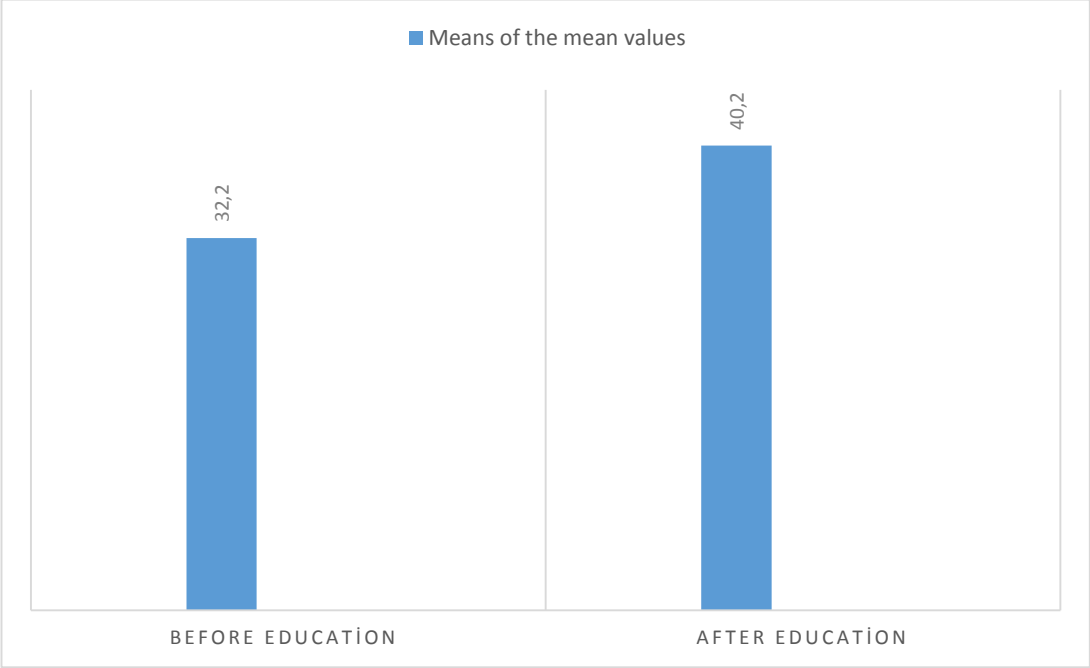
3.2. Knowledge and Practice of Nurses on Eight Rights of Medication Administration and Nursing Procedures Related to the Rights Before and After Education

Table 3.2. Comparison of Correct Knowledge and Practice Means Before and After Education

Knowledge and Practice	**Before Education**		**After Education**		**Statistical Analysis P < 0.05**
Correct Knowledge	**Mean**	**SD**	**Mean**	**SD**	
	29.3	.738	43.7	0.345	0.029
Correct Practice	32.2	.667	40.2	0.512	0.042



Graph 3.1. Means of Right Answers of Nurses on Eight Rights of Medication Administration and Nursing Procedures Related to the Rights Before and After Education



Graph 3.2. Means of Correct Practices of Nurses on Eight Rights of Medication Administration before and After Education

Knowledge and practices of nurses on eight rights of medication administration and nursing procedures related to the rights before and after education was shown in Table 3.2.

Means of right answers of nurses before and after education was shown in Graph 3.1. It was determined that, general right answer means of the nurses was 43.7 after education, while it was 29.3 before education and this difference was significant statistically ($P < 0.05$). Based on this improvement in knowledge of nurses on eight rights of medication administration and nursing procedures related to the rights as result of education, Hypothesis **"**Knowledge of nurses on intravenous medication safety will be improved after planned education" **(H1)** was accepted.

Means of correct practices of nurses before and after education was shown in Graph 3.2. It was found that, general correct practices means of the nurses was 40.2 after education, while it was 32.2 before education and this difference was significant statistically ($P < 0.05$). Based on this improvement in practice of nurses on eight rights of medication administration and nursing procedures related to the rights as result of education, Hypothesis **"**Practices of nurses on intravenous medication safety will be improved after planned education" **(H2)** was accepted.

Table 3.3. Knowledge of Nurses on Eight Rights of Medication Administration and Nursing Procedures Related to the Rights Before and After Education (N=52)

Right /Nursing Procedures	Correct Answers						Statistical Analysis P < 0.05
	Before Education			After Education			
	N	SD	%	N	SD	%	
Right Patient	52	.000	100	52	.000	100	1.000
-Check the name on the order and the patient.	45	.395	86.5	50	.098	96.1	*
-Use 2 identifiers.	5	.985	9.6	15	.786	28.8	0.042
-Ask patient to identify himself/herself.	20	.625	38.4	45	.429	86.5	0.001
-When available, use technology (for example, bar code system).	50	.126	96.1	52	.000	100	*
Right Medication	52	.000	100	52	.000	100	1.000
-Check the medication label.	45	.395	86.5	52	.000	100	*
-Check the order.	52	.000	100	52	.000	100	1.000
-Labeling the medication properly (If necessary)	40	.411	76.9	48	.162	92.3	*
-Giving the right medication	52	.000	100	52	.000	100	1.000
Right Dose	52	.000	100	52	.000	100	1.000
-Check the order.	52	.000	100	52	.000	100	1.000
-Confirm appropriateness of the dose using a current drug reference	20	.625	38.4	35	.532	67.3	0.023
-If necessary, calculate the dose and have another nurse calculate the dose as well.	10	.894	19.2	40	.354	76.9	0.004
-Giving the medication with right dose	52	.000	100	52	.000	100	1.000
Right Route/ Technique	50	.097	96.1	52	.000	100	*
-Check the order and appropriateness of the route ordered.	10	.895	19.2	40	.465	76.9	0.003
-Confirm that the patient can take or receive the medication by the ordered route	32	.642	61.5	44	.421	84.6	0.045
-Preventing drug-drug or drug- fluid interaction (Not giving the drugs in same catheter with another drug or fluid which may interact)	5	.975	9.6	28	.589	53.8	0.009
-Giving the medication with right route	52	.000	100	52	.000	100	1.000
-Giving the medication with right technique	50	.097	96.1	52	.000	100	1.000
Right Time	46	.264	88.4	51	.071	98.1	*
-Check the frequency of the ordered medication.	15	.934	28.8	39	.346	75	0.002
-Double-check that you are giving the ordered dose at the correct time.	10	.956	19.2	48	.264	92.3	0.000
-Confirm when the last dose was given.	8	.962	15.3	38	.487	73.1	0.000
-Giving the medication at the correct time	17	.834	32.6	47	.562	90.3	0.000
Right Documentation	41	.416	78.8	52	.000	100	0.180
-Document administration AFTER giving the ordered medication.	39	.598	75	51	.074	98.1	0.069
-Chart the time, route, and any other specific information as necessary. For example, the site of an injection or any laboratory value or vital sign that needed to be checked before giving the drug.	27	.689	51.9	46	.419	88.4	0.035
-Desired and undesired effects of the medication	5	.973	9.6	32	.569	61.5	0.000
Right Reason	2	.983	3.9	32	.549	61.5	0.000
-Confirm the rationale for the ordered medication. What is the patient's history? Why is he/she taking this medication?	0	1.000	0	18	.904	34.6	0.000
Right Response	5	.973	9.6	27	.698	51.9	0.000
-Ask the desired effect of the medication.	10	.964	19.2	36	.591	69.2	0.000
-Ask the undesired effects of the medication.	2	.985	3.8	43	.431	82.6	0.000

*****Test assumptions cannot be achieved

Knowledge of nurses on eight rights of medication administration and nursing procedures related to the rights before and after education was shown in Table 3.3. It was found that nurses in the critical care units showed statistically significant ($P<0.05$) improvement about following sub items;

Right Patient: "Identifying the patient through using two identifiers" and "Asking patient to identify himself/herself".

Right Dose: "Confirming appropriateness of the dose using a current drug reference" and "If necessary, calculating the dose and have another nurse calculate the dose"

Right Route/ Technique: "Checking the order and appropriateness of the route ordered", "Confirming that the patient can take or receive the medication by the ordered route" and "Preventing drug-drug or drug- fluid interaction (Not giving the drugs in same catheter with another drug or fluid which may interact)"

Right Time: In this item, nurses achieved a significant improvement of all procedures related to the "Right time through checking the frequency of the ordered medication", "Double-checking that you are giving the ordered dose at the correct time", "Confirming when the last dose was given" and "Giving the medication at the correct time".

Right Documentation: "Charting the time, route, and any other specific information as necessary".

Right Reason: "Confirming the rationale for the ordered medication"

Right Response: "Asking the desired and undesired effect of the medication".

There was no statistically significant improvement in sub items of "Right Medication".

However, they showed improvement in the percentage of utilizing these procedures to identify the right medication.

Table 3.4. Answers of the Nurses to the statements Related to Medication Administration Before and after Education (N =52)

Statement	Correct Answers						Statistical Analysis P < 0.05
	Before Education			After Education			
	N	SD	%	N	SD	%	
Hands washing with antiseptic or alcohol rub should be performed before preparation of IV antibiotic solution	43	.309	82.6	50	.296	96.1	0.086
It is not necessary to check expiry date for a medication that is recently indented from pharmacy	32	.432	61.5	44	.311	84.6	0.061
Preparation of IV Hydrocortisone solution does not require hands cleaning using antiseptic or alcohol rub	36	.045	69.2	46	.065	88.5	0.062
'cc' or 'ml' is the dosage expression for IV insulin	50	.139	96.1	52	.000	100	.702
The Cefoperazone vial top should be swabbed with alcohol swabs prior to reconstitution with NaCl 0.9%	37	.443	71.1	42	.339	80.7	*
Any reconstituted IV medications can still be used if it is less than 48 hours from the date of reconstitution or preparation	27	.569	51.9	35	.493	67.3	.0052
IV antibiotics are stable when diluted using NaCl 0.9% or NaCl 3%	52	.000	100	52	.000	100	1.000
When 6ml of IV Noradrenaline (4mg/ml) is diluted with 50ml of 5% dextrose saline, the final concentration of Noradrenaline infusion solution in g/ml is 480 g/ml. (1g=1000mg)	41	.294	78.8	46	.358	88.4	*
Patient's armband and IV catheter should be inspected for phlebitis or extravasations during administration of IV cytotoxic drugs.	51	.098	98.1	52	.000	100	*
Medication administered intramuscularly acts rapidly than if administered intravenously	52	.000	100	52	.000	100	1.000
KCl injection should be administered as slow bolus injection over 3 minutes during emergency such as ventricular fibrillation	49	.286	94.2	52	.000	100	*
IV Ceftriaxone (Rocephine®) can be administered simultaneously with solution containing Calcium Gluconate via a Y-site, at a slower rate of 5mg/min	45	.364	86.5	49	.286	94.2	*
Slow bolus IV injection means administration of intravenous medication in 1 minute.	46	.346	88.4	49	.286	94.2	*
Medications that are classified as High Alert Medication include Noradrenaline and Insulin	41	.327	78.8	52	.000	100	*
When an emergency happens such as hypocalcaemia tetany, 10% CaCl 210 ml should be administered in 1–2 minutes as bolus	44	.569	84.6	49	.432	94.2	*
Intravenous medication which requires maximum infusion rate of 120µg/hour should be infused at a constant rate of 4µg/min for the first 1 hour.	43	.552	82.6	46	.492	88.4	*
IV. medications can be given via the same catheter with blood	52	.000	100	52	.000	100	1.000
Mean	**41.6**			**45.5**			**0.831**

*****Test assumptions cannot be achieved

Table 3.4. Shows answers of the nurses to the statements related to medication administration before and after education. As can be seen in the table, there are improvements after the educational program in terms of percentage despite that this change does not reflected in the statistical analysis.

Regarding the preparation of IV medications, calculations and statement related to special procedures nurses have improved in terms of percentage. For example: "Hands washing with antiseptic or alcohol rub should be performed before preparation of IV antibiotic solution as procedure" has improved from 82.6% to 96.1%."When 6ml of IV Noradrenaline (4mg/ml) is diluted with 50ml of 5% dextrose saline, the final concentration of Noradrenaline infusion solution in g/ml is 480 g/ml. (1g=1000mg)" has improved from 78.8% to 88.4%.

Table 3.5. Practices of Nurses on Eight Rights of Medication Administration Before and After Education (N=52)

Medication Rights	Observations Before Education							Observations After Education							Statistical Analysis P < 0.05
	Observations							Observations							
	First		Second		Third			First		Second		Third			
	Correct Practice*						M SD	Correct Practice*						M SD	
	N	%	N	%	N	%		N	%	N	%	N	%		
Right Patient	42	80.7	39	75	37	71.1	39.3	51	98.1	49	94.2	50	96.1	50	.072
Right Medication	41	78.8	40	76.9	45	86.5	42	43	82.6	50	96.1	49	94.2	47.3	.095
Right Dose	41	78.8	39	75	45	86.5	41.6	50	96.1	49	94.2	50	96.1	45.6	.071
Right Route/ technique	50	96.1	37	71.1	40	76.9	42.3	50	96.1	42	80.7	45	86.5	45.6	*
Right Time	28	53.8	31	59.6	41	78.8	33.3	45	86.5	39	75	41	78.8	41.6	.047
Right Documentation	35	67.3	29	55.7	39	75	34.3	40	76.9	30	57.6	40	76.9	36.6	0.001
Right Reason	9	17.3	8	15.3	5	9.6	7.3	27	51.9	21	40.3	25	48.1	24.3	0.000
Right Response	17	32.7	15	28.8	21	40.3	17.6	31	59.6	28	53.8	35	67.3	31.3	0.000

*****Test assumptions cannot be achieved

******The correct practice means that all the sub items are performed truly.

Practices of nurses on eight rights of medication administration and nursing procedures related to the rights before and after education was shown in Table 3.5. It was found that nurses in the critical care units showed statistically significant (P<0.05) improvement about “Right time”, “Right documentation”, “Right reason” and “Right Response” items.

There was no statistically significant improvement in “Right patient”, “Right Medication” and “Right dose” items. However, nurses showed improvement in terms of means of these procedures.

Table 3.6. Medication Error Types of Nurses During Medication Administration Before and After Education (N=156)

Medication Error Types	**Observations before Education**			**Observations After Education**			**Statistical Analysis P < 0.05**
	N	**%**	**Chi Square**	**N**	**%**	**Chi Square**	
late/Early Administration	71	45.5	1.256	46	29.5	26.256	.000
Not Dispensed or Dispensed Late	15	9.6	101.769	13	8.3	108.333	.099
Wrong or Inappropriate Information	14	8.9	116.641	5	3.2	136.641	.009
Wrong Duration	70	44.8	1.641	57	36.5	11.308	.003
Administered But not Documented	17	10.8	106.333	13	8.3	108.333	*
Incomplete or no Documentation	41	26.2	35.103	31	19.8	54.256	.008
Administered Without Order	4	2.5	140.410	2	1.25	140.410	*
Wrong Mix or Volume	32	20.5	54.256	24	15.3	66.692	.018

*****Test assumptions cannot be achieved

Table 3.6. shows medication error types of nurses during medication administration before and after education. Evaluation of errors was made based on the total observation numbers (156 observations). Twenty types of errors were list in the observational form, but the observation revealed that seven types of errors were made. These errors was “Late/early administration”, “Not dispensed or dispensed late”, “Wrong or inappropriate information”, “Wrong duration”, “Incomplete or no documentation”, “Administered without order” and “Wrong mix or volüme”. It was also determined that, nurses achieved a statistically significant difference in decreasing the errors after education (P<0.05) about “Late/early administration”, “Wrong or inappropriate information”, “Wrong duration”, “Incomplete or no documentation”, “Wrong mix or volüme” items.

Table 3.7. Comparison of the Descriptive Characteristics with the Knowledge and Practice (N=52)

Descriptive Characteristics	**Knowledge Correct Answers**			**Practice Correct Practice**		
	Before Education Mean	**After Education Mean**	**Statistical Analysis P < 0.05**	**Before Education Mean**	**After Education Mean**	**Statistical Analysis P < 0.05**
Age						
< = 25	12.1	17.6	0.049	13.2	16.1	0.085
26-30	11.2	12.9	0.099	12.3	17.2	0.090
> =31	3.6	4.1	0.86	3.7	5.3	0.087
Educational Degree						
Bachelor	23.1	28	0.049	24.6	26	0.06
Master	3.1	4.6	0.05	3.1	4.7	0.04
Gender						
Male	11.3	13.1	0.055	14.7	18.1	0.05
Female	15.9	17.7	0.042	13.4	15.9	0.025
Position						
Head Nurse	2.1	2.5	0.049	2.2	2.5	0.04
Staff Nurse	25.2	36.1	0.061	28.9	39.1	0.035
Units/wards						
Medical ICU	16.8	17.9	0.069	15.1	17.2	0.065
Surgical ICU	10.6	16.1	0.046	11.3	13.6	0.035
CCU	9.4	11.2	0.049	8.2	10.8	0.045
Nursing Experience						
< = 5	25.6	28.1	0.044	23.2	29.1	0.04
6-10	6.1	7.2	0.092	8.3	10.1	0.08
> =11	2.2	3.1	0.09	3.3	4.1	0.045

Table 3.7. Shows comparison of descriptive characteristics of nurses between the mean correct answers of the knowledge questionnaire and the mean correct practice. Statistical analysis showed that nurses who aged equals or less than 25 years had significant improvement in the knowledge after the educational program ($p < 0.05$).

Nurses who had master degree showed statistically significant improvement in both knowledge and practice ($p < 0.05$). While nurse who bachelor degree had also showed a significant improvement in knowledge ($p < 0.05$). It was found that females had more significant improvement in knowledge ($p < 0.05$) and practice ($p < 0.05$) than males.

Nurses who were working at the surgical ICU and CCU had statistically significant improvement in terms of knowledge and practice ($p < 0.05$).

Nurses who had experience equals or less than five years accomplished statistically significant improvement in both knowledge and practice ($p < 0.05$) while nurses who had experience equals or more than 11 years showed statistically significant improvement in practice only ($p < 0.05$).

3.3. Perception of Nurses on Medication Errors before and After Education

Table 3.8. Perception of Nurses on Causes of Medication Errors Before and After Education (N=52)

Statement	**Before Education**	**After Education**	**Statistical Analysis P < 0.05**
	Mean	**Mean**	
Drug errors occur when the nurse fails to check the Patient's name band with the Medication Administration Record (MAR.)	26	37	.189
Drug errors occur when the physician's writing on the Doctor's order form is difficult to read or illegible.	48	45	.789
Drug errors occur when the medication labels/packaging Are of poor quality or damaged.	15	26	.620
Drug errors occur when there is confusion between two Drugs with similar names.	39	42	.264
Drug errors occur when the physician prescribes the Wrong dose.	17	20	.964
Drug errors occur when the nurse miscalculates the dose.	15	35	.025
Drug errors occur when the nurse sets up or adjusts an Infusion device incorrectly.	48	47	.992
Drug errors occur when nurses are confused by the Different types and functions of infusion devices.	46	47	.991
Drug errors occur when nurses are distracted by other Patients, coworkers or events on the unit.	47	48	.992
Drug errors occur when nurses are tired and exhausted.	51	52	.991

Table 3.8.Portrays the ranked causes of medication errors as perceived by the participating nurses. Nurses ranked the listed causes from 1 to 10, with 1 indicating most frequent cause and 10 indicating least frequent cause. Answers of the nurses were categorized based on the number of nurses who ranked each statement then Mean score was calculated for each category and are listed in the table. The table showed a significant change in the item of dug errors occur when the nurse miscalculates the dose. While top three means ranked perceived causes of drug errors before and after education value were the following: "Drug errors occur when nurses are tired and exhausted", "Drug errors occur when the nurse sets up or adjusts an Infusion device incorrectly", "and Drug errors occur when nurses are distracted by other Patients, coworkers or events on the unit".

Table 3.9. Perception of Nurses on Reporting of Medication Errors before and After Education (N=52)

Statement	**"Yes "Answers Before Education**		**"Yes "Answers After Education**		**Statistical Analysis P < 0.05**
	N	**%**	**N**	**%**	
It is not always clear to nurses whether what they view as a minor drug discrepancy should be reported as a medication error	35	67.3	39	75	.685
I am usually sure what constitutes a medication error	24	46.1	40	76.9	.009
I am usually sure when a medication error should be reported using an incident report	14	26.9	26	50	.558
Some medication errors are not reported because nurses are afraid of the reaction they will receive from the Nurse Manager	39	75	41	78.8	.698
Some medication errors are not reported because Nurses are afraid of the reaction they will receive from their coworkers.	34	65.3	36	69.2	.782
Have you ever failed to report a drug error because you did not think the error was serious to warrant reporting?	14	26.9	18	34.6	.681
Have you ever failed to report a medication error because you were afraid that you might be subject to disciplinary action or even lose your job?	5	9.6	8	15.3	.702

Table 3.9. Presents additional nurse responses to statements about reporting medication errors. Most nurses indicated statistically significant progress in "I am usually sure what constitutes a medication error" item between before and after the educational program (P<0.05). There were no statistically significant differences in terms of other items (P>0.05). Reasons for not reporting errors included "afraid of manager reaction" (75% before education, 78.8% after education), "afraid of coworkers' reactions" (65.3% before education, 69.2% after education) and "not thinking an error was serious enough" (26.9% before education, 34.6 % after education). However, the majority of nurses do not seem to fear disciplinary action (losing one's job) because of committing an error.

Table 3.10 Perception of Nurses on Human Factors Influencing IV Medication Errors in the Critical Care Units Before and After Education (N=52)

Statement	**Before Education**		**After Education**		**Statistical Analysis P < 0.05**
	N	**%**	**N**	**%**	
Nurse's fatigue or exhaustion	48	92.3	48	92.3	1.000
Work pressure, e.g., running out of time before handing over to the next shift	43	82.6	41	78.8	.985
Hesitance to request clarification from the physician's order, if it is unclear	15	28.8	13	25	.915
Unfamiliarity with the medication	27	51.9	30	57.6	.889
Distractions and interruptions during medication administration	48	92.3	47	90.3	.875
Incorrect dilution calculations	37	71.1	39	75	*
Incorrect dosage calculations	39	75	36	69.2	*
Incorrect rate calculations	48	92.3	51	98.1	.975
Nurse's lack of concentration	49	94.2	50	96.1	*
High patient/nurse ratio, e.g. ICU patient condition that deteriorates quickly	52	100	52	100	1.000
Failed communication, e.g. unclear verbal order	42	80.7	48	92.3	.968

*****Test assumptions cannot be achieved

Table 3.10. Presents the human factors that influence the IV medication errors. Nurses were considered "Nurse's fatigue or exhaustion", "Incorrect rate calculations", "High patient/nurse ratio, e.g. ICU patient condition that deteriorates quickly", "Distractions and interruptions during medication administration" and "Nurse's lack of concentration" as human factors that influence IV medication errors. The above mentioned factors are the most human factors that cause IV medication errors with no statistically significant changes after the educational program.

Table 3.11. Perception of Nurses on System Factors Influencing IV Medication Errors in the Critical Care Units Before and After Education (N=52)

Statement	**Before Education**		**After Education**		**Statistical Analysis P < 0.05**
	N	**%**	**N**	**%**	
Complicated/incomplete prescriptions	47	90.3	49	94.2	.964
Insufficient unit-specific training (Medication Administration Standards)	49	94.2	51	98.1	.976
Large number of medications scheduled at peak times	45	86.5	46	88.4	.984
Computerized Physician Order Entry (CPOE) systems, e.g. misplaced decimal points in the CPOE that can lead to confusion to staff	41	78.8	43	82.6	.862
Look alike, sound alike drugs	36	69.2	43	82.6	.568

Table 3.11 presents the system factors that influence the IV medication errors. Nurse considered “Complicated/incomplete prescriptions”, “Insufficient unit-specific training (Medication Administration Standards)” and “Large number of medications scheduled at peak times” as system factors that influence the IV medication errors. The above mentioned factors are the most system factors that cause IV medication errors with no significant changes after the educational program.

Table 3.12. Perception of Nurses on Environmental Factors Influencing IV Medication Errors in the Critical Care Units Before and After Education (N=52)

Statement	**Before Education**		**After Education**		**Statistical Analysis P < 0.05**
	N	**%**	**N**	**%**	
Work pressure, e.g., running out of time before handing over to the next shift	39	75	52	100	.009
Error prone situations, e.g. when protocol/policy is not followed	41	78.8	48	92.3	.216
The critical condition of the patient, e.g. increased workload for RN’s assigned patient	47	90.3	50	96.1	.865
High patient to nurse ratio	52	100	52	100	1.000
Multiple nursing tasks done in a limited time available.	41	78.8	45	86.5	.642
Increased workload	52	100	52	100	1.000
English is not the first language of the staff working at this hospital	8	15.3	7	13.4	.986

Table 3.12. Presents the environmental factors that influence the IV medication errors. Nurse considered “The critical condition of the patient, e.g. increased workload for RN’s assigned patient”, “High patient to nurse ratio” and “Increased workload” as environmental factors that influence the IV medication errors. The above mentioned factors are the most environmental factors that cause IV medication errors with no significant changes after the educational program**.**

According to all results related to perceptions of nurses on medication errors Hypothesis “Perceptions of medication errors of nurses will be changed after planned education” (**H3**) was rejected.

4. DISCUSSION

Nurses play a major role in reducing medication errors and frequently administer medications in patients' healthcare settings. Thus, they are the last line of defense to safeguard against medication errors as administration is the last part of the medication process. Therefore, the aim of the present study was to assess and evaluate the impact of the education program on the perception, knowledge and practice of medication administration errors, as well as the extent to which errors are reported on their units.

4.1. Knowledge and Practices of Nurses on Intravenous Medication Administration before and After Education

The current study showed that knowledge and practices of nurses on intravenous medication administration significantly improved after planned education. It was determined that, regarding to knowledge, general right answer means of the nurses was 43.7 after education while it was 29.3 before education and; general correct practices means of the nurses was 40.2 after education while it was 32.2 before education and these differences was significant statistically. The importance of education to improve safe medication administration is emphasized in the literature. This results are congruent with (Bakr, and Attala, 2012 and Anderson 2010) who revealed that nurses need a continuous education program to update their knowledge and practice and said that continuing education of the nursing staff can help reduce medication errors. In their study, it was also concluded that, medications that are new to the facility should receive high teaching priority and staff should receive updates on both internal and external medication errors. Also (Elliot, 2010) highlighted that, nurses and nurse managers need to be educated on medication errors and clearly defined working expectations.

When knowledge and practices of nurses on intravenous medication administration compared with their demographic characteristics, it was found that nurses who aged equals or less than 25 years had significant improvement in knowledge after our educational program compared to nurses who aged more than 26 years. Furthermore nurses who held master degree showed significant improvement in

both knowledge and practice compared with nurses holding bachelor degree who showed a significant improvement in knowledge only. This illustrated that nurses with higher educational degrees can possess a better improvement they can achieve after educational program. This is consistent with (Armutlu, Foley, Surette, Belzile, & McCusker, 2008) also another european study by (Cousins, Sabatier, and Begue, 2005) revealed nurses with higher education level can achieve significant improvement. Females show more significant improvement in knowledge and practice than males. Additionally nurses who had experience equals or less than 5 years showed improvement in both knowledge and practice compared to nurses with equal or more than 11 years who showed improvement in practice only. This finding is congruent with (Abualrab and Al-Zaru, 2008) who investigate the association between the clinical experience, performance and education. Surgical ICU and CCU nurses have shown significant improvement in both knowledge and practice after our in service education compared to nurses working in the general ICU area. This is congruent with survey of European intensive care nurses' knowledge levels (Fulbrook, Albarran, 2012).

Detailed examination of knowledge of nurses in terms of nursing procedures of each rights of medication administration showed that, there were statistically significant improvements about many sub items of "Right patient", "Right dose", "Right route/ technique", "Right time", "Right documentation", "Right reason" and "Right response". There was no statistically significant improvement in sub items of "Right medication". When findings were examined detailed in terms of nursing practices of each rights of medication administration, it was found that nurses in the critical care units showed statistically significant improvement about "Right time", "Right documentation", "Right reason" and "Right Response" items. There was no statistical significant improvement in "Right patient", "Right Medication" and "Right dose" items. This results congruent with several studies which investigated the adherence of the nurses to the patients' medication rights (Kim and Bates, 2013) investigated the adherence of the nurses to the patients' medication rights using checklist of basic medication guidelines including the five rights. In their study it was concluded that nurses showed low rates of adherence to patients' medication rights and guidelines, suggesting that many medication administration guidelines are not

strictly followed. (Kane-Gill, and Weber, 2006) reported that Experts have been critical of advances in patient safety. An analysis 5 years after the IOM Report cites little or no improvement in outcomes associated with patient safety. This finding indicates that knowledge, intervention, and research in medication patient safety are needed to affect patient care outcomes positively.

In our study, twenty types of errors were list in the observational form, but the observation revealed that seven types of errors were made. These errors was "Late/early administration", "Not dispensed or dispensed late", "Wrong or inappropriate information", "Wrong duration", "Incomplete or no documentation", "Administered without order" and "Wrong mix or volüme". It was also determined that, nurses achieved a statistically significant difference in decreasing the errors after education about "Late/early administration", "Wrong or inappropriate information", "Wrong duration", "Incomplete or no documentation", "Wrong mix or volüme" items. The Academy of Managed Care Pharmacy (AMCP) Board June 2010 investigated a list of medication errors and showed that errors caused by drug administration can be made by the health care provider or by the patient unaware that errors can happen and often do not take an active role in understanding what is being communicated to them. According to their investigation, errors most often occur when communication is unclear regarding: drug name, drug appearance, why the patient is taking the drug, how much and how often to take it, when is the best time to take it, how long to take it, what common side effects could occur, what to do about a missed dose, common interactions with other drugs or foods, and whether this new drug replaces or augments other therapy. There are also errors of omission, such as the failure to administer a drug that was prescribed or not administering a drug in a timely manner. AMCP had set a preventive measures to reduce the medication errors.

4.2. Perceptions of Nurses on Medication Errors Before and After Education

The current study showed that there was no significant improvement in majority of sub titles about medication error perception of nurses. A study which was done in Jordan by (Awwad, and Elayan, 2006) also a study by (Dorgham and Khamis, 2012) conducted a descriptive study, who used the Gladstone instrument to investigate the nurses perception toward medication errors, they suggested five categories for

reasons of why medication administration errors occur and three categories for reasons of why medication administration errors not reporting. Nurses perceive low percentages of medication administration errors reporting. Emergency room was more likely to report medication administration errors than other units. Medication errors are common in clinical practice. Also they conclude that reducing these errors requires the commitment of everyone with a stake in keeping patients safe; physician who wrote the prescription, pharmacist who dispensed it and the nurse who received the medicine and administered to the patient, all play an important role in preventing medication errors reaching to patient that there are differences in the perceptions of nurses about the causes and reporting of medication errors, medication errors are common in clinical practice.

Actually, reducing medication errors requires the commitment of everyone with a stake in keeping patients safe. The physician who wrote the prescription, pharmacist who dispensed it and the nurse who received the medicine and administered to the patient, all play an important role in preventing medication errors reaching to patient. Medication rights are designed to ensure patient safety and prevent harm.

Regarding the perceptions of the nurses on causes of medication errors, a significant change in the item of "Drug errors occur when the nurse miscalculates the dose" was found. While top three means ranked perceived causes of drug errors before and after education value were the following: "Drug errors occur when nurses are tired and exhausted", "Drug errors occur when the nurse sets up or adjusts an Infusion device incorrectly", and "Drug errors occur when nurses are distracted by other Patients, coworkers or events on the unit".

A survey conducted by (Cohen et al. 2003) mentioned five major reasons for what caused or increased the risk of medication errors; distractions and interruptions during MA, inadequate staffing and high nurse/patient ratios, illegible medication orders, incorrect dosage calculations and similar drug names and packaging.

When nurse responses to statements about reporting medication errors were investigated, it was determined that most nurses indicated statistically significant progress in "I am usually sure what constitutes a medication error" item between before and after the educational program. There were no statistically significant

differences in terms of other items. Reasons for not reporting errors included “afraid of manager reaction”, “afraid of coworkers’ reactions” and “not thinking an error was serious enough”. However, the majority of nurses do not seem to fear disciplinary action (losing one’s job) because of committing an error. In this respect, several studies like (Wakefield 2000, and Wakefield 2005), (Dorgham and Khamis, 2012) and (Abu Hashish & El-Bialy, 2013) used a similar instrument to investigate nurses ‘perceptions of not reporting medication errors and supported this findings.

Nurses considered “Nurse’s fatigue or exhaustion”, “Incorrect rate calculations”, “High patient/nurse ratio, e.g. ICU patient condition that deteriorates quickly”, “Distractions and interruptions during medication administration” and “Nurse’s lack of concentration” as human factors that influence IV medication errors. The above mentioned factors are the most common human factors that cause IV medication errors with no statistically significant changes after the educational program. In this study, results and analysis revealed that human factors that influence IV medication errors were consistent with (Mrayyan et al. 2007), (Momtahan, Burns, and Gabriele, 2008) who found that nurse’s fatigue or exhaustion, incorrect rate calculations, High patient/nurse ratio, e.g. ICU patient condition that deteriorates quickly, distractions and interruptions during medication administration, nurse’s lack of concentration.

In a recent observational study, researchers examined the frequency of interruptions that nurses experience during medication administration in a single medical care unit (Biron, Lavoie-Tremblay, and Loiselle, 2009). The researcher concluded that nurses experienced 374 interruptions or 6.3 work interruptions per hour during medication related activities. The researchers found that other nurses were the number one cause of medication related interruptions both during medication preparation (n= 36; 29.3%) and administration (n=29; 11.9%). The second cause being self-initiated interruptions (drug preparation: n=21; 17.1%; drug administration: n=41; 16.9%).

Nurses considered “Complicated/incomplete prescriptions”, “Insufficient unit-specific training (Medication Administration Standards)” and “Large number of medications scheduled at peak times” as system factors that influence the IV medication errors. The above mentioned factors are the most common system factors

that cause IV medication errors with no significant changes after the educational program. Our study showed results consistent with (Wakefield, 2005), (Dorgham, and Khamis, 2012) who showed that nurses need to be oriented regarding any new medication also training should be conducted frequently to enhance and support their technical skills.

Nurses considered "The critical condition of the patient, e.g. increased workload for RN's assigned patient", "High patient to nurse ratio" and "Increased workload" as environmental factors that influence the IV medication errors. The above mentioned factors are the most common environmental factors that cause IV medication errors with no significant changes after the educational program**.** This finding is congruent with a study done by (Roy et al, 2005) pointed out environmental factors such as lighting, heat, noise and interruptions that can distract health professional from their nursing tasks such as using abbreviations instead of writing the orders out completely, frequent substitution of the drug and pulling of nurses between teams and from other units. This result also concurring with the study findings of (Wakefield, 2005) which showed the systems issue is workload and type of care delivery system, and includes factors such as number of consecutive hours worked, rotating shifts, staffing mix and numbers, nurse-to-patient ratios, distractions and interruptions, assignment of floating nurses to unfamiliar units, and hospital – pharmacy design features.

4.3. Conclusion

Nurses are now responsible for the preparation and administration of IV medications in most European countries (Mathew 2007). (Hartley, and Dhillon, 1998; Ross et al. 2000). In the medication use process, the nurse at the bedside is most vulnerable to errors. (Bates, Cullen , Laird, et al, 1995). It has been estimated that 19% to 26% of a nurse's time is spent administering medications (Keohan et al., 2008; Westbrook, Duffield, and Creswick, 2011). The administration of medication in an acute care setting is also a fundamental role of a nurse and is the last step in the medication process preceded by the initiation and processing of the order (Agyemang& While, 2010). In our study, there were significant improvements in knowledge and practices of critical care nurses on intravenous medication

administration; however perceptions of nurses on medication errors were not changed as result of the education program. It is thought that education of nurses is important in improving medication administration and preventing errors.

5. RESULTS AND RECOMMENDATIONS

5.1. Results

Current study was performed to assess and evaluate the impact of the education program on the knowledge, practice on intravenous medication administration and perception of medication administration errors. Results of the study showed statistically significant improvement in knowledge and practice of nurses on eight rights of medication administration as result of education program; however perceptions of nurses on medication errors were not improved significantly. Detailed results of the study as following;

1. Of the total 52 nurses, 46.2% were female; 48.1% was the age of the equal or less than 25 years; majority of them (90.4%) held Bachelor degree in nursing; 94.3% were staff nurses; 44.2% was working at the medical ICU; 67.3% had nursing experience equals or less than 5 years (Table 3.1.1.).
2. Comparison of descriptive characteristics of nurses with the mean correct answers of the knowledge questionnaire and the mean correct practice showed that nurses who aged equals or less than 25 years had significant improvement in the knowledge after the educational program ($p < 0.05$). Nurses who had master degree showed statistically significant improvement in both knowledge and practice ($p < 0.05$). It was found that females had more significant improvement in knowledge ($p < 0.05$) and practice ($p < 0.05$) than males. Nurses who were working at the surgical ICU and CCU had statistically significant improvement in terms of knowledge and practice ($p < 0.05$). Nurses who had experience equals or less than five years accomplished statistically significant improvement in both knowledge and practice ($p < 0.05$) (Table 3.1.2.).
3. Findings related to knowledge of nurses on eight rights of medication administration before and after education showed that, general right answer means of the nurses was 43.7 after education while it was 29.3 before education and this difference was significant statistically ($P < 0.05$) . Based on this improvement in knowledge of nurses on eight rights of medication administration and nursing procedures related to the rights as result of

education, Hypothesis **"**Knowledge of nurses on intravenous medication safety will be improved after planned education" **(H1)** was accepted. (Table 3.2.1. Graph 3.2.1.). It was shown that, there were statistically significant improvements about many sub items of "Right patient", "Right dose", "Right route/ technique", "Right time", "Right documentation", "Right reason" and "Right response". There was no statistically significant improvement in sub items of "Right medication". (Table 3.2.1.)

4. General correct practices means of the nurses was 40.2after education while it was 32.2before education and this difference was significant statistically ($P < 0.05$). Based on this improvement in practice of nurses on eight rights of medication administration and nursing procedures related to the rights as result of education, Hypothesis **"**Practices of nurses on intravenous medication safety will be improved after planned education" **(H2)** was accepted. (Table 3.3.1. and Graph 3.3.1.). When findings were examined detailed in terms of nursing practices of each rights of medication administration, it was found that nurses in the critical care units showed statistically significant improvement about "Right time", "Right documentation", "Right reason" and "Right Response" items. There was no statistically significant improvement in "Right patient", "Right Medication" and "Right dose" items. (Table 3.3.1.).
5. Observation revealed that seven types of errors were made. These errors was "Late/early administration", "Not dispensed or dispensed late", "Wrong or inappropriate information", "Wrong duration", "Incomplete or no documentation", "Administered without order" and "Wrong mix or volüme". It was also determined that, nurses achieved a statistically significant difference in decreasing the errors after education ($P<0.05$) about "Late/early administration", "Wrong or inappropriate information", "Wrong duration", "Incomplete or no documentation", "Wrong mix or volüme" items. (Table 3.3.3.)
6. Findings showed a significant change in the item of dug errors occur when the nurse miscalculates the dose. While top three means ranked perceived causes of drug errors before and after education value were the following: "Drug errors occur when nurses are tired and exhausted", "Drug errors occur when

the nurse sets up or adjusts an Infusion device incorrectly", and "Drug errors occur when nurses are distracted by other Patients, coworkers or events on the unit". (Table 3.4.1.).

7. Regarding to reporting of medication administration error, most nurses indicated statistically significant progress in "I am usually sure what constitutes a medication error" item between before and after the educational program ($P<0.05$). There were no statistically significant differences in terms of other items ($P>0.05$). Reasons for not reporting errors included "afraid of manager reaction" (75% before education, 78.8% after education), "afraid of coworkers' reactions" (65.3% before education, 69.2% after education) and "not thinking an error was serious enough" (26.9% before education, 34.6 % after education). However, the majority of nurses do not seem to fear disciplinary action (losing one's job) because of committing an error. (Table 3.4.2.)
8. Nurses were considered "Nurse's fatigue or exhaustion", "Incorrect rate calculations", "High patient/nurse ratio, e.g. ICU patient condition that deteriorates quickly", "Distractions and interruptions during medication administration" and "Nurse's lack of concentration" as human factors that influence IV medication errors. The above mentioned factors are the most human factors that cause IV medication errors with no statistically significant changes after the educational program. (Table 3.4.3.).
9. Nurses considered "Complicated/incomplete prescriptions", "Insufficient unit-specific training (Medication Administration Standards)" and "Large number of medications scheduled at peak times" as system factors that influence the IV medication errors. The above mentioned factors are the most system factors that cause IV medication errors with no significant changes after the educational program. (Table 3.4.4.).
10. Nurses considered "The critical condition of the patient, e.g. increased workload for RN's assigned patient", "High patient to nurse ratio" and "Increased workload" as environmental factors that influence the IV medication errors. The above mentioned factors are the most environmental

factors that cause IV medication errors with no significant changes after the educational program**. (**Table 3.4.5.).

11. According to all results related to perceptions of nurses on medication errors Hypothesis "Perceptions of medication errors of nurses will be changed after planned education" (**H3**) was rejected.

5.2. Recommendations

Based on the results of the study following recommendations were made;

- Implementation and dissemination of comprehensive, systematic, and continuous educational programs in order to enhance the knowledge, practices and perceptions of nurse's on medication administration practices which will decrease the medication administration errors and using interactive teaching methods and technology in order to increase the efficiency of in-service trainings. Changing the perception on nurses toward the medication administration errors and practices need a collaborative work among the researchers, nurses, nursing managers, nursing schools, nursing curricula, nursing association, and health care settings.
- Development of institutional protocols, establishment of national drug policies, development of drug information centers and guidance booklets to provide drug-related information are required in order to prevent the errors that may arise during practice to ensure quality. Designing safe work environment conducive for patient care delivery and reduce the occurrence of medication administration errors.
- The implications of this research study have relevance to future nursing research as well as other related disciplines in the following ways. This is the first study which investigate the impact of education on the knowledge, practice and perception of medication administration errors in Palestine, so further longitudinal researches among Palestinian nurses is obviously necessary to ascertain and decrease the possibility of medication administration errors and to enhance the safety practice.

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Appendix I: Participant Information Cover Letter

Participant Information Cover Letter

The Impact of Medication Safety Education on Perception of Medication Errors, Knowledge, and Intravenous Medication Practice among Palestinian Critical Care Nurses

Aim of the Research

The aim of this interventional study is to measure the impact of medication administration safety practice education on the perception of medication errors, knowledge and practices among the critical care nurses in Palestine

Information to the Participant

You are being invited to take part in a research project focused on the Impact of Intravenous Medication Safety Education on perception of medication errors, Knowledge and Practices of Critical Care Nurses. Please take some time to read the information presented here, which will explain the details of this project. Please ask the researcher any questions about any part of this questionnaire that you do not fully understand. It is very important that you are fully satisfied and clearly understand what this study entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate before or during the study. If you say no, this will not affect you negatively in any way what so ever.

Anonymity will be ensured by the anonymous completion of the questionnaires and the collection of all the questionnaires by placing the completed questionnaires in a box provided.

All the information obtained from this research study will remain confidential. Only the researcher, statistician and research supervisor will have access to the collected data. There will be no identifying information on the questionnaires.

Although there are no immediate financial or other benefits to you in this research study, the result of the study may benefit nursing education and nursing practice by providing insight The Impact of Medication Safety Education on Perception of Medication Errors, Knowledge, and Intravenous Medication Practice among Palestinian Critical Care Nurses.

There are no risks associated with this research study, but you may experience some anxiety in the completion of the questionnaire or being observed because you are requested to reveal information related to IV medication errors that happened in your unit.

If you experience any distress, the researcher is available and can be contacted.

INFORMED CONSENT

Participation in the completion of the questionnaire is **voluntary**. If you participate, completion of the questionnaire and returning it to the researcher is seen as your informed consent to participate. The success of this study depends on your truthful completion of the questionnaire.

Thank you for agreeing to complete the research questionnaire. The questionnaire will take about 30 minutes to be completed. Please answer all the questions by filling in your response where requested. On completion of the questionnaire, please place the questionnaire in the envelope provided, and put it in the box, and research will collect boxes from the units.

Appendix II: Knowledge Determination Form

HACETTEPE ÜNİVERSİTESİ
SAĞLIK BİLİMLERİ ENSTİTÜSÜ

The Impact of Medication Safety Education on Perception of Medication Errors, Knowledge, and Intravenous Medication Practice among Palestinian Critical Care Nurses

Knowledge Determination Form

Table 1. Background of nurses

Age (years)
(a) <25
(b) 26–30
(c) 31–40
(d) > 41
Education degree
(a) Diploma
(b) Bachelor
(c) Master
Position
(a) Head nurse
(b) Staff Nurse
Wards/Units
(a) Medical ICU
(b) Surgical ICU
(c) CCU
Nursing experience (years)
(a) <1
(b) 2–5
(c) 6–10
(d) >11

Table 2.Please write the 8 rights of medication administration and nursing procedures related to the rights

Right	Nursing Procedures

Table 3. Please mark following sentences as true (T) or false (F). If the sentence is false, write the true answer.

Rank	Statement	(T/F)	(If It Is False) True Answer	Do Not Know
	Hands washing with antiseptic or alcohol rub should be performed before preparation of IV antibiotic solution			
	It is not necessary to check expiry date for a medication that is recently indented from pharmacy			
	Preparation of IV Hydrocortisone solution does not require hands cleaning using antiseptic or alcohol rub			
	'cc' or 'ml' is the dosage expression for IV insulin			
	The Cefoperazone vial top should be swabbed with alcohol swabs prior to reconstitution with NaCl 0.9%			
	Any reconstituted IV medications can still be used if it is less than 48 hours from the date of reconstitution or preparation			
	IV antibiotics are stable when diluted using NaCl 0.9% or NaCl 3%			
	When 6ml of IV Noradrenaline (4mg/ml) is diluted with 50ml of 5% dextrose saline, the final concentration of Noradrenaline infusion solution in g/ml is 480 g/ml. (1g=1000mg)			

Table 3. Please mark following sentences as true (T) or false (F). If the sentence is false write the true answer. (Cont.)

Rank	Statement	(T/F)	(If It Is False) True Answer	Do Not Know
9.	Patient's armband and IV catheter should be inspected for phlebitis or extravasations during administration of IV cytotoxic drugs.			
10	Medication administered intramuscularly acts rapidly than if administered intravenously			
11	KCl injection should be administered as slow bolus injection over 3 minutes during emergency such as ventricular fibrillation			
12	IV Ceftriaxone (Rocephine®) can be administered simultaneously with solution containing Calcium Gluconate via a Y-site, at a slower rate of 5mg/min			
13	Slow bolus IV injection means administration of intravenous medication in 1 minute.			
14	Medications that are classified as High Alert Medication include Noradrenaline and Insulin			
15	When an emergency happens such as hypocalcaemia tetany, 10% CaCl 210 ml should be administered in 1– 2 minutes as bolus.			
16	Intravenous medication which requires maximum infusion rate of 120μg/hour should be infused at a constant rate of 4μg/min for the first 1 hour.			
17	IV. medications can be given via the same catheter with blood			

Appendix II a: Knowledge Determination Form with correct answers

HACETTEPE ÜNİVERSİTESİ
SAĞLIK BİLİMLERİ ENSTİTÜSÜ

Appendix (IIa)

The Impact of Medication Safety Education on Perception of Medication Errors, Knowledge, and Intravenous Medication Practice among Palestinian Critical Care Nurses

Table 1. Background of nurses

Age (years)
(a) <25
(b) 26–30
(c) 31–40
(d) > 41
Education degree
(a) Diploma
(b) Bachelor
(c) Master
Position
(a) Head nurse
(b) Staff Nurse
Wards/Units
(a) Medical ICU
(b) Surgical ICU
(c) CCU
Nursing experience (years)
(a) <1
(b) 2–5
(c) 6–10
(d) >11

Table 2. Please write the 8 rights of medication administration and nursing procedures related to the rights

Rights of Medication Administration	**Nursing Procedures**
Right patient	Check the name on the order and the patient. Use 2 identifiers. Ask patient to identify himself/herself. When available, use technology (for example, bar-code system).
Right medication	Check the medication label. Check the order.
Right dose	Check the order. Confirm appropriateness of the dose using a current drug reference. If necessary, calculate the dose and have another nurse calculate the dose as well.
Right route	Again, check the order and appropriateness of the route ordered. Confirm that the patient can take or receive the medication by the ordered route.
Right time	Check the frequency of the ordered medication. Double-check that you are giving the ordered dose at the correct time. Confirm when the last dose was given.
Right documentation	Document administration AFTER giving the ordered medication. Chart the time, route, and any other specific information as necessary. For example, the site of an injection or any laboratory value or vital sign that needed to be checked before giving the drug.
Right reason	Confirm the rationale for the ordered medication. What is the patient's history? Why is he/she taking this medication? Revisit the reasons for long-term medication use.
Right response	Make sure that the drug led to the desired effect. If an antihypertensive was given, has his/her blood pressure improved? Does the patient verbalize improvement in depression while on an antidepressant? Be sure to document your monitoring of the patient and any other nursing interventions that are applicable.

Table 3. Please mark following sentences as true (T) or false (F). If the sentence is false, write the true answer**.**

Rank	Statement	(T/F)	(If It Is False) True Answer	Do Not Know
18	Hands washing with antiseptic or alcohol rub should be performed before preparation of IV antibiotic solution	T		
19	It is not necessary to check expiry date for a medication that is recently indented from pharmacy	F		
20	Preparation of IV Hydrocortisone solution does not require hands cleaning using antiseptic or alcohol rub	F		
21	'cc' or 'ml' is the dosage expression for IV insulin	T		
22	The Cefoperazone vial top should be swabbed with alcohol swabs prior to reconstitution with NaCl 0.9%	T		
23	Any reconstituted IV medications can still be used if it is less than 48 hours from the date of reconstitution or preparation	F		
24	IV antibiotics are stable when diluted using NaCl 0.9% or NaCl 3%	T		
25	When 6ml of IV Noradrenaline (4mg/ml) is diluted with 50ml of 5% dextrose saline, the final concentration of Noradrenaline infusion solution in g/ml is 480 g/ml. (1g=1000mg)	T		

Table 3. Please mark following sentences as true (T) or false (F). If the sentence is false write the true answer. (Cont.)

Rank	Statement	(T/F)	(If It Is False) True Answer	Do Not Know
26	Patient's armband and IV catheter should be inspected for phlebitis or extravasations during administration of IV cytotoxic drugs.	T		
27	Medication administered intramuscularly acts rapidly than if administered intravenously	F		
28	KCl injection should be administered as slow bolus injection over 3 minutes during emergency such as ventricular fibrillation	F		
29	IV Ceftriaxone (Rocephine®) can be administered simultaneously with solution containing Calcium Gluconate via a Y-site, at a slower rate of 5mg/min	F		
30	Slow bolus IV injection means administration of intravenous medication in 1 minute.	F		
31	Medications that are classified as High Alert Medication include Noradrenaline and Insulin	T		
32	When an emergency happens such as hypocalcaemia tetany, 10% CaCl 210 ml should be administered in 1– 2 minutes as bolus.	T		
33	Intravenous medication which requires maximum infusion rate of 120µg/hour should be infused at a constant rate of 4µg/min for the first 1 hour.	T		
34	IV. medications can be given via the same catheter with blood	F		

Appendix III: Nurse Perception of Medication Errors (Modified Gladstone Questionnaire 2013)

HACETTEPE ÜNİVERSİTESİ SAĞLIK BİLİMLERİ ENSTİTÜSÜ

The Impact of Medication Safety Education on Perception of Medication Errors, Knowledge, and Intravenous Medication Practice among Palestinian Critical Care Nurses

Please fill in the answers below:

1. **Age** _____ **Gender** _____M _____F

2. **Check highest level of education:**

_____Diploma in nursing _____ bachelor degree of nursing _____ Master Degree in nursing _____other: (specify)

3. **Please check your clinical experience:**

How long have you been qualified to administer medications? _____Years

How long have you been a practicing nurse? _____Years

What is your primary hospital work setting?

What is your work schedule? _____Full-time_____Part-time

Which shift do you work?

_____7:00am-2:00pm (morning shift)

_____2:00pm-9:00pm (evening shift)

_____9:00pm-7:00am (night shift)

_____Other

Why Do You Think Medication Errors Occur?

4. The following ten statements are all possible causes of medication errors. Please read them carefully and Rank #1 to #10. (#1 is the most frequent and #10 the least frequent).

a. Drug errors occur when the nurse fails to check the_____
Patient's name band with the Medication Administration Record (MAR.)

b. Drug errors occur when the physician's writing on the _____
Doctor's order form is difficult to read or illegible.

c. Drug errors occur when the medication labels/packaging _____
Are of poor quality or damaged.

d. Drug errors occur when there is confusion between two_____
Drugs with similar names.

e. Drug errors occur when the physician prescribes the Wrong dose._____

f. Drug errors occur when the nurse miscalculates the dose._____

g. Drug errors occur when the nurse sets up or adjusts an_____
Infusion device incorrectly.

h. Drug errors occur when nurses are confused by the _____
Different types and functions of infusion devices.

i. Drug errors occur when nurses are distracted by other_____
Patients, coworkers or events on the unit.

j. Drug errors occur when nurses are tired and exhausted._____

5. **In your estimation, what percentage of all drug errors is reported to the Nurse Manager by the completion of an incident report? (Please make an X on the line that corresponds most closely to your estimation.)**

1 __10____20____30____40___ 50____60____70____80____90____100 %

<u>NURSES' PERCEPTIONS ABOUT MEDICATION ERRORS</u>:

6. **It is not always clear to nurses whether what they view as a minor drug discrepancy should be reported as a medication error. In the following examples you are asked to indicate:**

   a. Whether or not a medication error occurred.

   b. Whether or not the physician should be notified.

   c. Whether or not an incident report should be completed.

Please answer "YES" or "NO" for each of the following statements:

7. **A patient misses his midday dose of oral ampicillin because he was in X-Ray for three hours.**

   a. Drug Error _____ Yes _____ No

   b. Notify Physician _____ Yes ____ No

   c. Incident Report Necessary _____Yes _____ No

8. **Four patients on a busy surgical unit receive their 6:00pm doses of IV antibiotics 4 hours late.**

   a. Drug Error _____ Yes _____ No

   b. Notify Physician _____ Yes _____ No

   c. Incident Report Necessary _____ Yes _____ No

9. **A patient admitted with status asthmaticus on 13/08/2013 at 2: am is prescribed ventolin nebulizers every four hours. The nurse omits the 6:00am dose on 14/08/2013 as the patient is asleep.**

   a. Drug Error _____ Yes _____ No

   b. Notify Physician _____ Yes _____ No

   c. Incident Report Necessary _____ Yes _____ No

10. **A patient is receiving a routine 9 am dose of digoxin every day. Yesterday's digoxin level was 1.8 (the high side of normal). A digoxin level was drawn at 6 am today. At 9 am the nurse holds the digoxin because the lab value is not available yet.**

    a. Drug Error _____ Yes _____ No

    b. Notify Physician _____ Yes _____No

    c. Incident Report Necessary _____ Yes _____ No

11. What are your views about reporting medication errors? Please check the most appropriate response:

a. I am usually sure what constitutes a medication error _____ Yes _____ No

b. I am usually sure when a medication error should be reported using an incident report

__ Yes _____ No

c. Some medication errors are not reported because nurses are afraid of the reaction they will receive from the Nurse Manager._____ Yes _____ No

d. Some medication errors are not reported because Nurses are afraid of the reaction they will receive from their coworkers. Yes _____ No

e. Have you ever failed to report a drug error because you did not think the error was serious to warrant reporting?__ Yes _____ No

f. Have you ever failed to report a medication error because you were afraid that you might be subject to disciplinary action or even lose your job?_ Yes _____ No

12. How many medication errors do you remember making over the course of your career? (Circle the correct answer.)

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, more than ten please specify _____.

13. Factors Influencing IV Medication errors in the Critical Care Units Human factors may contribute to the incidence of medication errors. Please select THE MOST IMPORTANT reason for medication errors by providing your answer with a tick (□) in the appropriate box (SELECT ONE):

□ Nurse's fatigue or exhaustion
□ Missing one or more than one of the 8 medication rights,
□ Work pressure, e.g., running out of time before handing over to the next shift
□ Error prone situations, e.g. when policy is not followed or asking another nurse for clarification, and not the physician directly, use of abbreviations

□ Hesitance to request clarification from the physician's order, if it is unclear
□ Unfamiliarity with the medication
□ Distractions and interruptions during medication administration
□ Incorrect dilution calculations
□ incorrect dosage calculations
□ Incorrect rate calculations
□ Nurse's lack of concentration
□ High patient/nurse ratio, e.g. ICU patient condition that deteriorates quickly
□Only one RN checking the rate of the pump with another colleague
□ Advanced drug preparation without rechecking
□ Failed communication, e.g. unclear verbal order
□ Administration of wrong IV medication dilute to central line/peripheral line
□ Misidentification
□ the nurse not performing double-checks or incomplete double-checks
□ Other

14. System factors may contribute to the incidence of medication errors. Please select THE MOST IMPORTANT REASON for medication error by providing your answer with a tick (□) in the appropriate box (SELECT ONE):

□ Complicated/incomplete prescriptions
□ Smart Pump difficult to operate/not user friendly
□Insufficient unit-specific training re: medication administration standards.
□ Large number of medications scheduled at peak times
□ Standard medication labelling
□ Computerized Physician Order Entry (CPOE) systems, e.g. misplaced decimal points in the CPOE that can lead to confusion to staff
□ Look alike, sound alike drugs
□ Other:

15. Environmental factors may contribute to the incidence of medication errors. Please select THE MOST IMPORTANT REASON for medication errors by providing your answer with a tick (□) in the appropriate box (SELECT ONE):

□ Work pressure, e.g., running out of time before handing over to the next shift
□ Error prone situations, e.g. when protocol/policy is not followed
□The critical condition of the patient, e.g. increased workload for RN's assigned patient
□ High patient to nurse ratio
□ Multiple nursing tasks done in a limited time available.
□ Increased workload
□ English is not the first language of the staff working at this hospital

Appendix IV: Practice Observation Form

HACETTEPE ÜNİVERSİTESİ

The Impact of Medication Safety Education on Perception of Medication Errors, Knowledge, and Intravenous Medication Practice among Palestinian Critical Care Nurses

Table 1. Order Information

Name of the medication	
Route	
Dose	
Time	
Verbal order **( ) YES ( ) NO**	**Procedure for verbal order:**
Clear order **( ) YES ( ) NO**	**Explanation:**

Table 2. Environmental / Institution Information

Pharmacist collaboration	( ) YES ( ) NO Explanation:
Hazardous medication list	( ) YES ( ) NO Explanation:
Look-like and sound-like medication list	( ) YES ( ) NO Explanation:
Abbreviation list	( ) YES ( ) NO Explanation:
Distractions	( ) YES ( ) NO Explanation:
Proper storage areas	( ) YES ( ) NO Explanation:
Medication error reporting system	( ) YES ( ) NO Explanation:

Table 3. Rights of Medication Administration

Right	Procedure	Performed	Not Performed	Not Observed	Explanation
1. Right patient	• Check the name on the order and the patient. • Use 2 identifiers. • Ask patient to identify himself/herself. • When available, use technology (for example, bar-code system). • Giving the medication to the right patient				
2. Right medication	• Check the medication label. • Check the order. • Labeling the medication properly (If necessary) • Giving the right medication				
3. Right dose	• Check the order. • Confirm appropriateness of the dose using a current drug reference. • If necessary, calculate the dose and have another nurse calculate the dose as well. • Giving the medication with right dose				
4. Right route/ technique	• Check the order and appropriateness of the route ordered. • Confirm that the patient can take or receive the medication by the ordered route. • Preventing drug-drug or drug-fluid interaction (Not giving the drugs in same catheter with another drug or fluid which may interact) • Giving the medication with right route • Giving the medication with right technique: ➢ Proper injection devices ➢ Proper storage ➢ Proper area ➢ Injecting with true angle ➢ Giving the medication with right period ➢ Proper procedure for wastes				
5. Right time	• Check the frequency of the ordered medication. • Double-check that you are giving the ordered dose at the correct time.				

	• Confirm when the last dose was given. • Giving the medication at the correct time				
6. Right documentation	• Document administration AFTER giving the ordered medication. • Chart the time, route, and any other specific information as necessary. For example, the site of an injection or any laboratory value or vital sign that needed to be checked before giving the drug. • Desired and undesired effects of the medication				
7. Right reason	• Confirm the rationale for the ordered medication. What is the patient's history? Why is he/she taking this medication?				
8. Right response	• Ask the desired effect of the medication. • Ask the undesired effects of the medication.				

Table 4. Medication error types

Number	Error types	Number of Errors	Percent
1	Late/early administration (Wrong time)		
2	Not dispensed or dispensed late		
3	Wrong or inappropriate information		
4	Omitted administration		
5	Wrong duration		
6	Over dose		
7	Unauthorized drug		
8	Under dose		
9	Duplicate		
10	Wrong drug		
11	Not transcribed		
12	Allergy		
13	Wrong patient		
14	Illegible order		
15	Failure to renew		
16	Administered but not documented		
17	Incomplete or no documentation		
18	Administered without order		
19	Wrong mix or volume		
20	Drug-drug interaction		
Total number of errors			

Appendix V: Ethical Approval

ETHICAL APPROVAL FROM HACETTEPE UNIVERSITY

T.C.
HACETTEPE ÜNİVERSİTESİ
Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu

Sayı : 16969557 -374

26 Mart 2014

ARAŞTIRMA PROJESİ DEĞERLENDİRME RAPORU

Toplantı Tarihi : 19.03.2014 ÇARŞAMBA
Toplantı No : 2014/05
Proje No : GO 14/185 (Değerlendirme Tarihi 19.03.2014)
Karar No : GO 14/185 - 25

Üniversitemiz Hemşirelik Fakültesi öğretim üyelerinden Prof. Dr. Nurhan BAYRAKTAR'ın sorumlu araştırmacı olduğu Imad. R.A. ABUKHADER'in tezi olan GO 14/185 kayıt numaralı ve ***"Filistin'de Kritik Bakım Hemşirelerinin İntravenöz İlaç Güvenliği Eğitiminin İlaç Hataları Algıları, İntravenöz İlaçlara İlişkin Bilgileri ve Uygulamalarına Etkisi"*** başlıklı proje önerisi araştırmanın gerekçe, amaç, yaklaşım ve yöntemleri dikkate alınarak incelenmiş olup, idari izinlerin tamamlanması kaydı ile etik açıdan uygun bulunmuştur.

1.Prof. Dr. Nurten Akarsu (Başkan)
GÖREVLİ
2. Prof. Dr. Nüket Örnek Buken (Üye)
3. Prof. Dr. M. Yıldırım Sara (Üye)
4. Prof. Dr. Sevda F. Müftüoğlu (Üye)
5. Prof. Dr. Cenk Sökmensüer (Üye)
6. Prof. Dr. Volga Bayrakçı Tunay (Üye)
7. Prof. Dr. Songül Vaizoğlu (Üye)
8. Prof. Dr. Yılmaz Selim Erdal (Üye)
9 Prof. Dr. Melahat Görduysus (Üye)
GÖREVLİ
10. Prof. Dr. Cansın Saçkesen (Üye)
11. Prof. Dr. R. Köksal Özgül (Üye)
12. Prof. Dr. Ayşe Lale Doğan (Üye)
13 Doç. Dr. S. Kutay Demirkan (Üye)
14. Prof. Dr Leyla Dinç (Üye)
15. Yrd. Doç. Dr. H. Hüsrev Turnagöl (Üye)
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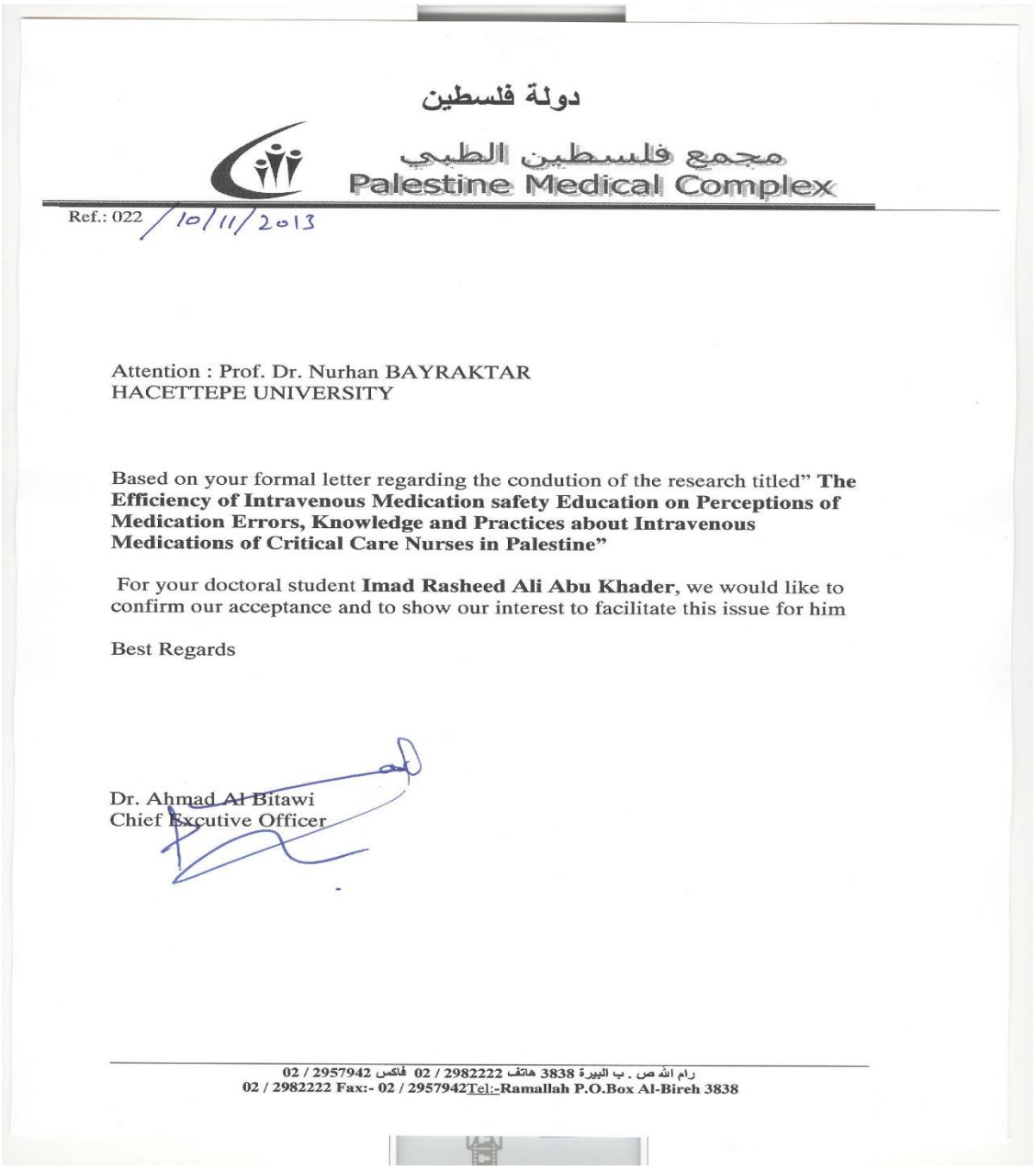
Ayrıntılı Bilgi için:

Appendix VI: Agreement to Conduct the Research from Palestine Medical Complex

Approval from Palestine Medical Complex



دولة فلسطين

مجمع فلسطين الطبي
Palestine Medical Complex

Ref.: 022 10/11/2013

Attention : Prof. Dr. Nurhan BAYRAKTAR
HACETTEPE UNIVERSITY

Based on your formal letter regarding the condution of the research titled" **The Efficiency of Intravenous Medication safety Education on Perceptions of Medication Errors, Knowledge and Practices about Intravenous Medications of Critical Care Nurses in Palestine"**

For your doctoral student **Imad Rasheed Ali Abu Khader**, we would like to confirm our acceptance and to show our interest to facilitate this issue for him

Best Regards

Dr. Ahmad Al Bitawi
Chief Excutive Officer

رام الله ص . ب البيرة 3838 هاتف 02 / 2982222 فاكس 02 / 2957942
02 / 2982222 Fax:- 02 / 2957942Tel:-Ramallah P.O.Box Al-Bireh 3838

Appendix VII: An Official Permission from Author to use the Gladstone Survey

On Wednesday, March 2, 2014 3:07 PM, "emadkhader2000@yahoo.com" <emadkhader2000@yahoo.com> wrote:

Dear Prof. Gladstone

My Name is Imad Abu Khader, I am PhD student at the Faculty of nursing / Hacettepe University / Turkey

It Is MY honor to use your survey to evaluate the critical care nurses perception toward medication errors

Could you please e mail me an official approval to conduct the research

Imad Abu Khader

Best regards

On Wednesday, December 16, 2014 1:17 AM, "Gladstonem@.gmail.com" <gladstonesm@gmail.com> wrote:

Dear Imad,

As Gladstone survey committee we can provide you with the official approval for the modified Gladstone survey.

And wishing you good luck

Best regards

Gladstone survey committee

Appendix VIII: Additional Table

Additional Table 1. Practices of Nurses on Eight Rights of Medication Administration before and After Education (N=52)

Medications Rights	**Observations Before Education**						**Observations After Education**					
	Observations						**Observations**					
	First		**Second**		**Third**		**First**		**Second**		**Third**	
	Correct Practice						**Correct Practice**					
	N	%	N	%	N	%	N	%	N	%	N	%
Right Patient	42	80.7	39	75	37	71.1	51	98.1	49	94.2	50	96.1
• Check the name on the order and the patient.	42	80.7	43	82.6	40	76.9	46	88.4	48	92.3	49	94.2
• Use 2 identifiers.	21	40.3	25	48.1	27	51.9	31	59.6	35	67.3	39	75
• Ask patient to identify himself/herself.	32	61.5	40	76.9	33	63.4	39	75	45	86.5	48	92.3
• When available, use technology (for example, bar-code system).	40	76.9	41	78.8	45	86.5	48	92.3	45	86.5	46	88.4
• Giving the medication to the right patient	52	100	52	100	52	100	52	100	52	100	52	100
Right Medication	41	78.8	40	76.9	45	86.5	43	82.6	50	96.1	49	94.2
• Check the medication label.	45	86.5	41	78.8	49	94.2	52	100	51	98.1	49	94.2
• Check the order.	44	84.6	40	76.9	43	82.6	50	96.1	49	94.2	49	94.2
• Labeling the medication properly (If necessary)	15	28.8	22	42.3	11	21.1	17	32.6	19	36.5	25	48.1
• Giving the right medication	52	100	52	100	52	100	52	100	52	100	52	100
Right Dose	41	78.8	39	75	45	86.5	50	96.1	49	94.2	50	96.1
• Check the order	48	92.3	42	80.7	45	86.5	51	98.1	49	94.2	43	82.6
• Confirm appropriateness of the dose using a current drug reference.	11	21.1	12	23.1	17	32.6	22	42.3	21	40.3	18	34.6
• If necessary, calculate the dose and have another nurse calculate the dose as well.	10	19.2	9	17.3	15	28.8	17	32.6	11	21.1	13	25
• Giving the medication with right dose	48	92.3	35	67.3	41	78.8	49	94.2	42	80.7	50	96.1
Right Route/ technique	50	96.1	37	71.1	40	76.9	50	96.1	42	80.7	45	86.5
• Check the order and appropriateness of the route ordered.	24	46.1	31	59.6	41	78.8	39	75	41	78.8	40	76.9
• Confirm that the patient can take or receive the medication by the ordered route.	45	86.5	48	92.3	46	88.4	50	96.1	52	100	52	100
• Preventing drug-drug or drug- fluid interaction (Not giving the drugs in same catheter with another drug or fluid which may interact)	37	71.1	40	76.9	36	69.2	44	84.6	42	80.7	40	76.9
• Giving the medication with right route	52	100	52	100	52	100	52	100	52	100	52	100
• Giving the medication with right technique	35	67.3	33	63.4	40	76.9	45	86.5	42	80.7	52	100
Right Time	28	53.8	31	59.6	41	78.8	45	86.5	39	75	41	78.8
• Check the frequency of the ordered medication.	35	67.3	37	71.1	34	65.3	40	76.9	42	80.7	52	100

• Double-check that you are giving the ordered dose at the correct time	15	28.8	22	42.3	21	40.3	25	48.1	31	59.6	35	67.3
• Confirm when the last dose was given.	18	34.6	22	42.3	11	21.1	40	76.9	28	53.8	30	57.6
• Giving the medication at the correct time	25	48.1	29	55.7	35	67.3	40	76.9	41	78.8	35	67.3
Right Documentation	35	67.3	29	55.7	39	75	40	76.9	30	57.6	40	76.9
• Document administration AFTER giving the ordered medication.	40	76.9	35	67.3	39	75	45	86.5	39	75	48	92.3
• Chart the time, route, and any other specific information as necessary. For example, the site of an injection or any laboratory value or vital sign that needed to be checked before giving the drug	21	40.3	25	48.1	20	38.4	35	67.3	37	71.1	33	63.4
• Desired and undesired effects of the medication	10	19.2	15	28.8	11	21.1	20	38.4	29	55.7	33	63.4
Right Reason	9	17.3	8	15.3	5	9.6	27	51.9	21	40.3	25	48.1
• Confirm the rationale for the ordered medication. What is the patient's history? Why is he/she taking this medication?	5	9.6	12	23.1	4	7.7	26	50	29	55.7	39	75
Right Response	17	32.7	15	28.8	21	40.3	31	59.6	28	53.8	35	67.3
• Ask the desired effect of the medication. .	23	44.2	29	55.7	19	36.5	35	67.3	34	65.3	28	53.8
• Ask the undesired effects of the medication	22	42.3	28	53.8	22	42.3	35	67.3	37	71.1	39	75

Appendix IX: Safe Medication Administration Educational Booklet for Nurses

SAFE MEDICATION ADMINISTRATION

Educational Booklet for Nurses

Introduction

Safety is a concern in many professions, including health care. It has been estimated that between 44,000 to 98,000 people die each year due to medical errors that could have been prevented (Kohn, Corrigan & Donaldson, 2000). Preventing medical errors and promoting patient safety and quality is currently a focus of many organizations, including the World Health Organization (WHO), United States Institute of Medicine (IOM) and The Joint Commission (TJC) (Kohn et al., 2000; AACN, 2008).

In 2002, WHO Member States agreed on a World Health Assembly resolution on patient safety. IOM has addressed this major public health concern by explicitly identifying and prioritizing patient safety as one of the areas that must be improved in the 21st century healthcare system. IOM defined safety as "freedom from accidental injury".

In 2002, Joint Commission established its National Patient Safety Goals (NPSGs) program. The NPSGs were established to help accredited organizations address specific areas of concern in regards to patient safety. A panel of widely recognized patient safety experts adviced The Joint Commission on the development and updating of NPSGs.

The purpose of the National Patient Safety Goals is to improve patient safety with the goals focusing on problems in health care safety and how to solve them.

The Joint Commission notes that quality will become one of the primary determinants of reimbursement levels. Improved and consistent quality will also reduce costs at hospitals by eliminating variability and risk to patients. Joint Commission 2014 Hospital Patient Safety Goals include;

- Identify patients correctly.
- Improve staff communication.
- Use medicines safely.
- Use alarms safely
- Prevent infection.
- Identify patient safety risks.
- Prevent mistakes in surgery.

Patient safety is also a concern in nursing education. It is a basic assumption of the American Association of Colleges of Nursing (AACN) that the baccalaureate graduate is prepared to promote safe, quality patient care (AACN, 2008). AACN has taken several actions to convey the importance of promoting safe, quality care and has defined specific standards, or competencies, for nursing education (Cronenwett et al., 2007). With inadequate nursing education about patient safety and quality, excessive workloads, staffing inadequacies, fatigue, illegible provider handwriting, flawed dispensing systems, and problems with the labeling of drugs, nurses are continually challenged to ensure that their patients receive the right medication at the right time

So the purpose of this program is to improve intravenous medication safety knowledge, practices and perceptions of medication errors of nurses through planned educational program.

Medication Errors.

Commonly used definition for a medication error is: Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use.

Most of the common types of errors resulting in patient death involved the wrong dose (40.9 percent), the wrong drug (16 percent), and the wrong route of administration (9.5 percent).

The causes of these deaths were categorized as oral and written miscommunication, name confusion (e.g., names that look or sound alike), similar or misleading container labeling, performance or knowledge deficits, and inappropriate packaging or device design.

Medication errors are considered the most common medical error (The Joint Commission, 2008). The IOM identified medication errors as a major source of error in healthcare which may negatively impact patient safety. While almost one-fifth of

all medical errors in hospital settings were deemed to be drug-related, over half of these were considered preventable. As such, the IOM has placed medication error reduction as a priority area within the reports To Err is Human (2000), Crossing the Quality Chasm (2001), Priority Areas for National Action (2003), and Patient Safety (2004).

The most recent IOM report, concerned the Preventing Medication Errors, which states that "a hospital patient is subject to at least one medication error per day, with considerable variation in error rates across facilities". Yet, despite numerous research findings, we cannot estimate the actual rates because they vary by site, organization, and clinician; because not all medication errors are detected; and because not all detected errors are reported.

Medication errors are a significant issue affecting patient safety and costs in hospitals often posturing dangerous consequences for patients. It has been estimated that 7000 deaths occur annually across all patient populations due to medication errors (Kohn et al., 2000). The researchers found that 3.7 percent of hospitalizations involved adverse events that prolonged hospital stay or were manifested as a new disability at the time of discharge. About one in four of these adverse events were judged to be attributable to negligence, and 58 percent were judged to be preventable.

Thus, interventions are needed to decrease medication errors and improve patient safety through safe medication administration. Understanding of medication errors can help healthcare professionals and managers to identify causes of medication errors and provide insight into how to make improvements to prevent or reduce those (Poon et al., 2010).

Adverse Drug Events (ADE) and Adverse Drug Reactions (ADR)

Adverse drug events are defined as injuries that result from medication use, although the causality of this relationship may not be proven. Some ADEs are caused by preventable errors.

ADEs that are not preventable are often the result of adverse drug reactions (ADRs), which are defined as "any response to a drug which is noxious and unintended and which occurs at doses normally used for prophylaxis, diagnosis or therapy of disease, or the modification of physiological function, given that this noxious response is not due to medication error." Potential ADEs or near misses/close calls are

medication errors that do not cause any harm to the patient because they are intercepted before they reach the patient or because the patient is able to physiologically absorb the error without any harm.

An adverse drug reaction is defined as "an undesirable response associated with use of a drug that either compromises therapeutic efficacy, enhances toxicity, or both." ADRs can be manifested as diarrhea or constipation, rash, headache, or other nonspecific symptoms. One of the challenges presented by ADRs is that prescribers may attribute the adverse effects to the patient's underlying condition and fail to recognize the patient's age or number of medications as a contributing factor.

Medication errors occur in all settings and may or may not cause an adverse drug event (ADE). Medications with complex dosing regimens and those given in specialty areas (e.g., intensive care units, emergency departments, and diagnostic and interventional areas) are associated with increased risk of ADEs. Phillips and colleagues found that deaths (the most severe ADE) associated with medication errors involved central nervous system agents, anti - neoplastic, and cardiovascular drugs.

Administration of following medications may associate with errors:

• Medications with similar names or similar packaging

• Medications that are not commonly used or prescribed

• Commonly used medications to which many patients are allergic (e.g., antibiotics, opiates, and non-steroidal anti-inflammatory drugs)

• Medications that require testing to ensure proper (i.e., nontoxic) therapeutic levels are maintained (e.g., lithium, warfarin, theophylline, and digoxin)

Look-Alike/Sound-Alike Medications

Look-alike/sound-alike medication names can result in medication errors. Misreading medication names that look similar is a common mistake. These look-alike medication names may also sound alike and can lead to errors associated with verbal prescriptions. The Joint Commission publishes a list of look-alike/sound-alike drugs that are considered the most problematic medication names across settings. (This list is available at www.jointcommission.org/NR/rdonlyres/ High-Alert Medications)

Medication errors are associated with high-alert medications. According to the Institute for Safe Medication Practices (ISMP), "High-alert medications are those

likely to cause significant harm when used in error." The top five high alert medications are "insulin, opiates and narcotics, injectable potassium chloride (or phosphate) concentrate, intravenous anticoagulants (heparin), and sodium chloride solutions above 0.9 percent". ISMP's list of high-alert medications is available at: www.ismp.org/tools/ high alert medications.

Impact of Working Conditions on Medication Errors

Medication safety for patients is dependent upon systems, process, and human factors, which can vary significantly across health care settings. Following the release of To Err Is Human, the focus on deaths caused by medication errors targeted system issues, such as high noise levels and excessive workloads, and system interventions, such as the need for computerized order entry, unit dose (e.g., single-dose packaging), and 24-hour pharmacy coverage.

The IOM's report, crossing the Quality Chasm, put forth the concept that poor designs set the workforce up to fail, regardless of how hard they try. Thus, if health care institutions want to ensure safer, higher-quality care, they will need to, among other things, redesign systems of care using information technology to support clinical and administrative processes.

There is association between working conditions/environment and medication errors. Early research in this area found a relationship between characteristics of the work environment for nurses and medication errors.

Aspects of working conditions in relation to medication safety.

System factors: The system approach to safety emphasizes the human condition of fallibility and anticipates that errors will occur, even in the best organizations with the best people working in them. This approach focuses on identifying predisposing factors within the working environment or systems that lead to errors.

Systems factors that can influence medication administration include nurse staffing, workload, organizational climate/favorable working conditions, policies and procedures, and technologies enabling safety or contributing to medication administration errors.

Nurse staffing: Medication administration is a key responsibility of nurses in many settings, and studies assessed the relationship between nurse staffing, hours of

nursing care in hospitals, nurse skill mix, and medication errors. Rates of medication administration errors, when the number of doses was the denominator, were highest in the critical care units; when patient days were the denominator, the highest rate was in Critical Care Unit.

Workloads: Heavy workloads have impact on medication administration errors. In one survey of nurses in 11 hospitals, both pediatric and adult nurses reported staffing ratios and the number of medications being administered as being the major reasons why medication errors occur.

Workload increases and insufficient staffing were noted to be causes of errors.

The effect of heavy workloads and inadequate numbers of nurses can also be manifested as long workdays, providing patient care beyond the point of effective performance.

Organizational climate: Other systems/organizational issues include the presence of favorable working conditions, effective systems, policies and procedures, and technologies that enable safety or contribute to medication administration errors. The organizational climate was found to be linked with safety behavior. Hofmann and Mark did find that the safety climate on patient care units was linked to the rate of harm-producing medication errors in a study using data collected from 82 units in 41 hospitals. Higher overall safety climate was related to lower rates of medication errors.

Policies, procedures, and protocols: Lack of appropriate policies, procedures, and protocols can impact medication safety. In a study of malpractice cases, medication errors were associated with lack of administration protocols and ineffective nurse supervision in delegating administration.

However, even when policies are in place, they may not necessarily improve safety. For example, a review of two studies in the literature found that medication errors did not necessarily decrease with two nurses administering medications (e.g., double-checking). In addition, appropriate policies may not be followed. In a review, failure to adhere to policies and procedures was associated with errors.

Process Factors

There are five stages of the medication process: (a) ordering/prescribing, (b) transcribing and verifying, (c) dispensing and delivering, (d) administering, and (e) monitoring and reporting.

Monitoring and reporting is a newly identified stage about which there is little research. Some of the most noted and early work on medication safety found hospitalized patients suffer preventable injury or even death as a result of medication administration errors associated with errors made during the prescribing, dispensing, and administering of medications to patients.

A few studies have indicated that one of every three medication errors could be attributed to either a lack of knowledge about the medication or a lack of knowledge about the patient.

Process factors that influence medication administration include latent failures that can investigate events resulting in errors, such as administrative processes, technological processes, clinical processes, and factors such as interruptions and distractions. These factors reflect the nature of the work, including "competing tasks and interruptions, individual vs. teamwork, physical/cognitive requirements, treatment complexity, and workflow."

Distractions and interruptions: Factors such as distractions and interruptions, during the process of delivering care can have a significant impact on medication safety. In many studies, nurses ranked distractions as major causes for the majority of medication errors.

Documentation of the medication administration process: Adherence to a hospital policy to document medications administered and their effects on patients is important in medication safety. Documents should contain information about medication name, dose, time of administration, desired or adverse effects of medications, assessment prior to administration, and medication education.

In addition, recognizing, documenting and reporting medication administration errors, and developing error reporting strategies are critical to the implementation of effective system-level approaches to reduce medication errors. Medication error reporting needs to be ongoing and part of a continuous quality improvement process.

Most significant barriers to reporting include:

(a) A hierarchical hospital culture/structure where the nursing staff disagreed about the definition of reportable errors,

(b) Fear of the response and reaction of hospital management/administrators and peers to a reported error,

(c) The amount of time and effort involved in documenting and reporting an error.

Communication: There is relationship between communication failures and medication errors. Nurses need to communicate with physicians and with pharmacists about medication administration. In related literature reviews it was indicated that illegible and poorly written drug prescriptions and breakdowns in communication led to errors. Another survey found that nurses ranked difficult/illegible physician handwriting as a cause of the majority of medication errors.

Verbal and telephone orders can be source of errors. Equipment failure while administering medication: Studies found that systems and process factors can interfere with medication administration when equipment used in administration does not perform properly, exposing the nurse and patient to safety risks. In ICU studies, infusion pump problems were involved in medication administration errors.

Monitoring and assessing: Monitoring and assessing the patient by the nurse is an essential component of the safe medication administration process. A qualitative analysis of observed medication administration found that participants monitored patients before, during, and after medication administration. Nurses assessed vital signs, lab values, allergic reaction, and patients' self- report of health.

Human Factors

Human factors have impact medication administration errors. There are studies that assessed the association of human factors with medication administration errors.

Fatigue, cognitive abilities, knowledge, experience, and skills are main human factors associated with medication administration errors.

Nurses are primarily involved in the administration of medications across settings. Nurses can also be involved in both the dispensing and preparation of medications (in a similar role to pharmacists), such as crushing pills and drawing up a measured amount for injections.

Early research on medication administration errors (MAEs) reported an error rate of 60 percent, mainly in the form of wrong time, wrong rate, or wrong dose. In other studies, approximately one out of every three ADEs were attributable to nurses administering medications to patients. In a study of deaths caused by medication errors reported to the FDA from 1993 to 1998, injectable drugs were most often the problem;

the most common type of error was a drug overdose, and the second most common type of error was administering the wrong drug to a patient.

Several studies showed that the human factors (e.g., knowledge or performance deficits) are the most common causes of medication administration errors.

Among many reasons for the prevalence of nurse involvement in medication errors is that nurses may spend as much as 40 percent of their time in medication administration.

Critical Care and Medication Errors

The Critical care Units brings together high-risk patients and interventions in a complex environment. The single strongest predictor of an ADE is patient illness severity. Critically ill patients are prescribed twice as many medications as patients outside of the Critical care Units. Most medications in the Critical care Units are administered as weight-based infusions. These infusions require mathematical calculations and frequently are based on estimated weights increasing the risk of error.

Multicenter studies by Ridley and colleagues and Calabrese and colleagues identified potassium chloride, heparin, magnesium sulphate, vasoactive drugs, sedatives, and analgesics as the medications with the greatest risk of error. Antibiotics frequently are empirically prescribed in the Critical care Units and errors have potential implications both for individual patients and populations.

Patients are prescribed these medications in an environment that is stressful, complex, changing, under the stewardship of multiple providers, and frequently managing patients in crisis.

It is important to remember that critically ill patients have fewer defenses against adverse events than other patients do. They have limited ability to participate in their medical care and they lack the physiological reserve to tolerate additional injury. Moreover, they are reliant on sophisticated technologies and equipment to deliver essential care and yet relatively little is known about medical equipment failures and the associated safety risks. Finally, lack of continuity of care at discharge from the Critical care Units is a well-known feature putting the patient at risk for errors and highlights the importance of communication with the future caregivers

Precautions to Decrease Medication Errors and Improve Medication Administration Safety

TJC's 2014 Hospital National Patient Safety Goals include following points related to "Using Medicines Safely":

• Before a procedure, label medicines that are not labeled. For example, medicines in syringes, cups and basins. Do this in the area where medicines and supplies are set up.

• Take extra care with patients who take medicines to thin their blood.

• Record and pass along correct information about a patient's medicines. Find out what medicines the patient is taking.

Compare those medicines to new medicines given to the patient. Make sure the patient knows which medicines to take when they are at home. Tell the patient it is important to bring their up-to-date list of medicines every time they visit a doctor.

General Precautions for Medication Administration Safety

The administration of medication is a cognitive and interactive aspect of nursing care and is more than just the psychomotor task of administering a medication to a client.

It involves client assessment, making clinical decisions and planning care based on this assessment. Medication administration is performed in collaboration with the client and family.

It is important that these principles of medication administration be known and followed by the nurse who is administering medications.

• A multidisciplinary team approach for medication management and the prevention of medication errors should be used.

• Medications, chemicals, reagents, and related supplies should be procured and stored in a manner that facilitates safe and efficient delivery to the patient. Medications should be stored according to manufacturer's medication storage requirements.

• Expiration date of the medication should be controlled; if the expiration date has passed it should be discarded or returned to pharmacy.

• Health care organizations should periodically review a list of look-alike, sound-alike medications

• Health care organizations should standardize medication delivery equipment (eg, infusion pumps).

• Prescribing personnel should provide clear, unambiguous, and accurate medication orders. Verbal medication orders should be limited, especially with medications identified as high risk for sound-alike errors or as having commonly confused names. Nurses should confirm verbal medication orders by reading back the order to the prescriber digit by digit and spelling out the medication name if necessary.

Nurses should immediately record verbal medication orders in the patient's record. Prescribers should review, validate, and sign the transcribed verbal medication order on the patient's record as close as possible to the time of the medication administration. When available, prescribers should use computerized provider order entry systems.

• Safe medication order transcribing processes should be implemented.

• Nurses must know the therapeutic use of the medicine to be administered, its normal dosage, side effects, precautions and contra-indications

• Nurses should collaborate with pharmacist

• Nurses should assess the patient and review the patient's record to confirm the patient's metric weight, medication history, and current medication orders before administering medications.

• Nurses should identify the client two or three ways before administering medications (Name, armband-depending on facility technology)

• Medication allergy and reaction information should be obtained from patients, family members, and previous medical records and should be documented clearly in the patients' records.

• Nurses who administer medications should not be interrupted or distracted when preparing and administering medications.

• When preparing medications for administration, the nurses should use safety devices.

• Medications should be prepared as close as possible to the time of use.

• The use of multi dose vials should be avoided.

• Nurses should follow the medication manufacturer's directions for use.

• Aseptic technique should be used in medication administration.

• Medications should be labeled that are not labeled. For example, medicines in syringes,

• Safe injection practices should be used (e.g. one syringe and one needle)

• Nurses should adhere to the eight rights of medication administration: Right patient, Right medication, Right dose, Right route, Right time, Right documentation, Right reason, and Right response.

• Nurses should administer only medications they themselves or a pharmacist have prepared, except in an emergency.

• Technology should be integrated to decrease medication errors at specific steps in the medication administration process.

• The health care organization must have updated list of high-risk medications. Specific protocols should be developed for high-risk drugs, including independent verification and double check procedures.

• Patient should be monitored for therapeutic effect or adverse reactions to medications.

• Potential hazards and near misses, as well as actual medication errors should be detected and reported.

• Patients should be educated related to medication use.

• A comprehensive safety program should be developed to medication administration safety.

Intravenous Medication Safety

In addition to above mentioned general strategies related to medication administration safety, the following precautions are important in intravenous medication administrations:

• Check:

- Medicine, Medicine dosage and prescribed route for administration
- Mathematical calculations for preparing and administering medications.

Expiry dates of Medicine, diluents, infusion fluid required

Ensure no faults in vials, ampoules and equipment.

• Use aseptic technique; Prior to preparation (proper hand washing and gloves)

• Prepare equipment as follows

Plastic tray for each patient

Syringes of required size

Needles

Swabs

Medicines and diluents as prescribed (check to ensure that storage instructions for medicine have been met)

• Properly use single-use medical devices (syringes, needles and infusion supplies)

• Use single-dose vials for one client only.

• Use single-dose vials and pre-filled syringes whenever possible.

• “ Where an intravenous insulin infusion is being prepared, it is important to use an insulin syringe to draw up the insulin dose which can then be mixed with appropriate diluent in a larger syringe for infusion”. (Under No Circumstances Should The Insulin Dose Be Drawn Up Usıng Any Other Type Of Syrınge.)

• Prepare medicine, checking for any discoloration or cloudiness. Preparation of substances for injection in advance of their immediate use or administration of medication drawn into a syringe or container by another practitioner when not in their presence is not acceptable.26

• The administration of intravenous medications can be given by direct injection (bolus), intermittent infusion or continuous infusion.

• Administer one drug at a time and do not mix drugs together in the same infusion.

• Check patency of cannula and IV line. Check cannula site for signs of infection, extravasations or phlebitis

• Flush between medications if appropriate to minimize the risk of drug interactions. A compatible flush should be administered before, between and after each medication. Flushes should be administered no faster than the rate of administration of the IV medication to be flushed. If appropriate, stop infusion and flush cannula with (prescribed) Sodium Chloride 0.9% unless incompatible or unless otherwise stated.

• Administer medicine at the correct rate, in accordance with the monograph instructions, using the correct delivery systems including pumps lines and filters.

• Establish if an electronically controlled infusion device is required and to be familiar with its use.

• Observe for adverse reactions, monitoring the patient as appropriate.

• Flush cannula with Sodium Chloride 0.9% (where compatible) and / or re-start infusion.

• Ensure that all sharps and non-sharp waste are disposed of safely.

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