Safety Intervention Educational Program to Reduce Medication Administration Errors and Interruptions

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Abstract:
Background: *Patients' safety is one major challenge that encounters health care system today. Medication errors represent major factors endangering the patient's safety. This study aims to assess the effectiveness of interventions to limit errors and interruptions during medication administration in medical and surgical unit at Mansoura University Hospital (MUH).*
Methods: *A quasi-experimental one group pre and post test design was used .The study has been conducted among 48 nurses assigned to administer medication to 90 patients in a working week at (MUH)in general medical units (n=2) and surgical units (n=2). Data were collected utilizing the following tools: 1) Structure Questionnaire to assess nurses' knowledge related to errors and interruption during medication administration, 2) Observational checklist to ensure the process is safe to reduce errors through using six safe practices, and determine the frequency of errors and interruption and 3) Demographic data form for collecting data related to socio-demographic data.*
Results: *The present study revealed that: (a) the nurses' knowledge increased immediately after intervention with statistical significant difference compared to pre intervention. (b) There was improved safe practice during medication administration as evidence by decrease error after intervention than pre intervention (c) There were decrease errors and interruptions immediately after intervention with a highly statistically significant difference in comparison to pre intervention.*
Conclusion: *This study concluded that improving nursing staff" knowledge and practice about safe medication administration is evident by decreasing frequency of the errors and interruptions nurses faced during medication administration after intervention.*
Recommendations: *The present study recommends conducting a continuous educational program for the nursing staff, as it is necessary for reducing medication errors and interruptions to protect the patients' safety.*
Keyword: *Safe medication administration, medication administration error, interruption, and patient safety*

I. Introduction

Patients' safety is one basic goal in any treatment protocol. It is also an essential concern of the latest health-care delivery systems (Sabry and Abbassi, 2014). In addition, this has been an obvious indicator about the level of health care (Startton, et al 2004). Medication errors represent critical effects on patients' safety (Benjamin, 2003). It can be acquainted as any preventable behavior that may cause inappropriate medication use or that may put patients at risk (Sahithi et al, 2015). Therefore, this may indulge nursing practice at risk and hence, create preventable risk for patients. The worth mentioned influence of medication administration errors burden patients in several ways. This includes morbidity, mortality, adverse drug events, and it also prolonged the time of hospital stay (Feleke et al, 2015). Additionally, this may raise costs for healthcare systems (Agalu et al, 2012).

Medication mistakes are in some ways linked to work exercise, patients' oriented reasons, health care products, actions taken, and systems. This includes prescribing; sequence communication; drug- labeling, packaging, absence of knowledge about medication administration, misinterpretation of oral directions and compounding; dispensing; distribution; administration; education; follow-up; and use (Johnson et al, 2011). A medication could basically happen in the form of time and rate mistaken timing, either mistaken dose or drug to patients (Weant et al, 2014), and hence, it can reduce medication errors and increase patients' safety that represents a basic concern of hospitals quality enhancement and problem solving (Al-Youssif et al, 2013). This should be based on the design and puts into effect more error-resistant systems and creates an environment in which staff can learn from failure - a safe, non- penal environment that may support staff handling of mistakes, their reasons, together with strategies of eliminating such mistakes (Hughes and Blegen, 2008).

Medication management procedures are a daily element of the nursing profession and a corner stone of the nursing career (Abusaad and Etawy, 2015 and Johari et al, 2013). Safe medication administration is essential

for all those indulged in the process. In fact, six processes are central to safe medication administration. They comprise comparing medication to medication administration record, keeping medication labeled through procedure, checking patient identifiers, explaining drug to patient, and promptly charting after administration (Miglani, 2015 and Ching et al, 2013). In this way, it is very basic to analyze the behavior of the nurses when they perform wrongly during the process. This is a state of non–compliance, neglect of action, and it leads to medication administration errors. Improving the medication administration procedure and controlling interruption can give the nurses more time for direct contact with patient, decreasing possible errors, and protecting patients' from risk (Arnodo, 2014).

Medication administration requires nurses' complete attention for conducting safe practice. Interruptions during medication administration have been implicated as a contributory cause of medication administration errors in the hospital which leads to patients' harm (Hopkinson, and Mowinski Jennings, 2013).The most common type of interruptions entails interactions among nurses, interactions with other health care providers, and any wrong procedure in the medication administration facilities.

A major concern is to comprehend how nurses acquire the ability to control and administer interruptions during the medication process at any clinical environment (Hayes et al, 2015). The intervention that is included does not interrupt vest warn by nurses during medication administration, signs requesting nurses administer medication to not be interrupted, marked quit zone for medication administration, checklists with the medication administration process carried by nurses. In addition, assign other staff not performing medication administration to respond to telephone calls during peak medication times (Arnado, 2014 ; Raban ,Lehnbom, and Westbrook, 2013).

The most basic responsibility of a nurse is the safety of the patient to whom she offers care. Medical-surgical nurses are challenged to reduce and eliminate medication errors. They use knowledge and skills innovations aimed at error prevention (Balas et al, 2004). Knowledge can change the attitude and develop confidence for practice. For this reason, assessing the rate of medication errors, the frequency of interruptions and associated factors of medication administration error have a major contribution in developing the quality of patients' care.

Operational definition:
Medication errors: It is known as any preventable cause of a patient's harm. This may be defined as any sort of errors in the prescribing and / or administrating the medication on behalf of the nurses.
Medication administration errors: This is known as any distinction between what the patient received and what the prescribing is intended for in the authentic orders administered by the nurses.
Interruption: It is a break in the performance that focuses on the task of administering medication initiated by source internal or external factors that can influence the nurses during medication administration.

Significance of the Study:
Medication administration errors remain an overwhelming reason for disability, death, physical and psychological harm. The deficiency of safe practice for medication administration by nurses can display significant threat to patient safety and quality of care. Medication safety and preventing medication errors continues on top of priorities for hospitals, making it one of the most costly in hospitals (Ching et al, 2014).

Unluckily, the medication administration process may be balanced through a myriad of interruptions in the course of the process. This study addresses the gap in nursing knowledge related to errors and interruptions and how to be stopped during medication administration. Thus, the present study aims at improving medication administration safety by application of intervention to raise awareness and practice of nurses so as to lower medication errors in medication administration in medical and surgical units at (MUH).

Aim of the Study:
The aim of the study was to assess the effectiveness of interventions to limit errors and interruptions during medication administration in medical and surgical unit at (MUH).
Research hypothesis:
  H1: There is significant different in knowledge related to errors and interruptions during medication administration before and after intervention.
  H2: There is significant different in frequency of errors and interruptions before and after intervention.
  H3: There is significant different in practice about safe medication administration before and after intervention.

II. Subjects and Methods

Design: A quasi-experimental one group pre and post design was used

Setting: This study has been carried out at Mansoura University Hospital in general medical units (n=2) and surgical units (n=2). This hospital is affiliated to teaching university hospital with total bed capacity is 1860 beds.

Subjects: The study has conducted among 48 nurses assigned to administer medication to 90 patients in a week working at MUH, with at least one year experience were included in the study and oriented to work condition to express their opinion about condition of work environment.

Tool of data collection:

Three tools have been employed for gathering the data:

First tool: Demographic data form:

This tool has been prepared by the researchers and was used to assess nurses' personal traits such as age, sex, marital status, education level, service unit, years of experience and types of work shifts.

Second tool: Structure Questionnaire:

This tool was prepared by the researchers upon literature review (Freeman, et al., 2012, and Feleke, Mulatu, and Yesmaw, 2015), to assess nurses' knowledge related to errors and interruptions nurses facing during medication administration. It consists of three parts:

Part one: safe medication administration to reduce errors:

This tool included the following: 1) causes of medication administration errors (physician communication, medication packing, transcription related, pharmacy related, nurse staffing related, patient related). 2) Types of errors (wrong route, wrong time, wrong patients, wrong drug, and wrong dose, medication administration after the orders discontinued and wrong documentation).

Part two: Interruption facing nurses during medication administration:

It included the following: Another nurse's needs assistance, phone calls, waiting for doctor / pharmacy, other patient needs attention and equipment not working / cannot be found.

Part three: Nurses suggestion to reduce error and interruption:

The part contained of 20 items, aimed to know the nurse view regarding reducing of errors and interruption during medication administration. Items included yes and no. The correct answer for each item was given a score of 1, and the incorrect given zero.

Third tool: Medication Administration Observation checklist:

This tool has been adopted from (Arnado, 2014, Redding and Robinson, 2009) with some modifications on behalf of the researchers. To make sure the process is safe to decrease errors, determine the frequency of errors and interruptions through using six safe practices. It includes a comparison between medication and medication administration record, labeling medication, checking two forms of patient identification, explaining medication to patient, administer of medication at right time and documenting medication correctly. Data collection ended when the nurse administered medications for their assigned patients. The scores of nurses' performance for the actual medication administration were (1) for done and zero for not done. Score for evaluating the interruptions during medication administration process have been one for each sort of interruption nurses encountered during administered of medication. Observation doses of administering medication about 225 doses

III. Methods of Data Collection

Method The study conducted through three phases' preparation, implementation, and evaluation phase.

Phase 1: Preparation phase:

- Consent to fulfill the study has been taken from the Mansoura Hospital director. This was achieved upon clear clarification of the goal and nature of the study in addition its expected outcomes. Ethical approval has been taken from all study subjects. After clarifying the objectives and procedures of the study. Additionally, they were noted that withdrawal can be done any time.

- In this phase the researchers prepare the tools of data collection and educational material (brochures, colored booklet and power point) after reviewing the related, scientific literatures.

- The educational program was designed and prepared by the researchers after reviewing the related literatures. A simple colored Arabic booklet was developed for nurses covering all items related to safe medication administration to control error and interruption. The Educational booklet includes definition of safe medication administration, medication errors ,medication administration error interruptions , causes and types of errors, types and sources of interruptions , Control of medication errors were based on implementing nursing standard work to control medication administration errors through using safe practice includes comparing medication with medication administration record, labeling medication, checking two forms of patient identification, explaining medication to patient, administration, and charting medication immediately. Also, control of the interruption during medication administration through using clerk triage of phone calls and pages during peak medication times, signs requesting nurses administer

medication to not be interrupted, brochure for patient family education about courses of interruption, effect of interruption on medication error and patient safety. In addition to, suggestion to control interruption. It was written in simple Arabic language containing colored pictures clarifying each part in all topics mentioned above for more understanding.

- Validity testing has been conducted to the tools by submitting the tools to experts in the field of nursing administration and medical surgical nursing. Necessary modifications were done.
- Reliability of tools were tested by Cronbach's Alpha (alpha= 0.882).
- A pilot study was conducted on five staff nurses who were selected randomly from Medical and surgical units at Main Mansoura University Hospital in order to ascertain clarity and feasibility of the research tools and to estimate the approximate time required for data collection. Accordingly the necessary modification was done, some questions were added and others were clarified or omitted. Subjects who shared in the pilot study were excluded from main study sample.
- Ethical considerations: Approval was obtained from the director of the Hospital. The aim and nature of the study explain for the nurses involved in medication administration program and agreed to participate. Oral informed consent was obtained from the nurses. The personality identity of the observed nurses was kept unknown. The nurse has right to withdrawal from study**.**

Phase 2: Implementation phase:

- The researcher introduced herself to nurses and informed about the aim of the study.
- Assessed the level of nursing knowledge concerning safe medication administration, causes, types of errors, causes of interruption and nursing suggestion to control error and interruption before starting the program. The Questionnaire Sheet (38 questions) distributed to the staff nurses by the researcher. Each nurse was interviewed individually to collect the baseline data using study tool. Tool filling took about 20-30 minutes.
- Assessed nurses' practice to medication administration on medical and surgical units by direct observations on the necessary steps to medication administration to ensure the process is safe to decrease errors and the frequency of errors and interruptions nurses faced during medication administration by using observation. The observation checklist took an average of 15-20 minutes each to complete. The observation was conducted during the day, evening, and night shifts in all 7 working days
- Conducting the program runs according to the nurses working hours schedule. Separating groups where each of which includes 10 nurses, excepting the last group to be of 8 nurses only.
- The program was conducted through 4 sessions; each group obtained the 4 sessions through 2 weeks, each session took about one hour.
- Control of medication errors were based on implementing nursing standard work to control medication administration errors through using safe practice includes comparing medication with medication administration record, labeling medication, checking two forms of patient identification, explaining medication to patient, administration, and charting medication immediately. Also instruct the nurses about causes of errors and interruptions, types of errors .In addition suggestion to control errors and interruptions as well as the head nurses decision to minimize phone calls during drug administration.
- Decrease the interruption during medication administration through using clerk triage of phone calls and pages during peak medication times, brochure for patient and family for education, and nursing education.
- Different teaching methods were used during the sessions including; simulation, role-play, and group discussion for mediation administration, interactive lectures. The teaching aids & media included flip charts, data show, handouts, picture, and brochure.
- Post-test immediately after implementation of the program to evaluate the change in the staff nurses knowledge regarding medication administration safety to control errors and interruptions by using knowledge questionnaire.
- Reassessed the nurses' practice of medication administration using observation checklist directly after intervention to estimate the improvement of their practice related to safe medication administration to reduce frequency of errors and interruptions after the intervention. This study consumed three months starting May 2016.

Statistical analysis:

Data have been sorted, coded, organized, categorized and then transferred into specific designed formats. Data have been analyzed using SPSS (Statistical Package for Social Sciences) version 19.The descriptive statistical (number percentage and standard deviations) have been employed to describe the study sample. A chi-square analysis has been employed to figure out the link between pre and post intervention. Interruptions frequencies have been calculated by type. The available graphs have been

constructed using Microsoft excel software where a sample size has been calculated using EPI inf. program version6.02, p <0 .05 has been looked at as having statistical significance.

IV. Results

Figure 1. shows the most of participants' age ranged from 25 to 35 years old. While (16.67) were more than 35 years old.

Table 1. reveals that the demographic characteristics of the study subjects. It noticed that mean age of the participants were (x = 28.5±6.5 SD years). The most (72.92) of sample were married. As regard to the educational qualification (93.75%) had diploma in nursing. While (27.1%) having technical institute degree in nursing. In relation to experience, about (58.3%) of participants had experience within 1-4 years. Most nurse have been working (58.33%) in medical wards and with morning shift (41.67%).

Table 2. reflects deficiency in nurses' knowledge regarding medication administration errors during the pre-program. The implementation of the program was associated with statistically significant improvements of nurses' knowledge regarding medication administration errors at the posttest respectively (p <0 .05).

Table 3. reveals that number and percent of nurses' suggestions for controlling errors and interruptions during medication administration. In this table (95.83%) of nurses proposed that supervision of new staff may reduce such errors. Additionally, 93.75% of nurses stated that the increasing number of nurses and modernizing equipment can also eliminate the frequency of medication errors. Furthermore, (89.85%) of nurses mentioned that to lessen medication errors can be by using brochure for patient and family education. Also, to control interruptions (85.41) nurses point out the need for education and training.

Figure 2. This figure displays that highly statistically significant improve safe practice regarding compared medication with medication administration record, labeling medication, checking two forms of patient identification, explaining medication to patient, administer of medication at right time and documenting medication correctly post intervention than before intervention.

Table 4. shows that that highly statistically significant decrease frequency of errors post intervention than before intervention.

Table 5. reveals that highly statistically significant decrease frequency of interruptions post intervention than before implementation of intervention (p <0 .05).

V. Discussion

Patients' safety and the reduction of medication errors represent a first priority for health care organizations, health care teams, and patients. Medication errors not only impact the outcomes financially but may result in adverse patients' outcomes (Freeman et al, 2012). Medication administration errors (MAE) count for 34% of preventable adverse drug events and are more likely to result in dangerous and death compared to other medication errors. Nurses are interrupted hundreds of times per day. These interruptions can have a negative influence on patients' safety in the course of medication administration (Raban et al, 2013). Hence, the aim of the study was to assess the effectiveness of interventions to limit errors and interruptions during medication administration in medical and surgical unit at (MUH).

Regarding to the sex, this study reported that the majority of the nurses were females. This result may be due to the old belief that nursing is a special profession to female so the majority of nurses in Egypt are females, opposite to COX, (2015) who stated that, nursing is the quintessential female profession. Longest time women could only be either nurses or school teachers. Today in the US, women in nursing are ten folds of men.

In relation to the years of experience about more than half (58.3%) of the participants were experienced within 1-4 years. This may be due to the reason that the majority of nurses providing direct care for the patients in nursing field in current study are young. This result was parallel to Flinkman et al, (2013) who found that, younger nurses had less intention to quit the profession than older nurses.

In relation to type of working shift nearly half the studied nurses (47.91%) were working in the morning shift. This may be due to that nursing is one of the occupations in which a high proportion of its members are involved in shift work with nurses working of day, afternoon night shifts or rotating shift patterns. Similarly to Zencirci and Arslan (2011) who stated that, most of nurses, 65.2% (n = 315) worked on shift based pattern (morning-evening-night shift), 5% (n = 24) constantly worked night shifts (evening or night shift), and 29.8% (n = 144) constantly worked morning shifts.

The present study showed that there was a highly significant difference between pre and post nurses' knowledge related to medication administration errors and interruption. This lack of knowledge may be due to the large number of nurses in the present study had diploma in nursing education, and not attending training

courses, refresher conferences, an orientation program related to safe medication administration to control errors and interruption and lack of handouts to be used as a nursing guide. This result is supported by Ebrahem and Elnagar (2016) who demonstrated that the majority of the nurses have limited awareness of medication errors and safety measures to prevent errors before the nursing intervention. So, (Weant et al, 2014) concluded that the major reason for medication errors on nurses was poor knowledge about medication. Having an insufficient knowledge base related to medication use has been ranked as a common root cause of medication errors. Also Shamsuddin and Shafie (2012) mentioned that the level of knowledge on the administration of medications was average as the nurses accomplished less than 50% of correct responses in half the number of statements.

In the present study there are many causes of medication errors .These causes includes abbreviations are used instead of writing the orders out completely, the packaging of many medications is similar, Medication orders are not transcribed to the Kardex correctly, pharmacy does not prepare the med correctly, when scheduled medications are delayed, nurses don't communicate the time when next dose is due, and plenty of the patient in the unit. This finding was in congruent with, Johari et al, (2013) who showed that the top three causes of errors were heavy workload, complicated orders and new staff. In addition to Preston, (2004) found that the major reason for medication errors on nurses was low knowledge about medication. Threats to safe medication administration include failure to communicate adequately among health care providers, unattainable or not up to date drug information, disturbing directions, poor technique, inadequate patients' information, lack of drug knowledge, incomplete patient medication history, lack of detailed safety checks, lack of evidence-based protocols, and nurse are not prepared for their roles Hughes (2008).

There is a significant improvement at the post- educational program as most nurses had high knowledge level regarding causes and types of medication administration errors and interruptions. This illuminates that nurses were capable of learning and get correct information about causes, types of errors and interruptions. This result was in agreement with Ebrahen, and Elnager (2016) who reported that there was a highly statistically significant difference between pre and posttest toward all tested items of nurses' knowledge about safety methods of medication administration.

This study shows nurse's suggestion to control errors and interruptions were supervisions of new staff, increase number of nurses, give brochure for patient and family for education, education and training for nurses, and improve equipment. This study was in line with (Camiré, Moyen and Stefox, 2009) who reported that improved medication safety can be achieved by optimizing the safety of the medication process, eliminating situational risk factors. Furthermore, (Relihan et al., 2010) discovered that patients' education about the importance of medication administration and the meaning of the nurse's red vest important in reducing medication errors and interruption (Relihan et al., 2010).In addition (Mohamed and Gabar, 2010) suggested orientation and training new nurses, maintain adequate number of nurses on each shift, as well as conducting close supervision during medication administration.

This study displays that, two thirds of the nurses had low level of practice to control errors before implementing the program. This finding may be related to nursing administrators who do not do the role in the management of medication errors; The head nurses do not have strong influence in clinical nurses' conduct to keep positive attitude towards the safe medication administration and reporting of medication errors, there is no cooperation between the head nurses and nurses for creating a safe environment , there is no head nurses decision to minimize phone calls during drug administration time and inadequate supervision.

This result was in contrast with (Hayes et al, 2015) who demonstrated that the important chance to promote skills better enabling nurses mission accomplishment of medication administration confidently and safely. Medication errors do occur and these can be minimized by a change in practice and behavior of those involved in medication use process. Additionally, Ching et al, (2013) spelled out that the lean interventions were aimed at reducing the medication administration errors through improving six safe practices, comparing medication with medication administration record, labeling medication, checking two forms of patients' identification, explaining medication to patient, charting medication immediately, and stopping any kind of distractions/interruptions to the process.

The study showed that there was a significant improvement in nurses' practice after intervention in comparison with their practice level before interventions. This may be due to the effect of demonstrating the safe medication administration in the educational program, using data show and implementing of safety process on the patient for study groups. This result was on bar with Schilling, Holmes and Robinson (2009) who found that a planned education program was highly effective enhancing the nurses' practice. In addition Schneider,

Pedersen , Montanya (2006) found that medication safety interactive CD-ROM program training increases nurses use of safe administration practices.

The study indicated that there was highly statistically significant decrease frequency of errors during medication administration post intervention in comparison with before interventions. This study was in contrast with Miglani (2015) who assured that medication errors may be reduced after intervention. In addition, Feleke, et al, (2015) reported that medication errors at the administration phase were highly prevalent. Each medication and each patient had at least one type of medication administration error. Documentation error was the most dominant type of error followed by technique and time error.

The study showed that there was highly statistically significant decrease the frequency of interruptions during nurses' practice post intervention in comparison with before intervention. This result was in agreement with Redding and Robinson, (2009) who found that the intervention decrease in frequency of interruptions during medication administration. Also, Rivera-Rodriguez and Karsh,(2010) and Colligan and Bass,(2012) stated that staff continuous training is mandatory to qualify both those interrupted and those doing the interrupting, controlling interruptions, and emphasizing the priorities and frequencies with a greater risk of work process damaging and patients' safety. In addition Redding and Robinson (2009) stated that any improvements to decrease the frequency of interruptions nurses encounter will improve healthcare quality and assist in assuring patients' safety.

VI. Conclusion and Recommendations

Upon the study outcomes, it is possible to state that improving nursing staff's knowledge and practice about safe medication administration evidence by decreasing frequency of the errors and interruptions nurses facing during medication administration after intervention.

Upon such outcomes, the following are recommended:

- Establishing an electronic medication system to every unit for delivering basic knowledge on medications.
- Enhancing cooperation among doctors, nurses and pharmacists is required to found policies, strategies and systems to control the occurrence of medication errors.
- Periodical assessment medication errors should be done.
- A systematic process is essential to control hospitals vulnerability to error, through monitoring, analyzing cause of errors and interruptions and apply preventive strategies to reduce them.
- Ongoing education should be done for nurses on medication safety.
- Embody computerized physician order entry into strategic planning.
- Using bar coding technology is needed.
- The need for future studies handling control of errors focus on nurse workloads and medication errors reporting is urgent.

Conflicting Interest:

The author declared that there was no conflict of interest.

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Results

Figure 1 . Age distribution of the study
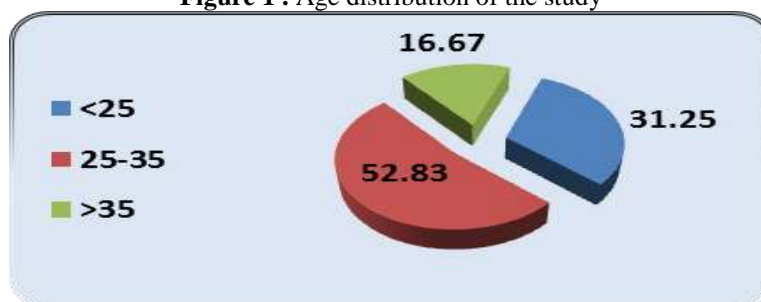
Table 1. Demographic characteristics of study subjects (n=48)

Items	Frequency	Percentage %
- Mean ± SD	28.5±6.5	
Marital status :		
- Married	35	72.92
- Not married	13	27.1
Educational qualification:		
- Diploma nurse	33	93.75
- Technical institute	13	27.1
- Bachelor of nurse	2	4.16
Working experience(years):		
- <1 years	7	14.58
- 1-4 years	28	58.3
- > 5 years	13	27.1
Type of working shift :		
- Morning	20	41.67
- Afternoon	18	37.5
- Night	10	20.83
Service unit		
- Medical	28	58.33
- Surgical	20	41.67

Table 2. Percentage distributions of nurses' knowledge related to medication administration errors and interruptions pre and post the nursing intervention (n = 48)

Knowledge Items	Time		Pre-post	
	Pre N (%)	Post N (%)	χ^2	P -Value
Definition of medication error				
Causes of medication administration errors				
1-Physician communication				
- The physicians' not always in the evening and night shifts can increase error	20(41.67)	32(66.67)	19.36	0.000
- The Physicians' medication orders are not clear	28(58.3)	39(81.25)	18.75	0.000
- Physicians change orders frequently	18(37.5)	31(64.58)	4.083	0.043
- Abbreviations are used instead of writing the orders out completely.	30(62.5)	42(87.5)	19.15	0.000
- Verbal orders are used instead of written orders	23(47.92)	45(93.75)	16.75	0.000
2-Medication packaging				
- The names of many medications are similar.	19(39.58)	32(66.67)	5.33	0.021
- Different medications look alike.	18(37.5)	38(79.16)	16.32	0.000
- The packaging of many medications is similar.	23(47.92)	40(83.33)	21.82	0.000
3-Transcription-related				
- Medication orders are not transcribed to the Kardex correctly.	20(41.67)	37(77.08)	14.083	0.000
- Errors are made in the Medication Kardex .	18(37.5)	40(83.33)	18.75	0.000

4-Pharmacy – related				
- Pharmacy delivers incorrect doses to the unit.	17(35.42)	36(75)	10.0835	0.001
- Pharmacy does not prepare the med correctly.	18(37.5)	31(64.58)	4.08	0.043
- Pharmacy does not label the med correctly.	16(33.3)	35(72.17)	10.08	0.0001
5-Nurse staffing				
- Nurse on the unit have limited knowledge about medications.	23(47.92)	41(85.42)	24.18	0.000
- Nurses don't follow patients five right.	20(41.67)	44(91.67)	21.32	0.000
- When scheduled medications are delayed, nurses don't communicated the time when next dose is due.	21(43.75)	35(72.92)	10.83	0.001
- Nurses don't adhere to the approved medication administration procedure.	18(37.5)	28(58.33)	1.33	0.024
- Nurse is unaware of a known allergy.	20(41.67)	42(87.1)	22.01	0.000
- Shit change as well as workload.	16(33.3)	39(81.25)	18.75	0.000
- Lack of supervision from head nursing.	19(39.58)	40(83.33)	21.33	0.000
6-Patient – related				
- Patients are of the ward for other care.	15(31.25)	35(72.92)	10.08	0.001
- Many patients are on the same in similar medication.	18(37.5)	30(62.5)	3.01	0.013
- Plenty of the patients in the unit.	26(54.17)	40(83.33)	21.33	0.000
Type of errors:				
- Wrong route (Medications have been administered via a route different than the intended route).	17(35.42)	33(68.75)	6.75	0009
- Wrong time (not follow standardized administration times)	18(37.5)	30(62.5)	3.13	0.013
- Wrong patient	17(35.42)	39(81.25)	3.49	0.003
- Wrong drug	19(39.58)	30(62.5)	6.75	0.009
- Wrong dose (Doses administered as different form than ordered)	16(33.3)	37(77.08)	16.33	0.000
- Medication administration after the orders discontinued	22(45.83)	34(70.83)	12.15	0.001
- Omission Errors (Failure to administer an ordered dose)	17(35.42)	30(62.5)	3.18	0.023
- Wrong documentation (Nurses did not document correctly immediately after administration of the drug).	23(47.92)	38(79.17)	16.33	0.000
Interruption:				
- Definition of interruption.	15(31.25)	42(87.5)	27.10	0.000
Causes of interruption				
- Another nurse needs assistance.	17(35.42)	39(81.25)	18.75	0.000
- Phone calls.	20(41.67)	40(83.33)	21.33	0.000
- Other patient needs attention.	19(39.58)	35(72.92)	10.083	0.001
- Family member questions.	23(47.91)	46(95.83)	20.33	0.000
- Equipment not working / not found	18(37.5)	38 (79.16)	16.42	0.000

(*) Statistically significant at $p < .05$

Table 3. Number and percent of nurses' suggestion for control errors and interruptions during medication administration (n=48)

Items	N	%
1. Hand washing before prepared medication	30	62.5
2. Dispensation in a package ready to be administered and individualized supply system of drugs.	32	66.66
3. Procedures, posters and brochures related to administration on the wards.	38	79.16
4. Using personal protective equipment	34	70.83
5. Follow the six right of medication administration	31	64.85
6. Perform a double check to verify the correct correspondence between prescription, preparation , and administration	36	75
7. The use of a single therapy chart prevents errors during the management process of drugs	33	68.75
8. Involve patients in their own care – give them a personalized drug card and get them to verify each drug	36	75
9. Developed hospital procedure effective for patient safety	31	64.58
10. Manger should monitor errors	34	70.83
11. Education and training for nurses	40	85.41
12. Report with harm occur or not	35	72.91
13. Supervision for new staff	46	95.83
14. Feedback system /increase number of nurses	45	93.75
15. Additional and Improved equipment	45	93.75
16. Provide support for nurse-led patient education and teach-back.	36	75
17. Better or more direct communication with Pharmacy	35	72.91
18. Wearing medication vest or sash during medication administration to alert others to not interrupt	32	66.67
19. Using clerk triage of phone calls and pages during peak medication times,	40	83.33
20. Brochure for patient and family education to prevent interruption	43	89.85

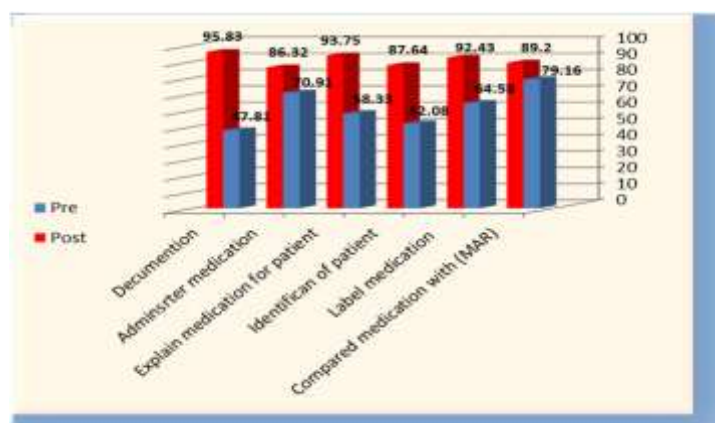**Figure 2.** Distribution of nurses' safe practice pre and post intervention (N = 48)

Table 4 . Frequency observed of medication administration errors

Items	Time		Pre-post	
	Pre	**Post**	**χ2**	**P- value**
- Omission	10(3.91)	6(2.34)	16.34	0.048
- Wrong time	32(12.5)	25 (9.76)	8.33	0.021
- Wrong preparation	12(4.68)	4(1.56)	12.31	0.001
- Wrong technique	44(17.18)	13(5.07)	10.06	0.001
- Total medication administration errors	89(39.55	48(21.33)	6.85	0.000

*Number of errors pre intervention (89) and number of errors post intervention (48) from doses 225

Table 5. Frequency of observed interruption

Items	Time		Pre-post	
	Pre	**Post**	**χ2**	**P- value**
- Another nurse needs assistance.	25(19.37)	14(16.27)	8.33	0.004
- Phone call	12(9.3)	8(9.30)	16.33	0.048
- Family question	38(29.45)	31(36.04)	11.83	0.043
- Patient need assistance	45(34.88)	30(34.88)	3.81	0.001
- Equipment not working / not found	9(31.08)	3(3.48)	18.75	.045
- Total interruption	129	86	5.980	0.000

*Total number of interruptions pre intervention (129) and total number of post intervention (86)