Root Cause Analysis of Medication Administration Error by Nursing Staff at a Number of Medical Institutes in Riyadh

Tahani Alrahbeni[1*] and Muteeb Eid Alenezi[1]

[1]*Department of pharmacy, Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Original Research Article	

ABSTRACT

Background: Medication errors genuinely influence patient safety, staying cost in hospital and integrity of nursing job, because the nurses play a specific part in managing the medication for the patients. The present study was done with the aim to investigate factors associated with nurses' medication errors in a number of medical institutes (Ministry of Health) and the role of clinical pharmacist in these errors.
Methodology: The present study was a cross-sectional study based on standardized questionnaire which was designed and distributed to the target nurses in a number of medical institutes (Ministry of Health). The target number was (171) which was achieved depending on the calculation of sample size after the questionnaires was gathered; data was subjected to descriptive and inferential statistics.
Results: The highest mean score of error was obtained in the factor related to medication packaging reason, which includes that different medications look alike, and the names of at least 60 medications were similar by 82.7%. The second group of reasons was system associated,

---

*Corresponding author: E-mail: ph.tahani@riyadh.edu.sa

which included: abbreviations were used instead of writing the orders out completely, overall 60.5% of the times nurses were pulled between teams. Third reason, overall 45.3% of the times the errors were associated with pharmacy when they did not prepare\label the medication correctly, and clinical pharmacist did not give education workshops to the nurses. Documentation issues were the fourth reason, 39.5% of the times nurses were interrupted while administering medication to perform other duties and nurses on the same unit did not adhere to the approved medication administration procedure.

Conclusion: The data of the current study suggested the ranking of five reasons or root causes of why medication errors happened. These are medication package, system related, pharmacy related, documentation-transcription reason and physician-nurse related respectively. Furthermore, clinical pharmacists must thrive to improve the nurses' knowledge of how these factors will lead to critical errors and help them discover strategies to prevent these errors from happening.

1. INTRODUCTION

These days, more than twenty thousand medications are consumed worldwide; the wrong utilization can cause extreme dangers and risks to the patients. The right technique for medication administration, which is important duty of nurses, appears to be crucial for safety of the patients. These includes, giving correct medication to the correct patient at the perfect time and at an appropriate dose through the execution with the correct technique, and the right recording concerning how the medications have to to be administered to the patients—is very critical. Nurses have an exceptionally critical obligation in keeping medicine blunders from occurring since they assume the primary part in medication administration [1].

Nurses have a role in the last but crucial steps in the medication administration procedure. The time spent by nurses on each shift to manage topics related with drugs comes up to 40% of their working time. Therefore, it is more probable for forefront healthcare professional of the drug procedure (nurses) to be rebuked for when medication errors happened. In fact, nurses are at the "sharp end" of this procedure [2]. Drug mistakes have a lot of undesired results, including mortality, prolonged hospitalization period, lose of quality of care, and increased treatment costs. It also hurts the trust of the patients and their families in the healthcare system. Moreover, drug mistakes initiates stress and clashes among nurses, accordingly diminishing the execution of healthcare forces [3].

Patient safety, as one of the key segments of healthcare quality is defined as "the prevention of harm to patients during medical care "Drug mistakes are among the most dangerous errors which affect patient safety and are known as one of the most common medical errors. Guaranteeing patient safety obscured medical errors are components of health services. For therapeutic establishments to give proper health administrations, it is important to satisfy these key prerequisites of patient safety. Medication administration error stands out amongst the most widely recognized mistakes in the medication errors procedure and occurs when an error happens between the medications got by the patient and the medication expected by the prescriber. For example, a study from United Kingdom's national patient agency revealed that of different types of medication errors which occurs, nearly 50% can be attributed to administration mistake contrasted with 18 % for dispensing, and 16% for prescribing [4].

Drug administration is considered as fundamental capacity for nurses, and that nurses competency and following rules of medication administration is a guarantee for patients' safety and quality of nursing care. Medication administration is center task for nurses at every day [5].

Patient safety is a worldwide concern and is a test confronting health care system today. Medication administration is regularly done under disordered and upsetting conditions and is most likely the heights hazard activity a nurse performs. Accordingly, nurses should be mindful of their legal and expert responsibility with respect to medication management. Medication administration requires broad information and expertise to perform correctly [6].

Reporting errors is essential to prevent them. It decreases the adverse effect of errors and adequately maintains a strategic distance from future errors that can cause patient harm.

additionally, reporting will decrease the personal suffering and the costs (EAE 2015). To have the capacity to make error free or low and to have enhanced safety in medicinal establishments, it is important to inspect the factors related with the nurses themselves and their work environment [7].

Correct use of medication is vital part in producing the needed and expected effect from medication. The clinical pharmacist is an important member of the health team. He ensures the correct drug information in related to nurses. This information includes the medication names, correct administration and its related data. The clinical pharmacist plays an important role in decreasing errors related to medical and subsequences positively effecting the patients care [8].

The role of clinical pharmacists of taking care of hospitalized patients has evolved over time, with expanded emphasis on collaborative care and patient interaction. Clinical pharmacists have the relevant background in therapeutics and give complete medication management to patients and provider including the nurses.

Studies demonstrate that the incorporation of the clinical pharmacists in the intensive care unit decrease mortality and adverse events enhances clinical outcomes and decrease hospital cost.

This study aims to investigate the factors associated with nurses' medication errors in a number of medical institutes (Ministry of Health) and the role of clinical pharmacist around these errors. Outcome of study will give an idea about the factors which affect medication errors among nurse staff and such factors will guide practitioners to prevent such errors in the future, and will help improve the patient safety, too.

2. METHODOLOGY

2.1 Study Design, Site of the Study and Instruments Used

Prospective, Observational – cross sectional study was carried out in 2017 during the period from July to December, at a number of medical institutes in KSA (six months). The tool of study was a well-structured questionnaire consisting of 14 questions that were distributed to the health care professional Nurses. The questionnaires was adapted and modified from Aboshaiqah 2014 et al. Additionally their questions were

previously developed by (Wakefield et al 1996), The study was conducted at the Ministry of Health hospitals at a number of medical institutes, Kingdom of Saudi Arabia. The targeted health care professionals were nurses. Fourteen questions were divided as follows, packaging factors, system, pharmacy, documentation and nurse-physician factors.

The Inclusion criteria for the study participants were Health care professionals target were (Nurses) who were working in the Ministry of Health during study time either male or female and also dealing with the patient directly in the wards of the hospital. Exclusion criteria was any medical experts other than nurses, nurses not working in ministry of health and any nurse who had not to be dealing with the patient directly in the wards of the hospital.

2.2 Data Collection and Sample Size

According to calculation of sample size by (www.raosoft.com) and the confidence level was 90% our target nurses were N=171 nurses from a total 457 nurses.

Questionnaires were distributed to participants, and all the 171 respondents were enrolled in the study.

2.3 Data Analysis

Data analyses had been performed using Statistical Package for the Social Sciences (SPSS/PC+, version 24) where P value less than 0.05 was considered significant.

3. RESULTS AND DISCUSSION

3.1 Demographic Characteristics

One hundred seventy one nurses responded to the survey. Of the 171 nurses, 45.6% (n=78) were Saudis and 54.4% (n=93) were non-Saudis (Fig. 1, Table 1). About 52% (n=89) of nurses had diploma and 48% (n=82) had bachelor degree or higher (Fig. 2, Table 1). The mean (±SD) total years of experience was 7.2±4.1 years (SE=0.31) and ranging from 1-20 years. The mean (±SD) years of experience inside KSA was 6.3±4.1 years (SE=0.32,range=1-16 years) and outside KSA was 3.2±1.8 years (SE=0.25,range=1-9 years) (Fig. 3, Table 2). The mean (±SD) years of experience of non-Saudi nurses was 7.8 (±4.1) years and Saudi nurses

was 6.5 (±3.9) years (p<0.05). Furthermore, mean (±SD) years of experience of diploma holders was 8.2 (±4.2) years and bachelor degree holders was 6.2 (±3.7) years (p<0.05).
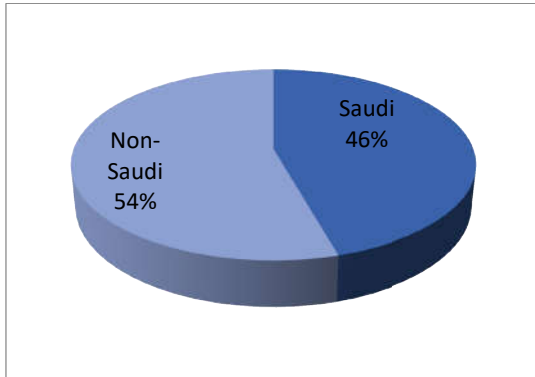

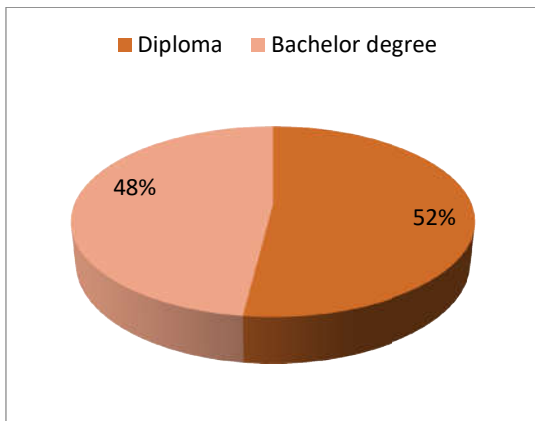**Fig. 1. Distribution of participants by nationality (n=171)**

Fig. 2. Distribution of participants by educational level (n=171)
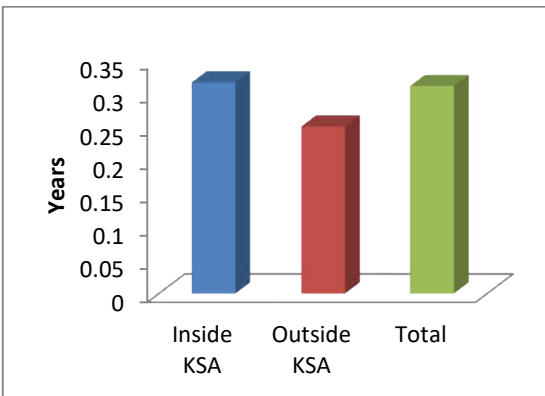

Fig. 3. Mean (±SD) years of experience

3.2 Root Cause Analysis of Medication Errors

Regarding **Root Cause Analysis of** medication errors, the analysis showed that the most commonly reported **Root Cause Analysis of** medication error is:" Different medications look alike" (86%, n=147), followed by "Nurses are pulled between teams and from other units" (79.5%, n=136) and "The names of many medications are similar" (79.4%, n=129), while the lowest reported factors are "Nurses on this unit do not adhere to the approved medication administration procedure" (23.4%, n=40), followed by "Equipment malfunctions or is not set correctly" (33.3, n=57), and "Physicians change orders frequently" (33.9, n=58) as seen in (Table 3)

3.3 Root Cause Analysis of Medication Errors by Nationality

Two-way cross-tabulation showed that Saudi nurses are more likely to agree that the most association factors are "Nurses on this unit have limited knowledge about medications" and "Nurses are interrupted while administering medications to perform other duties". Fisher's exact test showed that this association was statistically significant (p<0.05) (Table 4). Although non-Saudi nurses are more likely to agree on the majority of factors, no statistically significant association was found between them and nationality (p>0.05).

The most reported factors associated with medication error reported by Saudis and non-Saudis are "Different medications look alike" (85.9% and 86% respectively), followed by "Nurses are pulled between teams and from other units" (78.2% and 80.6% respectively) and "The names of many medications are similar" (73.1% and 77.4% respectively). The lowest reported factors by Saudis are "Physicians change orders frequently" (25.6%, n=20), followed by "Equipment malfunctions or is not set correctly" (28.2%, n=22) and "Nurses on this unit do not adhere to the approved medication administration procedure" (28.2%, n=22).

On the other hand, the lowest reported factor by non-Saudis are "Nurses on this unit do not adhere to the approved medication administration procedure" (19.4%, n=18), followed by "Nurses on this unit have limited knowledge about medications" (26.9%, n=25) and "Nurse is unaware of a known allergy" (29%, n=27).

Table 1. Distribution of participants by nationality and educational level

		Frequency (n)	Percent (%)
Nationality	*Saudi*	78	45.6
	Non-Saudi	93	54.4
Educational level	*Diploma*	89	52.0
	Bachelor degree	82	48.0

Table 2. Mean (±SD) years of experience

	Mean (±SD)	SE	Minimum	Maximum
Inside KSA	6.3±4.1	0.32	1	16
Outside KSA	3.2±1.8	0.25	1	9
Total	7.2 (±4.1)	0.31	1	20

Table 3. Root Cause Analysis of associated with Medication Errors (n=171)

Items	Yes n (%)	No n (%)
Different medications look alike	147 (86.0)	24 (14.0)
Nurses are pulled between teams and from other units	136 (79.5)	35 (20.5)
The names of many medications are similar	129 (79.4)	42 (24.6)
Physicians' medication orders are not legible\clear	95 (55.6)	76 (44.4)
Nurses are interrupted while administering medications to perform other duties	95 (55.6)	76 (44.4)
Pharmacists not give education workshop	92 (53.8)	79 (46.2)
Abbreviations are used instead of writing the orders out completely	71 (41.5)	100 (58.5)
Nurses on this unit have limited knowledge about medications	68 (39.8)	103 (60.2)
Pharmacy does not prepare\ label the medication correctly	63 (36.8)	108 (63.2)
Poor communication between nurses and physicians	61 (35.7)	110 (64.3)
Nurse is unaware of a known allergy	60 (35.1)	111 (64.9)
Physicians change orders frequently	58 (33.9)	113 (66.1)
Equipment malfunctions or is not set correctly	57 (33.3)	114 (66.7)
Nurses on this unit do not adhere to the approved medication administration procedure	40 (23.4)	131 (76.6)

3.4 Root Cause Analysis of Medication Errors by Educational Level

Two-way cross-tabulation showed that bachelor degree holders are more likely to agree on the majority of the contributing factors. However, Fisher's exact test showed no statistically significant association between any of the factors and educational level (p>0.05) (Table 5).

The most reported factors associated with medication error reported by diploma and bachelor degree holders are "Different medications look alike" (91% and 80.5% respectively), followed by "Nurses are pulled between teams and from other units" (78.7%, and 80.5% respectively) and "The names of many medications are similar" (75.3% and 75.6% respectively). The lowest reported factors by diploma holders are "Nurses on this unit do not

adhere to the approved medication administration procedure" (20.2), followed by "Equipment malfunctions or is not set correctly" (29.2) and "Physicians change orders frequently" (29.2).

On the other hand, the lowest reported factor by bachelor holder are "Nurses on this unit do not adhere to the approved medication administration procedure" (26.8%), followed by "Nurse is unaware of a known allergy" (34.1%) and "Nurses on this unit have limited knowledge about medications" (36.6%).

3.5 Perception of Participants for Why Medication Errors Occur

Fig. 4 and Table 6 represent perception of participants for why medication errors occur. Accordingly the ranking of the five average

values of causes stated that the medication package reason (82.7%) was perceived as the most important factor for reasons of medication error, followed by the system factors (60.5%), pharmacy factors (45.3%), and documentation-transcription factors (39.5%). Physician-Nurse factors (38.9%) was perceived as the least reason of medication error.

4. DISCUSSION

In this study, the outcomes of factors analyzed to five root causes of why medication errors happen that were recognized in the survey. These root causes were classified as medication packaging reasons, system related, pharmacy related, documentation-transcription reasons and physician-nurse reasons.

Medication packaging associated with two reasons, which are different medication look alike, and the names of many medications are similar. System associated with two reasons: abbreviations are used instead of writing orders completely and nurses are pulled between teams and from other duties. The third group is pharmacy, which includes: pharmacy dose not prepare\label the medication correctly and pharmacists do not give education workshop [9]. The documentation group comes with: nurses are interrupted while administering medication to perform other duties and nurses on this unit do not adhere to the approved medication administration procedure. The last group was physician\nurse which includes five reason: physician order not clear\legible, physician change order frequently, nurses on this unit have limited knowledge about medication, equipment malfunction or it is not set correctly, nurse is unaware of a known allergy and poor communication between physician and nurses.

In the present study, the first group of reasons why medication errors may happen was associated medication package reason, which further includes: different medication look alike and the names of many medication were similar. However, it was difficult to recognize medication when it has been removed from its original packaging and it is very simple to confuse it with other medication, thus, good label design will ensure safety due to avoiding the confusion with other medications[8].

The second group of reasons why medication errors happen was associated with the system and includes: abbreviations were used instead of writing the orders out completely and nurses were pulled between team and from other duties. This result was similar to what was reported by in contrast [9] reported that the second factor is the physician\nurse communication.

The present study showed that the pharmacy role was the third affecting group which includes: pharmacy did not prepare\label the medication correctly and pharmacist did not give education workshop and ideally the pharmacists should collaborate with the prescriber in developing and monitoring the therapeutic plan to produce defined therapeutic outcomes for the patients[5] reported in his study similar result and outcomes to the present one, in exception, the authors reported it as the major contributor, not the third as in this study.

The present study illustrates the participants' perceived Documentation issue was the fourth affecting reason of medication errors and these include: nurses were interrupted while administering medication to perform other duties and nurses on this unit did not adhere to the approved medication administration procedure[1]. These finding may be due to nurses missed what is written on documents and the nurses sometimes have difficult time to know some words especially if the team from different region and work experience also had an impact[10] reported a similar line of results as in this study, in exception, the author reported it as the major contributor, not the fourth as in this study.

Outcomes of this study indicate that the physician-nurse issue classified as the fifth and last group of why medication errors happened which includes: physician medication order were not legible\clear, physician change order frequently, nurses on this unit have limited knowledge about medication, equipment malfunction or it was not set correctly. Nurses were unaware of a known allergy and poor communication between nurses and physician. This finding was consistent with Dumo who reported that poor nurse\physician relationship may lead to medication errors, because the physician did not respect or care to listen to nursing perspective on patient care that lead to misunderstanding and conflict between physician and nurses [8-10].

Table 4. Root Cause Analysis of associated with medication errors by nationality (n=171)

Items	Nationality				p value
	Saudi		Non-Saudi		
	Yes n (%)	No n (%)	Yes n (%)	No n (%)	
The names of many medications are similar	57 (73.1)	21 (26.9)	72 (77.4)	21 (22.6)	>0.05
Different medications look alike	67 (85.9)	11 (14.1)	80 (86.0)	13 (14.0)	>0.05
Physicians' medication orders are not legible\clear	37 (47.4)	41 (52.6)	58 (62.4)	35 (37.6)	>0.05
Physicians change orders frequently	20 (25.6)	58 (74.4)	38 (40.9)	55 (59.1)	>0.05
Abbreviations are used instead of writing the orders out completely	29 (37.2)	49 (62.8)	42 (45.2)	51 (54.8)	>0.05
Pharmacy does not prepare\ label the medication correctly	26 (33.3)	52 (66.7)	37 (39.8)	56 (60.2)	>0.05
Nurses on this unit have limited knowledge about medications	43 (55.1)	35 (44.9)	25 (26.9)	68 (73.1)	<0.05*
Nurses are pulled between teams and from other units	61 (78.2)	17 (21.8)	75 (80.6)	18 (19.4)	>0.05
Nurses are interrupted while administering medications to perform other duties	51 (65.4)	27 (34.6)	44 (47.3)	49 (52.7)	<0.05*
Equipment malfunctions or is not set correctly	22 (28.2)	56 (71.8)	35 (37.6)	58 (62.4)	>0.05
Nurse is unaware of a known allergy	33 (42.3)	45 (57.7)	27 (29.0)	66 (71.0)	>0.05
Pharmacists not give education workshop	41 (52.6)	37 (47.4)	51 (54.8)	42 (45.2)	>0.05
Poor communication between nurses and physicians	29 (37.2)	49 (62.8)	32 (34.4)	61 (65.6)	>0.05
Nurses on this unit do not adhere to the approved medication administration procedure	22 (28.2)	56 (71.8)	18 (19.4)	75 (80.6)	>0.05

* indicates statistical significance
(0.05) was considered significance (*)

Table 5.Root Cause Analysis of medication errors by educational level (n=171)
(0.05) was considered significance (*)

| Items	Educational level				p value
	Diploma		Bachelor degree		
	Yes n (%)	No n (%)	Yes n (%)	No n (%)	
The names of many medications are similar	67 (75.3)	22 (24.7)	62 (75.6)	20 (24.4)	>0.05
Different medications look alike	81 (91.0)	8 (9.0)	66 (80.5)	16 (19.5)	>0.05
Physicians' medication orders are not legible\clear	45 (50.6)	44 (49.4)	50 (61.0)	32 (39.0)	>0.05
Physicians change orders frequently	26 (29.2)	63 (70.8)	32 (39.0)	50 (61.0)	>0.05
Abbreviations are used instead of writing the orders out completely	34 (38.2)	55 (61.8)	37 (45.1)	45 (54.9)	>0.05
Pharmacy does not prepare\ label the medication correctly	29 (32.6)	60 (67.4)	34 (41.5)	48 (58.5)	>0.05
Nurses on this unit have limited knowledge about medications	38 (42.7)	51 (57.3)	30 (36.6)	52 (63.4)	>0.05
Nurses are pulled between teams and from other units	70 (78.7)	19 (21.3)	66 (80.5)	16 (19.5)	>0.05
Nurses are interrupted while administering medications to perform other duties	45 (50.6)	44 (49.4)	50 (61.0)	32 (39.0)	>0.05
Equipment malfunctions or is not set correctly	26 (29.2)	63 (70.8)	31 (37.8)	51 (62.2)	>0.05
Nurse is unaware of a known allergy	32 (36.0)	57 (64.0)	28 (34.1)	54 (65.9)	>0.05
Pharmacists not give education workshop	42 (47.2)	47 (52.8)	50 (61.0)	32 (39.0)	>0.05
Poor communication between nurses and physicians	29 (32.6)	60 (67.4)	32 (39.0)	50 (61.0)	>0.05
Nurses on this unit do not adhere to the approved medication administration procedure	18 (20.2)	71 (79.8)	22 (26.8)	60 (73.2)	>0.05
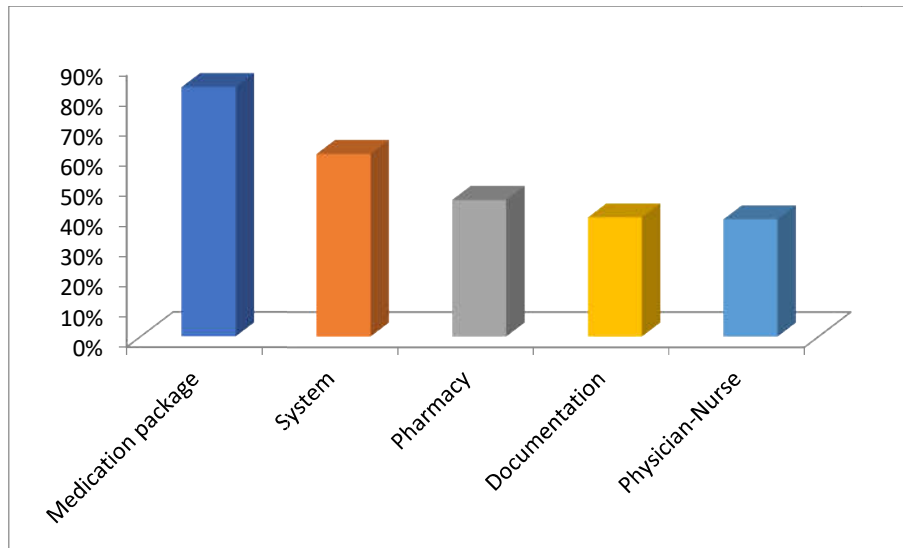
Fig. 4. Perception of participants for why medication errors occur

Table 6. Perception of participants for why medication errors occur

Reasons	Percent
Medication package	82.7
System	60.5
Pharmacy	45.3
Documentation	39.5
Physician-Nurse	38.9

The clinical pharmacist plays an important role in reducing medication errors and adverse drug reaction. The rounds taken by the clinical pharmacist with the team give a good outcome against medication errors by intervention and detecting the errors and by giving full information about the medication to the healthcare professionals. The role played by them by educating the staff nurse about the medication and counseling the medication to the patient [11-12].

5. CONCLUSION

In conclusion, the data of this study suggested the ranking of five reasons of why medication errors happen: medication package reason, system related, pharmacy related, documentation-transcription reason and physician-nurse reason respectively. Medication errors may happen in all medical fields and to reduce these errors the prescriber who decided the prescription and the pharmacist who dispensed the medication and the nurse who is at the last step of this process to give the medication to the patient must cooperate together to avoid these errors thus, all the medical field staff play a critical role in preventing these errors. Additionally its must improve the nurses' knowledge of how these factors will lead to critical errors and help them to discover strategies to prevent these errors from happening by a clinical pharmacist because the clinical pharmacist play an important role in reducing the errors by active intervention. The limitation of the study can be observed that since it was limited only to the nurses who were working in two Ministry of Health hospitals and dealing with patient directly in wards and other health care providers (physician and pharmacist) were not included in the study.

CONSENT AND ETHICAL APPROVAL

Study was approved by Riyadh Colleges of Dentistry and Pharmacy in 2017 by the number FPGRP/43639008/177. Participant's information was kept confidential. All the policies and procedures of the hospitals systems we visited it for collecting the data was respected. As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCE

1. Abbasinazari M, Talasaz AH, Eshraghi A, Sahraei Z. "Detection and management of medication errors in internal wards of a teaching hospital by clinical pharmacists. Acta Medica Iranica. 2013;51(7):482.
2. Aboshaiqah AE. "Nurses Perception of Medication Administration Errors." American Journal of Nursing Research. 2014;2(4): 63-67.
3. Ahmed SE, Al-Abbas SA, Al-Omran AS, Sadat-Ali M, Al-Shafei BA, Al-Turki RA. "Medication administration errors in Eastern Saudi Arabia ".Saudi Medical Journal. 2010;31(11):1257-12.4
4. Alves GMR, Varallo FR, Lucchetta RC, Mastroianni PDC. "Role of the clinical pharmacist in detection of drug therapy problemas in critically impatients: experience report." Journal of Phamacovigilance. 2014;1-6.
5. Arakawa C, Kanoya Y, Sato C. "Factors Contributing to Medical Errors and Incidents among Hospital Nurses—Nurses' Health, Quality of Life, and Workplace Predict Medical Errors and Incidents. Industrial Health. 2011;49(3):381.388-
6. Bifftu BB, Dachew BA, Tiruneh BT, Beshah DT. Medication administration error reporting and associated factors among nurses working at the University of Gondar referral hospital, Northwest Ethiopia. BMC Nursing. 2016;15(1):4.3
7. Cloete L. Reducing medication errors in nursing practice. Nursing Standard. 2015; 29(20):50-59.
8. Dibbi HM, Al-Abrashy HF, Hussain WA, Fatani MI, Karima TM. Causes and outcome of medication errors in hospitalized patients .Saudi Medical Journal. 2006;27(10):1489.
9. Dumo AMB. "Factors affecting medication errors among staff nurses: basis in the formulation of medication information guide." IAMURE International Journal Of Health Education. 2012;1(1):88-149.
10. Ebrahimipour H, Hooshmand E, Bayrami R, Pourshirazi M, Afiat M, Esmaili H, Vafaee Najar A. "Medication Errors and its Contributing Factors among Midwives." Journal of Midwifery and Reproductive Health. 2016;4(4):748-756.
11. Ehsani SR, Cheraghi MA, Nejati A, Salari A, Esmaeilpoor AH, Nejad EM. "Medication errors of nurses in the emergency department." J Med Ethics Hist Med. 2013;6: 11.
12. Hassani S, Eshraghi A, Hematian F, Taheri M, Sahraei Z. "Role of Clinical Pharmacists in Early Detection, Reporting and Prevention of Medication Errors in a Medical Ward." Journal of Pharmaceutical Care. 2017;3(3-4):54-60.