



Nursing Students' Experience of Medication Errors and Its Related Factors: A Questionnaire-Based Study

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Abstract

Introduction: Providing safe care is one of the nursing goals and medication errors are considered as one of the threatening factor for patient safety. The aim of this study was to determine the nursing students' experience of medication errors and its related factors.

Methods: This descriptive cross-sectional study was conducted on 120 nursing students, from third to eighth semester, in Kurdistan University of Medical Sciences, Iran, enrolled through the census. Data collection was performed using a three-part questionnaire including demographic features, types of medication errors and its causes. Data were analyzed through using descriptive statistics, Chi-square, Fisher's exact test, and correlation coefficient.

Results: The average number of student medication errors in the past semester was 20 (16.4%), in which 16 (13.1%) of them reported their errors. The most common types of medication errors was errors in determining the type of medication (66.4%, n=81). Also, the most common cause of medication errors in the viewpoints of nursing students were the lack of pharmacological information among students (83.1%, n=102), illegibility of drug orders (76.3%, n=93) and distraction (73.8%, n=90).

Conclusions: Based on the findings of this study, effective clinical and theoretical pharmacological educations are essential for increasing the pharmaceutical information of the students in order to reduce the amount of medication errors. It is necessary to increase the pharmacological information of nursing students by organizing various pharmacological workshops and giving time to students from training and internship to pharmaceutical conferences.

INTRODUCTION

Health care experts' major concern in regards to medicines use is to ensure patient safety. Patient safety is a significant concept and also a major index in controlling the quality of health services [1]. Medication error is a major index of health care among dangers for patient safety such as identifying the patient,

blood injection errors, and falling from height [2]. Human error is identified as an act done because of inadvertence and also done in deliberately. Psychologists declare that mistake or error is unavoidable for human being and is a part of humans' reality. Based on this, impression of human factors on

incidence of medical errors is accepted [3]. The error is not only the major threat of patients' safety but it is an important index of health care's quality [4].

Error is identified as defeat in physical and mental activities to achieve ideal outcome, when we are unable to relate the defeat to the chance [5, 6]. Medical error includes any error or mistake which is done by physician, nurse, midwives, etc. at the time of giving medical services [7]. In a research of USA's science academy's research, it was reported that 98,000 Americans die in hospitals each year as a result of medical error. This indicates low level of health service's quality [8].

Medication errors are common among physicians, nurses, pharmacists but they are more prevalent among nurses rather than other health professions [9, 10]. Doing medication orders is the operative part of treatment and patient's care process and it is also the main part of nurse's procedure. Based on this nurses should aware of medications recognition & correct order's importance to avoid dangers complications of medical errors [11]. It is estimated that 2% of patients received in hospitals of America experience medical errors [8, 12]. Based on recent studies, thousands of people die in America because of medical errors and unwanted medical events each year. Financial costs are almost 77 million dollars annually [13].

Before nursing students work in real practice situations of care, they should have sufficient medication administration competencies. However, they are still at risk of committing medication errors during their clinical training [14]. Practice in a clinical setting provides nursing students the opportunity to improve their medication administration skills, so the probability of medication errors exists in this phase [15]. The rate of medical errors and specially nursing students is very high. It was determined that 75.4% of nursing students have had medical errors specially forgetting injection of medication [16]. A study in Kenya showed that the most common medical error of just graduated nurses is the wrong injection of intravenous medications and the most important cause of it was the low knowledge of pharmacology [17]. Also Wolf et al study have shown that less than 3% of medical errors have caused patients hurt [18]. Altogether giving medication to the patient is a complicated process and also needs knowledge, decision making and correct procedure. Medical errors may occur in each level of this process [19]. Identified common errors include administering wrong type of medications, not administering at the right way, error in concentration of intravenous medication and giving the medication to the wrong patient [20]. In a study conducted in Turkey, 38.6% of nursing students had made medication administration errors [21]. In a study conducted in Iran, 17.1% of nursing students had committed medication errors [1]. Taking care about

giving the right medication to right patient on the right time with correct concentration and by the correct method; will reduce medical errors but there are multiple factors interfering incidence of medication errors. Lack of pharmacologic information, paying no attention to medication concentration written in the kardex, false medication calculations and not paying to the medication label are the causes of medication errors [22]. Altogether it should be said that the medication error exists among nursing students and it's an important matter in nurses' training. Eliminating medication errors is impossible but reducing it to lowest amount depends on investigating the background factors, kind of errors and eliminating the related factors as much as we can. Also nursing instructors have a great role in preventing students' mistakes. They should recognize students' weaknesses in administering medications and try to reform them. So recent study was done to determine the nursing students' experience of medication errors and its related factors in Kurdistan University of Medical Sciences.

METHODS

The aim of this study was to determine the nursing students' experience of medication errors and its related factors in Kurdistan University of Medical Sciences. This study was descriptive cross-sectional. In Iran, the undergraduate nursing education is four-year full time with 8 semesters. The study population was the 3rd to 8th semester nursing students of Kurdistan University of Medical Sciences. Based on the information achieved from the university; there were 200 3rd to 8th semester students. The sampling method was census. For sampling at the first step the list of students was brought from the education department of university and then the students who had the inclusion criteria were selected by census method. The inclusion criteria were passing the theoretical pharmacology course, administration of medications in the past semester, as well as having the desire to participate in the study. The exclusion criteria were working as an assistant nurse before entering the undergraduate.

For gathering information three questionnaires were used. First questionnaire was about demographic characteristics like age, gender, educational semester, ward, last semester grade point average, passing the pharmacology course and grade of clinical pharmacology course. The other questionnaires included frequency of medication errors (2 questions: Did you commit a medication error in the past semester? Did you report the medication error you have committed?), type of medication errors (16 questions), and causes of medication errors (29 questions). This questionnaire designed in 47 items after reviewing the texts and considering relevant tools and questionnaires [23, 24]. Answering the questionnaire was done by 5 graded Likert's measurement that contains absolutely agree, agree, no idea, disagree and absolutely disagree.

For investigation of most common items the absolutely agree and agree items aggregated. To determine the content validity of questionnaires they were given to 10 masters of faculty of Kurdistan University of Medical Sciences included 3 MSNs and 7 PhD of nursing. Comments and suggestions of these masters were gathered and analyzed by research team and the questionnaire was reformed. Corrected questionnaire was given to 2 expert masters again for final reform. To check the reliability of questionnaire it was given to 30 nursing students who were not participated in the study and was assessed by Cronbach's alpha method ($\alpha=0.71$).

Analyzing the data was done by SPSS software version 16 and descriptive statistic tests, Chi-squared and Fisher's exact test (relationship between gender, marital status, ward, passing the pharmacology course with error committing and most common types and cause of medication errors), Mann-Whitney and Kruskal-Wallis (relationship between age, last semester grade point average, the grade of theoretical and clinical pharmacology courses with error committing and most common types and cause of medication errors) used.

RESULTS

In this study, 120 3rd to 8th semester students were completed the study. The rate of response rate was 60%. Most of the studied cases were at 7th (21.3%), 6th (20.5), 3rd (18.3%) semester of their educational course. An average of 58.2 % (n=71) had passed unit of clinical pharmacology course (Table 1). Among the studied cases 16.4% (n=20) had committed medication errors and 13.1% (n=16) had reported their error.

Table 2 shows the frequency of different types of medication errors. Based on this table error in

determining the type of medication (66.4%, n=81), administering the medication more than the prescribed dose (64.7%, n=78), selecting the wrong solvent (63.1%, n=77) and error in method of administering the medication (62.2%, n=76) were the most frequent errors in previous semester.

Based on Table 3 that shows the most common causes of medication errors; lack of students' pharmacologic information (83.6%, n=102), illegible medication orders in the kardex (76.3%, n=93), distraction (73.8%, n=90), stress in urgency situations (73%, n=89), not taking care about label of medication for determining dose of medication (71.3%, n=87) were the most common causes of medication error in the view of nursing students.

There was significant statistic relationship between passing the clinical pharmacology course and error in determining the medication ($P=0.16$), error in method of administering medication ($P=0.01$), giving the medication to wrong patient ($P=0.01$). Also there was significant statistic relationship between the related ward and forgetting and not administering the medications ($P=0.03$), error in method of administering the medication ($P=0.02$), giving the medication to wrong patient ($P=0.03$), lack of pharmacologic information ($P=0.003$), not taking care about written dose on the kardex ($P=0.02$).

Also there was relationship between grade of pharmacology course and error in method of giving the medication ($P=0.03$), educational semester and method of giving the medication ($P=0.01$) also between marital status ($P=0.004$) and training ward ($P=0.02$) and not taking care about the written dose on the kardex. Also there was relationship between type and illegibility of medication errors written in the kardex.

Table 1. Demographic Characteristics of the Study Samples

	Values
Gender	
Female	81(78.5)
Male	29(21.5)
Term Course	
3	23(18.8)
4	17(13.9)
5	14(11.5)
6	25(20.5)
7	26(21.3)
8	17(13.9)
Passing unit of clinical pharmacology course	
Yes	71(58.2)
No	49(40.2)
Error committing in past semester	
Yes	20(16.2)
No	102(83.6)
Age	21.49±1.35
Total grade average	15.34±1.72
Grade of clinical pharmacology course	15.21±2.22
Grade of theoretical pharmacology course	14.25±2.60

Data are presented as Mean ± SD or No (%)

Table 2. The Viewpoints of the Nursing Students' about the Type of Medication Error they Committed

Phrase	Absolutely Disagree		Disagree		No idea		Agree		Absolutely Agree	
	N	%	N	%	N	%	N	%	N	%
Administering the medication more than the prescribed dose	8	6.6	26	21.3	9	7.4	48	39.3	31	25.4
Administering the medication less than the prescribed dose	10	8.2	26	21.3	18	14.8	38	31.1	30	24.6
Error in determining the type of medication	11	9	15	12.3	15	12.3	29	23.8	52	42.6
Administering the medication more than the time predetermined	5	4.1	32	26.2	34	27.9	36	29.5	15	12.3
Administering the medication less than the time predetermined	8	6.6	20	16.4	33	27	41	33.6	20	16.4
Forgetting and not administering the medications	12	9.8	18	14.8	19	15.6	27	22.1	46	37.7
Administering the medication in different time against the time predetermined	8	6.6	20	16.4	27	22.1	44	36.1	23	18.9
Error in method of administering the medication	15	12.3	14	11.5	17	13.9	33	27	43	35.2
Giving the medication to wrong patient	17	13.9	11	9	19	15.6	20	16.4	55	45.1
Calculating the wrong volume of solvent	8	6.6	13	10.7	29	23.8	51	41.8	21	17.2
Selecting the wrong solvent	11	9	18	14.8	16	13.1	47	38.5	30	24.6
Repeating administration of a medication	7	5.7	21	17.2	39	32	29	23.8	26	21.3
Lack of documenting the medication administration in nursing report	11	9	19	15.6	34	27.9	34	27.9	24	19.7
Lack of patient monitoring after medication administration	6	4.9	21	17.2	33	27	42	34.4	20	16.4
Administration of a medication twice instead of one	13	10.7	18	14.8	20	16.4	41	33.6	30	24.6
Other	2	1.6	6	4.9	100	82	3	2.5	11	9

Table 3. The Viewpoints of the Nursing Students' about the Causes of Medication Error they Committed

Phrase	Absolutely Disagree		Disagree		No Idea		Agree		Absolutely Agree	
	N	%	N	%	N	%	N	%	N	%
Lack of students' pharmacologic information	0	0	8	6.6	12	9.8	53	43.4	49	40.2
Not taking care about determining dose in Medication Administration Record (MAR)	1	0.8	19	15.6	16	13.1	54	44.3	32	26.2
Not taking care about label of medication for determining dose of medication	3	2.5	13	10.7	19	15.6	57	46.7	30	24.6
Failure to follow the therapies and procedures	2	1.6	9	7.4	35	28.7	55	45.1	21	17.2
Not paying attention to the PRN orders of the medication	9	7.4	19	15.6	35	28.7	37	30.3	22	18
Illegible medication orders in the cardex	4	3.3	11	9	14	11.5	45	36.9	48	39.3
Illegible medication orders in the medication card	4	3.3	10	8.2	23	18.9	42	34.4	43	35.2
Student low clinical skill	10	8.2	19	15.6	22	18	44	36.1	27	22.1
Nominal similarity in the name of the medications	2	1.6	15	12.3	20	16.4	57	46.7	28	23
Similarity in the form of medications	4	3.3	15	12.3	20	16.4	57	46.7	26	21.3
Using different names for a medication	5	4.1	12	9.8	22	18	59	48.4	24	19.7
Different routine for calculating the concentration of infusion medications	4	3.3	15	12.3	27	22.1	53	43.4	23	18.9
Doing oral orders (without checking kardex)	8	6.6	15	12.3	21	17.2	47	38.5	31	25.4
Stress in urgency situations	1	0.8	13	10.7	19	15.6	61	50	28	23
Lack of familiarity with the equipment of medication administration	4	3.3	11	9	27	22.1	60	49.2	20	16.4
Mistake in recording the medication at kardex	4	3.3	11	9	26	21.3	54	44.3	27	22.1
Giving medicine without prescription	6	4.9	23	18.9	33	27	36	29.5	24	19.7
Hurry up in medication administration	3	2.5	17	13.9	29	23.8	49	40.2	24	19.7
Lack of clinical instructor	7	5.7	28	23	38	31.1	35	28.7	14	11.5
Student congestion	8	6.6	18	14.8	34	27.9	41	33.6	21	17.2
Congestion in hospital' wards	6	4.9	14	11.5	26	21.3	49	40.2	27	22.1
Incompatibility of medication intervention with last clinical guidelines	4	3.3	10	8.2	47	38.5	47	38.5	14	11.5
Incompatibility of kardex and Medication Administration Record (MAR)	5	4.1	14	11.5	32	26.2	52	42.6	19	15.6
Stress	7	5.7	20	16.4	34	27.9	46	37.7	15	12.3
Lack of previous education about on specific medications	4	3.3	11	9	23	18.9	59	48.4	25	20.5
Nonadherence with given tutorials during drug administration	2	1.6	9	7.4	25	20.5	61	50	25	20.5
Distractions	3	2.5	9	7.4	20	16.4	69	56.6	21	17.2
Routine based action	0	0	7	5.7	39	32	63	51.6	13	10.7
Other	1	0.8	3	2.5	98	80.3	9	7.4	11	9

DISCUSSION

Safety in medication administration is a critical skill for nursing students [15]. Nature of nursing students' error defined as acting against the instruction set and repeating the same mistake clinical nursing instructors [25]. Findings of recent study showed that 16.4% of students have committed medication errors. In another study that was done by Kouhestani et al, 17.1% of nursing students had committed medication errors and 43.2% of them were about to near medication errors [1]. In recent study near medication errors that were impending were not assessed. In another study by Yaghooobi et al 58.1% of students had committed medication errors [20]. The types of medication errors committed by Indonesian nursing students were timing-related errors, errors in patient identification, and improper drug preparation [14]. The most medication error reported by Iranian nursing students was an infusion of multi-drug in micro-set regardless of drug interactions (9.2 %) and give the wrong number of drugs (5.7 %) [26]. In comparison with these studies the frequency of errors in recent study has been lower which is probably because of small studied population. Therefore, clinical instructors should try preventing incidence of medication errors by identifying types and causes of medication errors.

Also the results showed that the most common causes of medication errors were lack of pharmacologic information, illegibility of medication orders in the kardex, distraction, stress in urgency situation and paying no attention to labels of medication for determining dose of medications. Kouhestani et al study also showed the lack of pharmacologic information (15.25%) as the most common cause of medication errors in nursing students [1, 2]. In a study in Japan it was determined that the most common error of just graduated nurses is wrong administration of IV medications and the most common cause of it was lack of pharmacologic information [27]. The causes of medication errors by Indonesian nursing students reported as lack of knowledge and skills, lack of good role models, and lack of proper supervision [14]. In clinical instructors' perspectives, personal characters (being in a hurry, stress, lack of motivation, distractions) and educational characters (student congestion, shortage of instructors, unreasonable expectations from the students, following the wards' nurses, inappropriate communication) were the causes of Iranian nursing students' errors [25]. In a systematic review the most frequently contributing factors of medication errors by nursing students reported as inexperience and distractions [15]. These findings show the necessity of increasing students' pharmacologic information. Also

the students' information can get increased by holding different pharmacologic workshops and allocating a part of internship and apprenticeship time to pharmacology conferences. Encouraging students to pay their most attention and use their most concentration in hospitals and read the label of medication carefully and the importance of this matter should be declared to them.

There was significant statistic relationship between passing the pharmacology and passing the clinical pharmacology course with error in determining medication ($p=0.16$), error in method of administering medications ($p=0.02$), and administering medication to wrong patient ($p=0.03$). Hence passing the clinical pharmacology course can be mentioned as an important factor to reduce the medication errors. Relationship between medication knowledge and risk of errors reported in graduating nursing students [28]. Therefore efficient education according to pharmacologic needs and identifying the medication errors to students can be helpful.

There was meaningful relationship between related ward and forgetting and not administering the medication, error in method of administering the medication, administering the medication to wrong patients, lack of pharmacologic information and not paying attention to written dose in the kardex. So it can be concluded that difference of medications of different wards and variation of available medications is affective in committing medication errors. There is difference between medication error incidence in various wards of the hospital and medication errors are more common in critical care units [29]. Students do not have the ability or opportunity to study medications of different wards and it is probably one of the causes of not paying attention to medication doses and untidiness and not writing them.

Also there is significant statistic relationship between grade of clinical pharmacology and error in method of administering the medication. A relationship was found between educational semester and error in administering the medication. Teaching and training reported as practical ways of medication error prevention [30]. Nursing education can play an important role in improving medication management and error prevention [31]. So it can be concluded that level of student's information and experience, and increasing the time of training can be helpful for decreasing the level of medication errors.

Also there was relationship between type and illegibility of medication orders of the kardex. The illegible orders of doctors were considered by nurses as one of the main factors of medication errors [32]. In the context of the study, medication orders documented in kardex by the nurse, so good handwriting of the in-charge nurse for

documenting recommended. Also, using electronic typing recommended for the prevention of this cause of medication errors. So clinical instructors should double-check the medication orders with nursing students for the prevention of medication errors. Finally, studies are required to identify and evaluate the effective strategies for the prevention and detection of nursing students' medication errors. Also, the effective supervision of nursing students by clinical instructors is necessary.

Limitations and Suggestions

One of the limitations of the recent study was the confidence of researched cases about the honesty of reporting the medication errors which was tried to gather absolute information by gaining their trust. The low response rate may affect the result of this study, and more studies with a higher sample size recommended. In this study, the committing medication error asked by yes or no question, so it recommended to measure the amount of medication error in the futures studies. Cases of recent study were the nursing students; therefore, we suggest identified studies on midwives and operating room students. Also checking the frequency of students' error reporting of errors and its causes is recommended.

CONCLUSIONS

Less than a fifth of nursing students committed medication errors in the past semester. Most common types of medication errors were errors in determining the type of medication and the most common cause of medication errors in viewpoints of nursing students was for the lack of pharmacological information among students. According to the outcomes of this research we can reduce the frequency of medical errors by affective theoretic and clinical teaching of pharmacology and determining different types of medications and their common doses. Also absolute explanation of how to use medication and determining special solvent can be helpful. According to determined causes of different

indices we should try our best reduce and control medication errors.

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ETHICAL CONSIDERATION

After receiving the letter of introduction from Ethic Committee of Kurdistan University of Medical Sciences No. IR.MUK.REC.1396.30 and presenting it to nursing students the aims of study were described to all of them. This study was done based on the Declaration of Helsinki about studies on humans that contains saving private information, considering participant's comfort, giving written consent, and staying anonymous. After coordinating with students and explaining that answering the questionnaire is voluntary they started answering the questions.

AUTHORS CONTRIBUTIONS

S R: Conception and design, data collection, analysis and interpretation, writing the manuscript

Sh V: Conception and design, data collection, analysis and interpretation, writing the manuscript

BN: Statistic advisor, editing the manuscript, critical revision of the manuscript

SV: Conception and design, data collection, analysis and interpretation, writing the manuscript, critical revision of the manuscript.

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CONFLICT OF INTERESTS

The Authors declares that there is no conflict of interest.

REFERENCES

- Kouhestani H, Baghchehi N. Refusal in Reporting Medication Errors from the Viewpoints of Nursing Students in Arak University of Medical Sciences. *Iran J Med Educat*. 2008;8(2):285-92.
- Koohestani HR, Baghchehi N. Barriers to the reporting of medication administration errors among nursing students. *Australia J Advance Nurs*. 2009;27(1):66.
- Mansouri A, Ahmadvand A, Hadjibabaie M, Kargar M, Javadi M, Gholami K. Types and severity of medication errors in Iran; a review of the current literature. *Daru*. 2013;21(1):49. doi: 2008-2231-21-49 pmid: 23787134
- Goras C, Wallentin FY, Nilsson U, Ehrenberg A. Swedish translation and psychometric testing of the safety attitudes questionnaire (operating room version). *BMC Health Serv Res*. 2013;13:104. doi: 1472-6963-13-104 pmid: 23506044
- Mohammad Nejad I, Hojjati H, Sharifniya SH, Ehsani SR. Evaluation of medication error in nursing students in four educational hospitals in Tehran. *Iran J Med Ethic History Med*. 2010;3(1):60-9.
- Saremi M, Fallah MR. Subjective fatigue and medical errors among nurses in an educational hospital. *Iran Occupat Health*. 2013;10(4):1-8.
- Mirzaei M, Khatony A, Faramani RS, Sepahvand E, Prevalence. Types of Medication errors and Barriers to Reporting Errors by Nurses in an Educational Hospital in Kermanshah. *Hayat*. 2013;19(3).
- Kohn LT, Corrigan J, Donaldson MS. To err is human: building a safer health system: National academy press Washington, DC2000.
- Mirzaee H, Mostafaie D, Estebsari F, Bastani P, Kalhor R, Tabatabaee S. Medication errors in hospitals: A study of factors affecting nursing reporting in a selected center affiliated with Shahid Beheshti University of Medical Sciences. *J Pharmaceut Care*. 2014;96-102.
- Sarhadi M, Sheikhbardsiri H, Dastres M, Moein H. A Comparative Study of Barriers to Reporting Medication Errors in Nursing Students in Zahedan University of Medical Sciences, Iran. *J Manage Med Inform School*. 2014;2(1):46-38.

11. Sari AB, Sheldon TA, Cracknell A, Turnbull A, Dobson Y, Grant C, et al. Extent, nature and consequences of adverse events: results of a retrospective casenote review in a large NHS hospital. *Qual Saf Health Care*. 2007;16(6):434-9. doi: [10.1136/qshc.2006.021154](#) PMID: 18055887
12. MUSAREZAIE A, MOMENI GGT, ZARGHAM BA, HAJ SE. Survey of the medication errors and refusal to report medication errors from the viewpoints of nurses in hospitals affiliated to Isfahan university of medical sciences, Iran. 2013.
13. Reid-Searl K, Moxham L, Walker S. Medication administration and final year nursing students. 2008.
14. Musharyanti L, Claramita M, Haryanti F, Dwiprahasto I. Why do nursing students make medication errors? A qualitative study in Indonesia. *J Taibah Univ Med Sci*. 2019;14(3):282-8. doi: [10.1016/j.jtumed.2019.04.002](#) PMID: 31435418
15. Asensi-Vicente J, Jimenez-Ruiz I, Vizcaya-Moreno MF. Medication Errors Involving Nursing Students: A Systematic Review. *Nurse Educ*. 2018;43(5):E1-E5. doi: [10.1097/NNE.0000000000000481](#) PMID: 29210898
16. Saghiri S. The errors of nursing and develop strategies to reduce errors in nurses. *J Depart Nurs Army Islam Repub Iran*. 2010;2(10):35-40.
17. Ndambuki JM, Odhiambo E, Chege M, Mirie W. Factors influencing Quality Management of Medication by Nurses at Kenyatta National Hospital Paediatric Wards. Nairobi, Kenya. *J Biol Agric Healthc*. 2013;3(18):93-9.
18. Wolf ZR, Hicks R, Serembus JF. Characteristics of medication errors made by students during the administration phase: a descriptive study. *J Prof Nurs*. 2006;22(1):39-51. doi: [10.1016/j.profnurs.2005.12.008](#) PMID: 16459288
19. Abolghasem GH, Ravaghi H, Pirouzi M, Mansourzade A. Utilizing integrated prospective and retrospective risk analysis Method on general processes patient flow in operating room in Seyed Alshohada Hospital in Semirom, Iran. *Health Informa Manage*. 2013;10(3):1-10.
20. Yaghoobi M, Navidian A, Charkhat-Gorgich EH, Chackerzahi F, Salehiniya H. Survey of medication errors in nursing student and reasons for not reporting it from their perspective. *Nurs Physic Quarter Razum*. 2014;6(3):11-5.
21. Cebeci F, Karazeybek E, Sucu G, Kahveci R. Nursing students' medication errors and their opinions on the reasons of errors: A cross-sectional survey. *J Pak Med Assoc*. 2015;65(5):457-62.
22. Seidi M, Zardosht R. Survey of nurses' viewpoints on causes of medicinal errors and barriers to reporting in pediatric units in hospitals of mashhad university of medical sciences. *J Fasa Univ Med Sci*. 2012;2(3):142-7.
23. Azarabad S, Zaman S, Nouri B, Valiee S. Frequency, Causes and Reporting Barriers of Nursing Errors in the Operating Room Students. *Res Med Educat*. 2018;10(2):18-27. doi: [10.29252/rme.10.2.18](#)
24. Taifoori L, Valiee S. Understanding or nurses' reactions to errors and using this understanding to improve patient safety/Comprendre les reactions des infirmieres de sop face aux erreurs et se servir de cette comprehension pour ameliorer la securite des patients. *ORNAC J*. 2015;33(3):13-34.
25. Valiee S, Fathi M, Shahoei R. Nursing students' errors and their causes: A qualitative exploration of clinical instructors' perspectives. *J Patient Safety Quality Improve*. 2019;7(1):1-8.
26. Khalili Z, Molavi Vardanjani M, Shamsizadeh M, Alimohammadi N, Tohidi S, Fallahinia G. Medication errors in nursing students. *Sci J Nurs Midwife Paramed Facult*. 2018;3(3):8-16. doi: [10.29252/sjnmp.3.3.8](#)
27. Kawamura H. The approaches to factors which cause medication error--from the analyses of many near-miss cases related to intravenous medication which nurses experienced Cancer & chemotherapy. 2001;28(3):304-9.
28. Simonsen BO, Daehlin GK, Johansson I, Farup PG. Differences in medication knowledge and risk of errors between graduating nursing students and working registered nurses: comparative study. *BMC Health Serv Res*. 2014;14:580. doi: [s12913-014-0580-7](#) PMID: 25413244
29. Kaboodmehri R, Hasavari F, Adib M, Khaleghdoost Mohammadi T, Kazemnejhad Leili E. Environmental Factors Contributing to Medication Errors in Intensive Care Units. *J Holistic Nurs Midwife*. 2019;29(2):57-64. doi: [10.32598/JHNM.29.2.57](#)
30. Likic R, Maxwell SR. Prevention of medication errors: teaching and training. *Br J Clin Pharmacol*. 2009;67(6):656-61. doi: [10.1111/j.1365-2125.2009.03423.x](#) PMID: 19594534
31. Tshiamo WB, Kgositau M, Ntsayagae E, Sabone MB. The role of nursing education in preventing medication errors in Botswana. *Int J Africa Nurs Sci*. 2015;3:18-23. doi: [10.1016/j.ijans.2015.06.001](#)
32. Salmani N, Fallah Tafti B. Frequency, type and causes of medication errors in pediatric wards of hospitals in Yazd, the Central of Iran. *Int J Pediatr*. 2016;4(9):3475-87.