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A Survey of Nursing Staff's Perspective Regarding Reasons for Medication Errors

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Abstract

Background: Health care services are associated with risks for their recipients. Medication errors can lead to many negative consequences for the health care system, including prolonged hospital stay and increased cost per patient. The aim of this study was to investigate the nursing staff's perspective regarding reasons for medication errors in Ayatollah Kashani hospital, Shahrekord, Iran.
Methods: 207 nurses working in the ICUs of the hospital were selected by convenience sampling and their comments about effective factors in the incidence of medication errors were investigated by a researcher-made questionnaire. To examine the reliability and validity of the questionnaire, we offered it to 5 nursing experts and necessary corrections were made based on the comments. The reliability of the questionnaire was also investigated by Cronbach's alpha coefficient that gave the value of 85%. The first section of the questionnaire consisted of questions about demographic characteristics and the second section investigated the reasons for medication errors in nursing-related area, workplace-related area, director of nursing-related area, and drug-related area. For each item, there were four choices, i.e. none, little, moderate, and much and therefore, the level of importance scored between 0 and 3. The data were analyzed by SPSS 17.
Results: In this study, the most important reasons for medication errors were related to workload-induced fatigue (mean: 2.37) in the nurses-related area, high labor-intensity in department (mean: 2.32) in the workplace-related area, insufficient nursing staff proportional to the number of patients in department (mean: 2.41) in the director of nursing-related area, and drug name confusion in the drug-related area (mean: 2.04).
Conclusions: The officials of health care systems should focus on the effective processes in reducing medication errors including appropriate training of the staff and holding in-service training sessions about drug information as well as appropriate planning for employment of adequate workforce.

Keywords: Medication Errors, Nurses' Perspectives, Patient Safety

1. Background

Patient safety has attracted special attention since 2000. The institute of medicine has issued a report to attract further attention to the issue of medical errors and promote patient safety in delivering health care services. According to this report, errors are a main reason for mortality and harm to patients (1). Providing safety for patients is a main concern of health care professionals, and patient safety is currently being addressed as a key concept in and an important index of controlling quality of health care services (2). demonstrate demonstrate that over 50 medications, which comprise approximately 1/3 of the nurse's working time, are implemented by a nurse during a shift work. Therefore, nurses are in the first line of medication errors (3).

Greenfield states that 2.2 million people each year are injured because of medication errors, including 106,000 inpatients who finally die due to these errors (4). In 2002, 1/5 of litigation cases and judicial complaints in the USA were related to medication errors (5). There are no compiled statistics on nursing errors in Iran; however, the ministry of health and medical education has declared that billions of Tomans each year are spent for hospitalizing and caring for the patients due to medical errors. This statement is confirmed by increased number of the complaints filed about physicians' and nurses' medical errors (6). Medication error refers to any preventable event throughout the process of pharmacotherapy that can lead to inappropriate medication use or harms to the patients (7).

A number of studies have investigated the rate of medication errors in Iran. For example, Farzi et al. study demonstrated that nursing staff in intensive care units (ICUs), as with other members of health care team, were likely to commit errors in delivering health care services for several reasons with a variety of consequences such as jeopardizing their own employment and harming the patients (8).

Cheraghi et al. reported insufficient drug information to be the most common reason for committing medication errors among nurses so that 19% of the medication errors were found to be due to miscalculations of drug dose (9). In addition to causing harm to patients, the nurses' medication errors can lead to several problems such as unsuccessful and defective treatment, increased length and cost of hospital stay, and the patients' distrust with health care system (10). Besides that, crowdedness of workplace and heavy workload may result in distractions and interruptions in the nurses' work and therefore medication errors become more likely to happen (11). Severity of these errors can be minimal, severe, life-threatening, and fatal (12).

A study conducted in Mashhad, Iran, reported that from the nurses' perspectives, the nurses' erroneous transfer of medication orders (73.9%) was the most important reason for medication errors followed by prescription of wrong dose of the drug by physicians and incorrect adjustment of infusion instruments (64.1%) (13). Implementing medication orders has a significant contribution to the process of treatment and health care services delivery (14) so that nurses spend over 40% of their working time to implement medication orders; therefore, maintenance of safety and prevention of harms to patients due to medication errors are highly important from nursing perspective (15).

Disclosure of errors is known to be the basis for maintaining and improving patient safety. Although providers of the services are ethically and professionally committed to disclosing the errors, the rate of errors reported by nurses is much lower than that of all committed errors (16, 17). Fear of legal issues and cases, being interrogated by the relevant officials, and reaction of director of nursing and colleagues are barriers to reporting the errors voluntarily (18, 19).

Tol et al. found managerial factors to be the most important reason for lack of reporting medication errors among nurses (20). Kim et al. study reported identification of real and potential errors to be the most important factor for advancing delivery of safe health care services to children and culture of reporting (21). A study conducted in the USA demonstrated that use of computer systems to register drug prescription was an important factor for reducing medication errors (22). The medication errors can lead to many negative outcomes in the health care system including increased length of hospital stay and therefore associated costs per patient. Moreover, a number of patients may die or sustain long-term or short-term disabilities because of the side effects of drugs. In the light of large number of accident and traumatic patients admitted to Ayatollah Kashani hospital, Shahrekord, Iran, and because this hospital is a teaching hospital, we conducted this study to investigate the reasons for medication errors from the nurses' perspectives in this hospital, in addition to offering some recommendations to improve the status of disclosing medication errors, so as to help reduce medication errors.

2. Methods

This descriptive-analytical study was conducted in Ayatollah Kashani hospital, Shahrekord, Iran, in 2013 - 2014. The study population consisted of all nursing staff in the ICUs of this hospital. The participants were selected according to random sampling. According to the formula of sample size calculation, the sample size was determined to be 207 people. The inclusion criteria were being consent to participate in the study and having work experience of at least one year.

The data were gathered by a researcher-made questionnaire consisting of two sections: demographic characteristics and survey of nurses' perspectives about incidence of medication errors. This questionnaire was developed according to reliable references and articles on the reasons for medication errors (20, 23, 24). To examine the reliability and validity of the questionnaire, we offered 5 copies to nursing experts and necessary corrections were made based on their comments. The reliability of the questionnaire was also investigated by Cronbach's alpha coefficient that gave the value of 85%. The first section of the questionnaire consisted of seven items on demographic characteristics (age, gender, marital status, education level, history of nursing work, shift work, and type of employment) and the second section investigated the level of importance attributed to the reasons for medication errors with 46 items on different areas, including nursing-related area (18 items), workplace-related area (nine items), director of nursing-related area (nine items), and drug-related area (10 items). For each item, there were four choices, i.e. none, little, moderate, and much and therefore, the level of importance scored between 0 and 3, representing minimum and maximum importance, respectively.

The questionnaires were distributed to the participants and necessary explanations were given to them. Four days later, the completed questionnaires were collected. If a questionnaire was not fully completed, the researchers

followed up the respondent to investigate the reason behind not completed questionnaire).

The data were analyzed by SPSS 17. Descriptive statistics were used to calculate measures of central tendency and distribution, and analytical statistics, consisting of Pearson correlation coefficient, ANOVA, and independent t test to investigate correlation and association among the variables. To observe ethical considerations, the researchers explained the research purposes to the participants after the research and technology deputy provided the approval to conduct this study. Besides that, participation in the study was voluntary and the participants provided informed consent to participate in the study. The questionnaires were completed anonymously and the participants ensured that the data would be kept confidential.

Regarding employment status, most (52.7%) of the participants were contractually employed, 15 (7.2%) worked in the internal department, 48 (23.2%) in the ICU department, 10 (4.8%) in the surgical department, 20 (9.8%) in the emergency department, 7 (3.4%) in the urology department, 20 (9.7%) in the men surgical department, 6 (2.9%) in the ophthalmology department, and 8 (3.9%) in the ENT department.

3. Results

207 nurses participated in this study. The participants' age was 20 - 50 years and most (47.8%) of them were in range of 30 - 39 years. 87% of the participants were female, 77.3% married, and 22.7% single. Regarding work experience, most (56%) participants had over 6 years of work experience. In this study, 89.4% of the participants were MA/MSc. holders, 8.6% associate degree holders, and 1.9% high school completion certificate holders.

From the participants' perspectives, the most common reasons for incidence of medication errors, according to the range of attainable scores for each area, were related to director of nursing-related area with mean score of 1.93 followed by nurses-related area (1.89), workplace-related area (1.78), and drug-related area (1.76).

From the nursing staff's perspectives, the most and the least important reasons for medication errors were reported to be insufficient nursing staff proportional to the number of patients (60.9%) and evening shift work (33.3%) in the director of nursing-related area, workload-induced fatigue (56%) and paying no attention to the time of medication (35.3%) in the nurses-related area, high labor-intensity in the department (53.6%) and lack of drug information resources in the department (40.6%) in the workplace-related area, and drug name confusion (37.7%) and large variety of the drugs in the department (33.6%) in the drug-related area, respectively (Tables 1 - 4).

4. Discussion

The main purpose of this study was to investigate the nursing staff's perspectives about incidence of medication errors in Ayatollah Kashani hospital, Shahrekord, Iran. In this study, the reasons were assigned to four areas. Insufficient nursing staff proportional to the number of patients was reported to be the most common reason in the director of nursing-related area, workload-induced fatigue in the nurses-related area, heavy workload in the department in the workplace-related area, and drug name confusion in the drug-related area.

Bijani et al. reported that the most important reasons for incidence of medication errors were related to workload-induced fatigue followed by inadequate number of staff proportional to number of patients, long working hours, and high labor-intensity of nurses in the department. Moreover, other variables such as work experience were found to be significantly associated with incidence of medication errors (25). A finding of the present study was nursing staff's workload in caring for patients. Consistent with this finding, heavy workload of the nursing staff and disproportionate number of patients to the number of nurses, chaotic working conditions, and inadequate staffing were some of the most important reasons for medication errors in previous studies (23, 26, 27). Noorian et al. study reported in line with our study that low number of workforce, heavy workload, and nurses' physical fatigue were the most important reasons for incidence of medication errors (28).

The findings of the present study on nurses-related area demonstrated that fatigue was the most important reason for incidence of medication errors. Moreover, Oladi Ghadikalaee et al. study showed that nurses' fatigue was the most important reason for medication errors (19). Koohestani et al. study, conducted on 100 patients, reported that fatigue and high labor-intensity in the department were among the most important factors attributing to incidence of medication errors from the nurses' perspectives (29). Pape et al. reported nurses' fatigue to be the third leading cause of medication errors (30). Besides that, Soozani et al. found nurses' overtime-induced fatigue and mental problems to be reasons for medication errors (31).

These findings confirm that nurses' fatigue is a potential factor for incidence of medication errors. Lawton and Parker argued that the role of human factors in incidence of medication errors was important (17). In the present study, nurses-related factors were derived to be important for incidence of medication errors so that the mean score for this area was 26.56. Ito et al. study conducted in Japan demonstrated that more years of work experience contributed to reduced medication errors (32). Consistently,

Table 1. Frequency and Absolute Frequency of the Questions Related to Incidence of Medication Errors Among the Studied Nursing Staff Due to Workplace-Related Factors[a]

Effective Factors on Incidence of Medication Errors Related to Working Conditions in Department	Factor Importance				Mean
	None	Little	Moderate	Much	
Environmental conditions leading to distraction (noise, etc.)	25 (12.1)	52 (25.1)	69 (33.3)	59 (28.5)	1.77
Large number of critically ill patients	10 (4.8)	36 (17.4)	64 (30.9)	97 (46.9)	2.19
Medication room space (light, physical space, etc.)	24 (11.6)	64 (30.9)	73 (35.3)	46 (22.2)	1.68
High labor-intensity in department	7 (3.4)	30 (14.5)	59 (28.5)	111 (53.6)	2.32
Type of drug arrangement in drug shelf	24 (11.6)	57 (27.5)	71 (34.3)	55 (26.6)	1.75
Department's drug protocol	26 (12.6)	68 (32.9)	75 (36.2)	38 (18.4)	1.60
Different routine guidelines for infusion drugs among departments	18 (8.7)	70 (33.8)	78 (37.7)	41 (19.8)	1.68
Lack of drug information resources in department	28 (12.1)	84 (40.6)	64 (30.9)	34 (16.4)	1.51
Lack of necessary equipment to inject drug and regulate drops appropriately	27 (13)	70 (33.8)	73 (35.3)	37 (17.9)	1.57

[a]Values are expressed as No. (%).

Table 2. Frequency and Absolute Frequency of Questions Regarding Incidence of Medication Errors Due to Nurses-Related Factors[a]

Effective Nurses-Related Factors in Incidence of Medication Errors	Factor Importance				Mean
	None	Little	Moderate	Much	
Discouragement and apathy towards nursing profession	22 (10.6)	57 (27.5)	78 (37.7)	50 (24.2)	1.75
Nurses' economic difficulties	28 (13.5)	36 (17.4)	58 (28)	85 (41.1)	1.96
Nurses' family difficulties	24 (11.6)	50 (24.2)	71 (34.3)	62 (30)	1.82
Nurses' mental difficulties	17 (8.2)	44 (21.3)	72 (34.8)	74 (35.7)	1.98
Overtime-induced fatigue	7 (3.4)	25 (12.1)	59 (28.5)	116 (56)	2.37
Doing something else alongside drug administration	9 (4.3)	29 (14)	85 (41.1)	84 (40.6)	2.17
Excessive (over 40) working hours per week	10 (4.8)	27 (13)	70 (33.8)	100 (48.3)	2.25
Feeling stressful while administering drug in emergency conditions	10 (4.8)	44 (21.3)	83 (40.1)	70 (33.8)	2.02
Lack of drug information	11 (5.3)	48 (23.2)	90 (43.5)	58 (28)	1.94
Naive staff in department (insufficient work experience)	5 (2.4)	33 (15.9)	88 (42.5)	81 (39.1)	2.18
Paying no attention to drug in drug Kardex	19 (9.2)	61 (29.5)	69 (33.3)	58 (28)	1.80
Medication miscalculations	21 (10.1)	54 (26.1)	81 (39.1)	51 (24.6)	1.78
Drug prescription without physician's order	41 (19.8)	61 (29.5)	64 (30.9)	41 (19.8)	1.50
Lack of knowledge about methods of using new equipment among staff	17 (8.2)	69 (33.3)	77 (37.2)	44 (21.3)	1.71
Negligence of appropriate time of drug administration	24 (11.6)	73 (35.3)	66 (31.9)	44 (21.3)	1.62
Lack of taking essential measures regarding the drugs needing special attention (taking the pulse and measuring blood pressure)	13 (6.3)	79 (33.3)	81 (39.1)	44 (21.3)	1.75
Combining drugs with no attention to potential drug interactions	30 (14.5)	49 (23.7)	76 (36.7)	52 (25.1)	1.72
Lack of knowledge about new equipment's instructions among staff	19 (9.2)	66 (31.9)	74 (35.7)	48 (23.2)	1.72

[a]Values are expressed as No. (%).

in the present study, a statistically significant association was observed between work experience and incidence of medication errors.

Tang et al. study on 72 nurses demonstrated that certain factors such as nurses' carelessness, increased workload, and naïve nurses played a role in incidence of medication errors (33). In the current study, the medication errors were found to occur most frequently in morning and

Table 3. Frequency and Absolute Frequency of Questions Regarding Incidence of Medication Errors Due to Director of Nursing-Related Factors[a]

Effective Director of Nursing-Related Factors in Incidence of Medication Errors	Factor Importance				Mean
	None	Little	Moderate	Much	
Lack of nursing staff proportional to number of patients	5 (2.4)	31 (15)	45 (21.7)	126 (60.9)	2.41
Methods of monitoring and supervising the department	16 (7.7)	72 (34.8)	52 (25.1)	67 (32.4)	1.82
Illegibility of physician's order in patient's medical file	5 (2.4)	45 (21.7)	31 (30.4)	94 (45.4)	2.18
Drug dose miscalculations by physicians	9 (5.3)	59 (28.5)	55 (26.6)	82 (39.6)	2.00
Kardex illegibility	13 (6.3)	66 (31.9)	68 (32.9)	60 (29)	1.84
Writing a wrong drug in patient's Kardex	14 (6.8)	56 (27.1)	69 (33.3)	68 (32.9)	1.92
Morning shift work	30 (14.5)	73 (35.3)	56 (27.1)	48 (23.2)	1.58
Evening shift work	31 (15)	69 (33.3)	71 (34.3)	36 (17.4)	1.54
Night shift work	13 (6.3)	45 (21.7)	60 (29)	89 (43)	2.08

[a]Values are expressed as No. (%).

Table 4. Frequency and Absolute Frequency of Questions Regarding Incidence of Medication Errors Due to Drug-Related Factors[a]

Effective Drug-Related Factors in Incidence of Medication Errors	Factor Importance				Mean
	None	Little	Moderate	Much	
New side effects	16 (7.7)	60 (29)	70 (33.8)	61 (29.5)	1.85
Different doses of a drug	8 (3.9)	44 (21.3)	99 (47.8)	56 (27.1)	1.98
Drug name confusion	9 (4.3)	50 (24.2)	70 (33.8)	78 (37.7)	2.04
Referring to drugs with abbreviated instead of full names	12 (5.8)	61 (29.5)	65 (31.4)	69 (33.3)	1.92
Complex methods of prescribing drugs	10 (4.8)	65 (31.4)	81 (39.1)	51 (24.6)	1.83
Drug shape confusion	9 (4.3)	55 (26.6)	72 (34.8)	16 (7.7)	1.99
Drug shape confusion	16 (7.7)	56 (27.1)	72 (34.8)	63 (30.4)	1.87
Large variety of drugs in the department	21 (10.1)	70 (33.8)	65 (31.4)	51 (24.6)	1.70
Inappropriate drug labeling or packaging	22 (10.6)	72 (34.8)	57 (27.5)	56 (27.1)	1.71
Using certain drugs rarely	19 (9.2)	64 (30.9)	64 (30.9)	60 (29)	1.79

[a]Values are expressed as No. (%).

night shift works. Moreover, Hesari et al .study demonstrated that incidence of medication errors was higher in the night shift work than morning and evening shift works (34). Similar studies have reported that poor working conditions including crowdedness and stressors in the department (8) and physicians' illegible medication orders (15) may result in the incidence of medication errors. Leufer and Cleary-Holdforth argued that crowdedness of the working environment and heavy workload can lead to distraction and interruptions in nurses' work and therefore, committing medication errors by the nurses (11).

In drug-related area, drug name confusion was reported to be the most important reason for the incidence of medication errors, which is consistent with Cheraghi et al. study (35). Moreover, Nikpeyma and Gholamnejad reported that drug name confusion was the reason for 35% of medication errors (36). Because drug name confusion has been frequently found to be a main source of medication errors, codification of a protocol to name, label, and package drugs can be an effective measure in this regard. Lack of drug information among nurses has been reported to play an important role in the incidence of medication errors. This finding is consistent with the present study results demonstrating that this factor is one of the most important reasons for incidence of medication errors in nurses-related area (37). Consistently, many nursing researchers have referred to increasing drug information among nurses as a very important strategy to reduce

medication errors and argued that updating nurses' drug information can play a role in reducing medication errors (38).

In this study, the physicians' illegible medication order was derived to be the second leading cause of incidence of medication errors in the director of nursing-related area. In this regard, Ammenwerth et al. reported consistent findings (39). Seeking to reduce and manage medication errors depends on a systemic approach to study predisposing factors and eliminate these factors as much as possible; therefore, certain measures should be taken to adjust working hours of nurses and impose restrictions on the number of overtime shift works. In addition, for medication errors due to drug name confusion, the protocols of designing and packaging the drugs should be amended in a manner that the incidence of medication errors is minimized.

Because side effects are not the only risks due to drugs consumption, and since many failures can occur throughout prescription, distribution, and implementation of medication, the incidence of medication errors is considered to be an important index to measure decline in quality of the process of drug administration in all steps of prescription, preparation, and implementation of medication; therefore, the officials of health care systems should focus on the effective processes in reducing medication errors including appropriate training of the staff. Holding in-service training sessions about appropriate techniques of drug prescription and encouraging nurses by directors of nursing are some of the strategies that can have optimal effects on reducing medication errors in clinical settings as much as possible in the light of the current capabilities and limitations.

4.1. Implications of the Study

Failure of health care systems causes increase in the medication errors.

Identification of these factors in the health care system helps the nurses eliminate them, decrease medications errors, improve quality of the delivered health care services, and increase patient safety. Overall, the findings of this study demonstrated certain important points regarding the incidence of medication errors. To reduce medication errors and maintain patient safety, certain measures such as holding in-service training sessions on psychology and appropriate principles of implementing medication errors, improving working conditions of the nurses, promoting disclosure of the medication errors, providing necessary infrastructure for computer prescription, disseminating culture of patient safety, and commissioning a comprehensive and inclusive system to register medication errors are necessary.

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Footnote

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References

1. Homsted L. Institute of Medicine report: to err is human: building a safer health care system. *Fla Nurse.* 2000;**48**(1):6. [PubMed: 11995167].
2. Hajibabaee F, Joolaee S, Peyravi H, Haghani H. The relationship of medication errors among nurses with some organizational and demographic characteristics. *IJNR.* 2011;**6**(20):83–92.
3. Bergqvist M, Karlsson EA, Björkstén KS, Ulfvarson J. Medication Errors by Nurses in Sweden-Classification and Contributing factors. *Open Access Sci Rep.* 2012;**1**(11):1–5.
4. Greenfield S. Medication error reduction and the use of PDA technology. *J Nurs Educ.* 2007;**46**(3):127–31. [PubMed: 17396552].
5. Fry MM, Dacey C. Factors contributing to incidents in medicine administration. Part 1. *Br J Nurs.* 2007;**16**(9):556–8. doi: 10.12968/bjon.2007.16.9.23435. [PubMed: 17551449].
6. Mayo AM, Duncan D. Nurse perceptions of medication errors: what we need to know for patient safety. *J Nurs Care Qual.* 2004;**19**(3):209–17. [PubMed: 15326990].
7. Dennison RD. A medication safety education program to reduce the risk of harm caused by medication errors. *J Contin Educ Nurs.* 2007;**38**(4):176–84. [PubMed: 17708117].
8. Farzi S, Abedi H, Ghodosi A, Yazdannik AR. Nurses'experiences of medication errors. *J Qual Res Health Sci.* 2014;**2**(4):310–9.
9. 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. [PubMed: 24427488].
10. 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. *J Health Sys Res.* 2013;**9**(1):76–85.
11. Leufer T, Cleary-Holdforth J. Let's do no harm: medication errors in nursing: part 1. *Nurse Educ Pract.* 2013;**13**(3):213–6. doi: 10.1016/j.nepr.2013.01.013. [PubMed: 23474430].
12. Levinson W. Disclosing medical errors to patients: a challenge for health care professionals and institutions. *Patient Educ Couns.* 2009;**76**(3):296–9. doi: 10.1016/j.pec.2009.07.018. [PubMed: 19683408].
13. 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.
14. Mark BA, Belyea M. Nurse staffing and medication errors: cross-sectional or longitudinal relationships?. *Res Nurs Health.* 2009;**32**(1):18–30. doi: 10.1002/nur.20305. [PubMed: 18825733].
15. Ebrahimpour F, Shahrokhi A, Ghodousi A. Patients' safety and nurses' medication administration errors. *IJFM.* 2014;**20**(1):401–8.
16. Blegen MA, Vaughn TE, Goode CJ. Nurse experience and education: effect on quality of care. *J Nurs Adm.* 2001;**31**(1):33–9. [PubMed: 11198839].
17. Lawton R, Parker D. Barriers to incident reporting in a healthcare system. *Qual Saf Health Care.* 2002;**11**(1):15–8. [PubMed: 12078362].

18. Mansouri A, Ahmadvand A, Hadjibabaie M, Javadi M, Khoee SH, Dastan F, et al. A review of medication errors in iran: sources, underreporting reasons and preventive measures. *Iran J Pharm Res.* 2014;**13**(1):3–17. [PubMed: 24734052].
19. Oladi Ghadikalaee R, Ravaghi H, Hesam S. Study Of Nurses' Perceptions On Medication Errors In Pediatric Hospitals In Tehran, Iran. *J Payavard Salamat.* 2015;**9**(3):315–28.
20. Tol A, Mohebbi B, Gazi Z. The causes of not reporting medication errors from the viewpoints of nursing in Baharlo hospital in 2010. *J Hospital.* 2010;**9**(1):19–24.
21. Kim KS, Kwon SH, Kim JA, Cho S. Nurses' perceptions of medication errors and their contributing factors in South Korea. *J Nurs Manag.* 2011;**19**(3):346–53. doi: 10.1111/j.1365-2834.2011.01249.x. [PubMed: 21507105].
22. Radley DC, Wasserman MR, Olsho LE, Shoemaker SJ, Spranca MD, Bradshaw B. Reduction in medication errors in hospitals due to adoption of computerized provider order entry systems. *J Am Med Inform Assoc.* 2013;**20**(3):470–6. doi: 10.1136/amiajnl-2012-001241. [PubMed: 23425440].
23. Salavati S, Hatamvand F, Tabesh H. Nurses' Perspectives on Causes of Medication Errors and Non-Reporting at ED. *Iran J Nurs.* 2012;**25**(79):72–83.
24. Petrova E. Nurses' perceptions of medication errors in Malta. *Nurs Stand.* 2010;**24**(33):41–8. doi: 10.7748/ns2010.04.24.33.41.c7717. [PubMed: 20461923].
25. Bizhani M, Kouhpayeh SA, Abadi R, Tavacool Z. [U+064D] Effective factors on the Incidence of medication errors from the nursing staff perspective in various department of Fasa Hospital. *J Fasa Univ Med Sci.* 2013;**3**(1):88–93.
26. Dehghan-Nayeri N, Bayat F, Salehi T, Faghihzadeh S. The effectiveness of risk management program on pediatric nurses' medication error. *Iran J Nurs Midwifery Res.* 2013;**18**(5):371–7. [PubMed: 24403939].
27. Delcour F. Building a learning environment at work HRM Guide website; 2012. Available from: http://www.hrmguide.net/guest/learning-environment.htm.
28. Noorian M, Rassouli M, Kavousi A. Nurses' perspectives on factors related to medication errors in neonatal and neonatal intensive care units. *Iran J Nurs.* 2013;**25**(80):65–74.
29. Koohestani HR, Baghcheghi N, Khosravi SH. Frequency, type and causes of medication errors in student nurses. *Iran J Nurs.* 2008;**21**(53):17–27.
30. Pape TM, Guerra DM, Muzquiz M, Bryant JB, Ingram M, Schranner B, et al. Innovative approaches to reducing nurses' distractions during medication administration. *J Contin Educ Nurs.* 2005;**36**(3):108–16. [PubMed: 16022030] quiz 141-2.
31. Soozani A, Bagheri H, Poorheydari M. Survey nurse's view about factors affects medication errors in different care units of Imam Hossein hospital in Shahroud. *J Knowledge Health.* 2007;**2**(3):8–13.
32. Ito H, Yamazumi S. Common types of medication errors on long-term psychiatric care units. *Int J Qual Health Care.* 2003;**15**(3):207–12. [PubMed: 12803348].
33. Tang FI, Sheu SJ, Yu S, Wei IL, Chen CH. Nurses relate the contributing factors involved in medication errors. *J Clin Nurs.* 2007;**16**(3):447–57. doi: 10.1111/j.1365-2702.2005.01540.x. [PubMed: 17335520].
34. Hesari B, Ghodsi H, Hoseinabadi M, Chenarani H, Ghodsi A. A survey of nurses' perceptions of the causes of medication errors and barriers to reporting in hospitals affiliated to Neyshabur University of Medical Sciences, Iran. *J Kerman Univ Med Sci.* 2014;**21**(1):105–11.
35. Cheraghi MA, Nasabadi N, Reza A, Mohammad Nejad E, Salari A, Kheyli EK, et al. Medication errors among nurses in intensive care units (ICU). *J Mazandaran Univ Med Sci.* 2012;**21**(1):115–9.
36. Nikpeyma N, Gholamnejad H. Reasons for medication errors in nurses'views. *Fac Nurs Midwifery Q.* 2009;**19**(64):18–24.
37. Page K, McKinney AA. Addressing medication errors–The role of undergraduate nurse education. *Nurse Educ Today.* 2007;**27**(3):219–24. doi: 10.1016/j.nedt.2006.05.002. [PubMed: 16839646].
38. Lisby M, Nielsen LP, Mainz J. Errors in the medication process: frequency, type, and potential clinical consequences. *Int J Qual Health Care.* 2005;**17**(1):15–22. doi: 10.1093/intqhc/mzi015. [PubMed: 15668306].
39. Ammenwerth E, Schnell-Inderst P, Machan C, Siebert U. The effect of electronic prescribing on medication errors and adverse drug events: a systematic review. *J Am Med Inform Assoc.* 2008;**15**(5):585–600. doi: 10.1197/jamia.M2667. [PubMed: 18579832].