

## A Survey on the Frequency of Medication Errors Caused Due to Look-Alike Drugs in the Emergency Department of the Educational Hospitals of Shiraz, Iran, 2016

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### ABSTRACT

The words “look-alike” and “sound-alike” are used to express the confusion caused by drugs whose names or features are similar. Look-alike/sound-alike (LASA) drugs are one of the most common causes of medication errors. The emergency department is the first place where mistakes related to LASA drugs occur. Medicinal errors increase health care costs by about two billion dollars annually. This study examines the frequency of errors resulting from LASA drugs in the emergency department and identifies the main causes of these errors. This sectional analytical study was conducted in 2016 in the Namazi and Faghihi hospitals of Shiraz. The questionnaire was developed by the researcher and its validity was confirmed by the experts. The stratified sampling method was used and the sample size was determined to be 106 people, based on the Cochran formula. The data were analyzed using the software SPSS 20 by the Pearson correlation coefficient, the independent t-test, and an analysis of variance (ANOVA). Seventy-seven nurses stated that during the past six months they had made at least one error resulting from look-alike medication and a total of 132 errors were reported. The most common errors in medication related to ampoules and vials. The rate of errors was statistically significant in terms of marital status ( $p < 0.05$ ), work experience ( $p < 0.0001$ ) and age ( $p < 0.0001$ ). Providing training courses for recently appointed nurses, using experienced nurses in the emergency department can be an effective step toward reducing the errors relating to LASA drugs.

**Key words:** Medication Errors, Nurses, Hospitals, Patient Safety, Workload, LASA drugs

### INTRODUCTION

The main goal of the health care system is the preservation and promotion of better health. Patient safety is one of the key aspects of the health care provision system and is an important factor in maintaining the quality of health services [1]. Human errors indicate that current health care systems have some problems and endanger the patients [2]. The published information indicates the expansion of an increase in common mistakes leading to disastrous events [3]. According to the American Medical Association's report on human error, between 44,000 and 98,000 people in US hospitals annually die due to medical errors that are preventable. This is more than that of motor vehicle accidents, breast cancer, or AIDS, which receive greater public attention as they are perceived to be major causes of death [4, 5]. An error in medicine administration can be defined as a failure in the treatment process that potentially causes harm to the patient [6]. Errors may occur when the

medications appear to be similar or have similar names. These errors are called look-alike/sound-alike medication errors (LASA) [7]. It is estimated that about one quarter of the errors in the United States are cases of misidentification of look-alike medications [8]. In 1973, Benjamin Teplitsky published a list of LASA drugs, and this was the first warning about the confusion caused by LASA drugs [9]. The World Health Organization explicitly identifies LASA drugs as one of the most common causes of medication errors [10]. This occurs mainly because of slippage in the degree of attention due to which even after cross-checking our minds tend to see what it has already presumed to be right. Also, to add to this, similar packaging and appearance causes deadly errors [11]. Although several ways have been outlined to prevent or mitigate these errors, none of them are completely effective and may not be a suitable alternative to ensure continuous alertness in the drug administration process [12]. LASA drugs,

especially when they do not perform the same function, should be placed on separate shelves [13]. Medication errors are largely due to misunderstanding of the prescriptions, inadequate knowledge, and misidentification of drugs due to their shape, color, or packaging, which causes the unwanted replacement of drugs by pharmacists and nurses, and leads to either injury or death of the patient [14–16]. Identifying LASA medication errors is like trying to find a needle in a haystack [17]. The more important issue is the behavior of the pharmaceutical companies toward this issue. They do not pay attention to designing packages in order to avoid these errors as they are legally only required to insert information on the package of medications providing user guidance and informing about drug combinations [18].

The emergency department is the first place of occurrence for medication errors arising from similar names and packaging [11]. The urgency of the emergency response and unpredictability of the emergency department has made it a high-risk environment for making medication errors [19]. Despite these potential dangers, there is relatively little knowledge, at this moment, about the nature of medication errors in the emergency department. The error frequency estimate in the emergency department varies from 4%–14% [5, 20]. Among children, this estimate is higher than 39% [21]. The emergency department faces many challenges to perform its duty of providing high-quality, efficient, and safe care to a diverse range of patients [22].

Emergency medicine has been described as the co-care of multiple patients with a wide range of conditions who are often heavily ill [23]. Thus, this department is prone to drug events for various reasons such as chaotic work environment, rapid deterioration of the patient's condition and congestion in the department [24]. Based on various studies, about a third of the adverse drug-related events are associated with medication errors that are preventable [25]. According to the reports by the American Medical Association, medication errors increase health care costs by about \$2 billion annually [26]. Human casualties caused by avoidable medication errors represent a massive economic burden on society [27].

Therefore, this study aims to determine the frequency of errors relating to look-alike drugs and to identify the most important factors affecting it from the perspective of a nurse. After evaluation of the results by the authorities, effective measures can be taken to improve the packaging of the medicines and to resolve the problems associated with these drugs, ultimately leading to a decrease in the error rate relating to look-alike drugs, an increase in the safety

and health of the patients, and a reduction in the mental stress of the nurses.

## MATERIALS AND METHODS

### *Design and Sampling*

In this study, errors that result from look-alike drugs in the emergency department of the educational public-sector hospitals of the Shiraz University of Medical Sciences have been investigated. These include the Namazi and Shahid Faghihi hospitals. This choice has been made as these two are the major hospitals in the Fars province and the only educational public-sector hospitals of Shiraz. The study is of the sectional analytical type. In this study, a questionnaire was developed by a researcher based on the research goals and its validity, which was then confirmed by the experts. Using this questionnaire, the magnitude of the error in the emergency department of the mentioned hospitals was determined. The sample size of the questionnaire was calculated to be 106 people according to the Cochran formula.

The stratified sampling method was used for this study. Each of the treatment centers was selected as one of the sampling classes. As per the proportional allocation method, 70 questionnaires were distributed in the Namazi Hospital and 36 in the Faghihi hospital randomly among the nurses and the information was collected. The reliability of the questionnaire was determined using a Cronbach's alpha of 90%.

### *Structure and the Study Instrument*

The questionnaire consisted of three parts. The first part contained information about the participant's demographic (age, sex, education, work experience, and employment status). The second part consisted of two parts: The first part included nine items about the type of errors that can occur because of look-alike medication, the frequency of each error occurring over the past six months, how many of these errors were recorded formally, and how many weren't. The second part included the type of drug that was injected (with the name to indicate which drug was used and which drug it was used instead of). The third part contains 25 questions about the factors affecting the occurrence of these errors according to the degree of importance based on the Likert 5 spectrum. The number 1 signified least importance while the number 5 was the most important factor in the occurrence of errors due to look-alike medication in the emergency department.

For ethical reasons, the following formalities were carried out: presentation of a written letter of recommendation, emphasis on voluntary participation in the research, lack of registration and surname, and confidentiality of information, and in case of willingness, submitting the research results.

This study was conducted after approval and authorization by the Shiraz University of Medical Sciences. In this study, a p value less than 5% was determined as the significant level.

#### Study populations

The research population consisted of nurses from the emergency ward of Namazi Hospital and Shahid Faghihi Hospital. The reason for deciding on six months as the minimum required time period was so that the staff did not have any concerns such as unfamiliarity with the way of work and current processes in the emergency department, and to ensure that they had full control of their working conditions so that these factors did not interfere in research.

#### Data Analysis

The data was analyzed using descriptive and inferential statistical methods with the help of the SPSS 20 software. Pearson's correlation test was used to determine the relationship between age and work experience and the frequency of errors due to look-alike medication. The ANOVA was used to determine the relationship between employment status and the frequency of these errors. Also, to determine the relationship between gender, marital status, and hospital and the frequency of these errors, the independent t-test was used. The nurses' entry

criteria included being employed in the emergency department for at least six months.

## RESULTS

In this study, answers to the prepared questionnaire were collected from 106 nurses of the emergency department of the Namazi and Faghihi hospitals and analyzed. The mean age of the respondents was  $27.00 \pm 4.58$ ; for Namazi Hospital it was  $26.50 \pm 4.40$  while for Faghihi Hospital it was  $28.00 \pm 4.81$ . The demographic characteristics of the participants are presented in Table 1.

Out of the 106 nurses participating in the study, 77 stated that during the past six months there was at least one mistake in the use of drugs with similar appearances, and a total of 132 errors were reported over the period of six months. It should be noted that out of the 106 nurses who participated in the study, 70 nurses were from Namazi Hospital (91 errors in medication in the past six months) and 36 nurses were from Faghihi Hospital (41 errors in medication in the past six months). The results are presented in Table 2. Out of the 132 errors caused by look-alike medication, only 14 cases were reported in writing. The results are shown with respect to each hospital and in terms of number and percentage (Table 3).

**Table 1:** Demographic characteristics of the 106 participating nurses from the emergency department

Variable	Variable grouping	Frequency (percentage)	Namazi hospital	Faghihi hospital
Gender	Male	(34) %32.1	(22) %31.4	(12) %33.3
	Female	(72) %67.9	(48) %68.6	(24) %66.7
Marital status	Married	(40) %37.7	(24) %34.3	(16) %44.4
	Single	(66) %62.3	(46) %65.7	(20) %55.6
Education	Bachelor's degree	(103) %97.2	(67) %95.7	(36) %100
	MS	(3) %2.8	(3) %4.3	(0) %0
Employment status	Official	(7) %6.6	(5) %7.1	(2) %5.6
	Contractual	(26) %24.5	(13) %18.6	(13) %36.1
	Project	(73) %68.9	(52) %74.3	(21) %58.3
Work experience	Less, equal to 5 years	(83) %78.3	(60) %85.7	(23) %63.9
	Between 5 and 10 years	(15) %14.2	(7) %10.0	(8) %22.2
	More than 10 years	(8) %7.5	(3) %4.3	(5) %13.9

**Table 2:** The total number of errors and the number of nurses with at least one error in the emergency department within six months

Error report	Without separation of Hospital	Namazi Hospital	Faghihi Hospital
At least one error	(77) 72.6%	(51) 48.1%	(26) 24.5%
Total Error	(132) 100%	(91) 69%	(41) 31%

**Table 3:** Reporting of errors due to look-alike medication by emergency department nurses within six months

Error Report	Total Error	Record of Error Report	Lack of record of Error Report
Without hospital separation	100% (132)	10.6% (14)	89.4% (118)
Namazi Hospital	100% (91)	12% (11)	88% (80)
Faghihi Hospital	100% (41)	7.3% (3)	92.7% (38)

As seen in Table 4, the highest frequency in errors due to look-alike drugs is given by the type of medication. Among these, 64 cases are of ampoules

**Table 4:** Reporting of errors due to look-alike medication by 106 nurses in the emergency department based on the type of drug for six months

and 34 cases of vials. This type of error accounts for 74% of the total errors.

Results based on the type of error	Without separating the Hospital	Namazi Hospital	Faghihi Hospital
Ampoule	48.5% (64)	65.6% (42)	34.4% (22)
Vial	25.7% (34)	67.6% (23)	32.4% (11)
Serum	6.8% (9)	88.9% (8)	11.1% (1)
Tablet	12.8% (17)	76.5% (13)	23.5% (4)
Capsule	2.3% (3)	66.7% (2)	33.3% (1)
Syrup	0.75% (1)	0	100% (1)
Drop	0	0	0
Ointment	0.75% (1)	100% (1)	0
Spray	2.3% (3)	66.7% (2)	33.3% (1)

A number of participants also stated that they did not remember the name of the drug, which led to the confusion between drugs that have almost features similar. Among the number of cases mentioned, the highest medication error in the ampoules was related to the pair of drugs heparin and atropine (13 cases). In vials, the highest was for ceftriaxone and cefazolin (three cases) and for meropenem and imipenem (three cases). As for tablets, the pair nitrocontin and warfarin caused two cases of errors. In the case of serums, normal saline irrigation and dextrose saline were mixed up (2 cases).

The magnitude of error of the look-alike drugs according to the type of hospital was not significantly different from the independent t-test. ( $p > 0.05$ ,  $t = 679$ ). Also, the rate of error due to look-alike drugs by nurses in the emergency department was not statistically significant in terms of gender on the independent t-test. Without segregating the hospital data it was  $p > 0.05$ ,  $t = -0.24$ . For Namazi Hospital it was  $p > 0.05$ ,  $t = -0.12$ , while the results for Faghihi Hospital were  $p > 0.05$ ,  $t = -0.24$ . The rate of error for the look-alike medication by nurses in the emergency department was statistically significant in terms of marital status as per the independent t-test. Thus, there was a higher level of error among single individuals than married ones. The results for this are as follows: without hospital data segregation:  $p < 0.05$ ,  $t = -2.27$ ; for Namazi Hospital:  $p > 0.05$ ,  $t = -1.26$ ; and for Faghihi Hospital:  $p < 0.05$ ,  $t = -0.2$ , 30. The mean and standard deviation for single individuals without hospital data segregation was  $1.43 \pm 1.15$ , for Namazi

Hospital was  $1.43 \pm 1.22$ , and for Faghihi Hospital was  $0.75 \pm 0.77$ . As for the married participants, the mean and standard deviation without hospital data segregation was  $0.92 \pm 1.09$ , for Namazi Hospital it was  $1.04 \pm 1.26$ , and for Faghihi Hospital it was  $1.45 \pm 0.99$ . There was no significant difference in the degree of error for look-alike drugs in the emergency department based on the employment status as given by the ANOVA test. The results are: without hospital data segregation:  $p > 0.05$ ;  $f = 1.33$ ; for Namazi Hospital:  $p > 0.05$ ,  $f = 0.19$ ; and for Faghihi Hospital:  $p > 0.05$ ,  $f = 0.2, 17$ . The rate error for look-alike drugs by nurses in the emergency department showed a statistically significant and inverse relationship with work experience based on the Pearson correlation test. Increase in the work experience led to the drop in the rate of error; without hospital data segregation:  $p < 0.0001$ ,  $r = -0.338$ ; for Namazi Hospital:  $p < 0.01$ ,  $r = -0.295$ ; and for Faghihi Hospital:  $p < 0.01$ ,  $r = -0.432$ . The frequency in error based on the participants' age also showed a significant and inverse nature based on the correlation coefficient of the Pearson correlation test. So, by increasing the age, a decrease in the rate of error was observed; without hospital data segregation:  $p < 0.0001$ ,  $r = -0/345$ ; for Namazi Hospital:  $p < 0.05$ ,  $r = -0/268$ ; and for Faghihi Hospital:  $p < 0.01$ ,  $r = -0/519$ .

The most important causes of errors arising from look-alike medication from the nurses' viewpoint in the emergency department of Namazi and Faghihi hospitals are shown in terms of importance (Table 5).

**Table 5:** The most important causes of errors arising from look-alike medication from the viewpoint of 106 nurses in the emergency department

Major Causes of Error Occurrence	Without Hospital Separation	Namazi Hospital	Faghihi Hospital
Low nurse ratio to patient	67% (71)	70% (49)	61.1% (22)
Extra work followed by excessive fatigue	66% (70)	72.9% (51)	52.8% (19)
Overcrowding	63.2% (67)	65.7% (46)	58.3% (21)
Excessive work and outsourcing	58.5% (62)	61.4% (43)	52.8% (19)
Type of working shift	51.9% (55)	54.3% (38)	47.2% (17)
The presence of ill patients in the department	48.1% (51)	52.9% (37)	38.9% (14)
Inappropriate Physical Environment (Light, Temperature, Noise ...)	46.2% (49)	45.7% (32)	47.2% (17)
The division of labor between nurses	37.7% (40)	40% (28)	33.3% (12)

## DISCUSSION

The results show that 72% of the population who were studied had at least one error due to look-alike medication over the period of six months, which indicates a high percentage of these errors. In the study of Bagheri-Nesami *et al.*, drug packaging mistakes accounted for 24% of the errors and were the second leading cause of intravenous medication administration errors [28]. In the study of Seidi and Zardosht, low-quality labeling and packaging, from the nurses' point of view, was the fifth-most important factor, causing 53.9% of the medication errors [29]. In a study conducted by Mrayyan *et al.*, the most important cause of medication errors was found to be inappropriate labeling and packaging of the drug. It was found to have an average of 5.71 and a standard deviation of 3.09 [30].

Based on the results, more than 89% of nurses' medication errors are not reported. The study of Duarte *et al.* points out that the reporting of medication errors is still neglected due to the existence of a culture of error. There is a big problem of the acceptance of error, fear of punishment, and lack of understanding of the society as well [31]. A study by Alqubaisi *et al.* also found that although patient safety and organizational goals are facilitators of error reporting, a number of key factors including concern about the consequences of the error (impact on professional reputation, communication, and career development), emotions (fear and worry), and underlying issues (time spent on error reporting) prevent its occurrence [32]. In the study of Bahadori *et al.*, the most important reasons for not reporting medication errors were related to managerial factors ( $3.56 \pm 0.986$ ), factors associated with the error-reporting process ( $3.32 \pm 0.779$ ), and fear of the outcomes of reporting error ( $1.039 \pm 3.01$ ) [33]. The low percentage of error reporting in this study can also be due to the response of managers, inadequacy of the culture of error reporting, fear of consequences, impact on career advancement, and so on.

Based on the results of this study, the most common medication errors associated with ampoules and vials have been explored in a study by Lu *et al.*, which suggested that some high-alert drugs, such as heparin, were being more commonly used in departments. They emphasized separating the storage area of these drugs by segregating it into sections [34]. The study of Esfahani *et al.*, while referring to high-risk drugs such as heparin and warfarin, states that although risky drugs account for only 7% of medication errors, they account for 65% of serious adverse events [35]. According to the results of this study, since the highest rate of error was related to ampoules and vials, special focus in this area and the adoption of special measures can lead to a significant reduction

in the frequency of errors caused by look-alike medication. In the present study, there was a significant relationship between the age, work experience, and marital status and the number of errors caused. However, the study of Farzi *et al.* found no significant relationship between age and work experience with the frequency of medication errors [36]. Also, in the study of Noorian *et al.* (2013), there was no significant relationship between age, work experience, and marital status [37]. In Fahimi *et al.* as well, no significant relationship was found between medication error and marital status, work experience, and gender [38]. The study of Gorgich *et al.* did not show a significant relationship between sex and medication error rates [39]. The reason for the significant reverse relationship between the age of an individual, work experience, and error rate in this study can be due to the increased experience and skills that the nurses gain after a long service period and service history. The reason that single individuals have a higher error rate than married ones can be because of the fact that the single people usually have more concerns about their career and personal life. These factors can cause distraction and lack of concentration in the workplace. One of the most important factors for errors in the present study was the low nurse-patient ratio, forced labor, and consequently high fatigue, overcrowding, and high workload. Participants in this study regularly point out the shortage of nursing staff, the high volume of patients, and the fact that a nurse must take care of a large number of patients in each shift of work leads to these errors. In a systematic review study by Salmasi *et al.*, the lack of staff, high volume of nurses' work, distraction of physicians and nurses, and misinterpretation of prescriptions were named as factors affecting medication errors [40]. The Kang *et al.* study showed that the workload of nurses was associated with adverse events of patients and an increase in medication errors, and also pointed out that if the workload of nurses, which plays a vital role in improving the quality of safety and providing nursing services, decreased, the patient's safety increased effectively [41]. In the study of Yousefi *et al.*, the most important factors affecting medication errors from the nurses' point of view are the shortage of nurses and the fatigue caused by extra work [42], which are consistent with the results of this study. One of the limitations of the study was studying the crowding of the emergency department and the high workload of the nurses as it was difficult to seek the nurses' cooperation for longer periods of time and also as numerous researchers could not be recruited to handle all the shifts. In addition to this, the small sample size surveyed was not a good representative

for the entire hospital. This issue should be examined on a wider scale.

## CONCLUSION

The drug authorities must adopt measures such as concessions to pharmaceutical companies that work in this area to reduce the mistakes caused by LASA drugs. Adopting strategies to increase the number of nurses by the authorities, and organizing training courses for new staff can be effective in reducing LASA drug mistakes. Considering that most nurses of the emergency department are plan forces, short-term training courses are essential for familiarity with the environment, medications, common mistakes, and emergency situations. It is also recommended that managers use experienced nurses in the emergency department and for further care as well. The support of managers for nurses after committing errors, and particularly proper handling following error awareness can bring about peacefulness for nurses, enhanced error reporting.

## ETHICAL ISSUES

Ethical issues such a plagiarism has been observed by the authors.

## COMPETING OF INTEREST

The authors have declared that no competing interest exists.

## AUTHORS CONTRIBUTION

All authors equally help to write this manuscript.

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## REFERENCES

- [1] Ehsani SR, Cheraghi MA, Nejati A, Salari A, Esmaeilpoor AH, Nejad EM. Medication errors of nurses in the emergency department. *Journal of medical ethics and history of medicine*. 2013;6(11):1-7.
- [2] Jepson ZK, Darling CE, Kotkowski KA, Bird SB, Arce MW, Volturo GA, *et al*. Emergency department patient safety incident characterization: an observational analysis of the findings of a

standardized peer review process. *BMC emergency medicine*. 2014;14(1):20-12.

[3] Buckle P, Clarkson P, Coleman R, Ward J, Anderson J. Patient safety, systems design and ergonomics. *Applied ergonomics*. 2006;37(4):491-00.

[4] Donaldson MS, Corrigan JM, Kohn LT. *To err is human: building a safer health system*. United States: Washington,DC: National Academies Press; 2000.

[5] Pham JC, Story JL, Hicks RW, Shore AD, Morlock LL, Cheung DS, *et al*. National study on the frequency, types, causes, and consequences of voluntarily reported emergency department medication errors. *The Journal of emergency medicine*. 2011;40(5):485-92.

[6] Aronson JK. Medication errors: definitions and classification. *British journal of clinical pharmacology*. 2009;67(6):599-04.

[7] Schnoor J, Rogalski C, Frontini R, Engelmann N, Heyde C-E. Case report of a medication error by look-alike packaging: a classic surrogate marker of an unsafe system. *Patient safety in surgery*. 2015; 9(1):12.

[8] Bryan R, Aronson JK, ten Hacken P, Williams A, Jordan S. Patient safety in medication nomenclature: orthographic and semantic properties of international nonproprietary names. *PloS one*. 2015;10(12): e0145431.

[9] Ciociano N, Bagnasco L. Look alike/sound alike drugs: a literature review on causes and solutions. *International journal of clinical pharmacy*. 2014;36(2):233-42.

[10] Naunton M, Gardiner HR, Kyle G. Look-alike, sound-alike medication errors: a novel case concerning a slow-Na, slow-K prescribing error. *International medical case reports journal*. 2015;8:51-53.

[11] Tuohy N, Paparella S. Look-alike and sound-alike drugs: errors just waiting to happen. *Journal of emergency nursing*. 2005;31(6):569-71.

[12] Walliser G, Grossberg R, Reed MD. Look-alike medications: A formula for possible morbidity and mortality in the long-term care facility. *Journal of the American Medical Directors Association*. 2007;8(8):541-42.

[13] Zhao R-y, He X-w, Shan Y-m, Zhu L-l, Zhou Q. A stewardship intervention program for safe medication management and use of antidiabetic drugs. *Clinical interventions in aging*. 2015;10:1201-12.

[14] Chen M-J, Yu S, Chen I-J, Wang K-WK, Lan Y-H, Tang F-I. Evaluation of nurses' knowledge and understanding of obstacles encountered when administering resuscitation medications. *Nurse education today*. 2014;34(2):177-84.

- [15] Emmerton LM, Rizk MF. Look-alike and sound-alike medicines: risks and 'solutions'. *International journal of clinical pharmacy*. 2012;34(1):4-8.
- [16] Kenagy JW, Stein GC. Naming, labeling, and packaging of pharmaceuticals. *American Journal of Health-System Pharmacy*. 2001;58(21):2033-41.
- [17] Basco WT, Ebeling M, Hulsey TC, Simpson K. Using pharmacy data to screen for look-alike, sound-alike substitution errors in pediatric prescriptions. *Academic pediatrics*. 2010;10(4):233-37.
- [18] Ostini R, Roughead EE, Kirkpatrick CM, Monteith GR, Tett SE. Quality Use of Medicines—medication safety issues in naming; look-alike, sound-alike medicine names. *International Journal of Pharmacy Practice*. 2012; 20(6): 349-57.
- [19] Schenkel S. Promoting patient safety and preventing medical error in emergency departments. *Academic Emergency Medicine*. 2000;7(11):1204-22.
- [20] Caterino JM, Emond JA, Camargo CA. Inappropriate medication administration to the acutely ill elderly: a nationwide emergency department study, 1992–2000. *Journal of the American Geriatrics Society*. 2004;52(11):1847-55.
- [21] Marcin JP, Dharmar M, Cho M, Seifert LL, Cook JL, Cole SL, *et al*. Medication errors among acutely ill and injured children treated in rural emergency departments. *Annals of emergency medicine*. 2007;50(4):361-67.
- [22] Rothschild JM, Churchill W, Erickson A, Munz K, Schuur JD, Salzberg CA, *et al*. Medication errors recovered by emergency department pharmacists. *Annals of emergency medicine*. 2010;55(6):513-21.
- [23] Fordyce J, Blank FS, Pekow P, Smithline HA, Ritter G, Gehlbach S, *et al*. Errors in a busy emergency department. *Annals of emergency medicine*. 2003;42(3):324-33.
- [24] Epstein SK, Huckins DS, Liu SW, Pallin DJ, Sullivan AF, Lipton RI, *et al*. Emergency department crowding and risk of preventable medical errors. *Internal and emergency medicine*. 2012;7(2):173-80.
- [25] Stratton KM, Blegen MA, Pepper G, Vaughn T. Reporting of medication errors by pediatric nurses. *Journal of pediatric nursing*. 2004;19(6):385-92.
- [26] Bates DW, Spell N, Cullen DJ, Burdick E, Laird N, Petersen LA, *et al*. The costs of adverse drug events in hospitalized patients. *Jama*. 1997;277(4):307-11.
- [27] Peth HA. Medication errors in the emergency department: a systems approach to minimizing risk. *Emergency medicine clinics of North America*. 2003;21(1):141-58.
- [28] Bagheri-Nesami M, Esmaeili R, Tajari M. Intravenous Medication Administration Errors and their Causes in Cardiac Critical Care Units in Iran. *Materia socio-medica*. 2015;27(6):442-46.
- [29] 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. *Journal of Fasa university of medical sciences*. 2012;2(3):142-47.
- [30] Mrayyan MT, Shishani K, AL-FAOURI I. Rate, causes and reporting of medication errors in Jordan: nurses' perspectives. *Journal of nursing management*. 2007;15(6):659-70.
- [31] Duarte SdCM, Stipp MAC, Silva MMd, Oliveira FTd. Adverse events and safety in nursing care. *Revista brasileira de enfermagem*. 2015;68(1):144-54.
- [32] Alqubaisi M, Tonna A, Strath A, Stewart D. Exploring behavioural determinants relating to health professional reporting of medication errors: a qualitative study using the Theoretical Domains Framework. *European journal of clinical pharmacology*. 2016;72(7):887-95.
- [33] Bahadori M, Ravangard R, Aghili A, Sadeghifar J, Gharsi Manshadi M, Smaeilnejad J. The factors affecting the refusal of reporting on medication errors from the nurses' viewpoints: a case study in a hospital in Iran. *ISRN nursing*. 2013;.
- [34] Lu M-C, Yu S, Chen I-J, Wang K-WK, Wu H-F, Tang F-I. Nurses' knowledge of high-alert medications: a randomized controlled trial. *Nurse education today*. 2013;33(1):24-30.
- [35] Esfahani AK, Varzaneh FR, Changiz T. The effect of clinical supervision model on high alert medication safety in intensive care units nurses. *Iranian Journal of Nursing and Midwifery Research*. 2016;21(5):482-86.
- [36] Farzi S, Farzi S, Alimohammadi N, Moladoost A. Medication errors by the intensive care units' nurses and the Preventive Strategies. *Anesthesiology and Pain*. 2016;6(2):33-45.
- [37] Taheri HabibAbadi E, Noorian M, Rassouli M, Kavousi A. Nurses' perspectives on factors related to medication errors in neonatal and neonatal intensive care units. *Iran Journal of Nursing*. 2013;25(80):65-74.
- [38] Fahimi F, Ariapanah P, Faizi M, Shafaghi B, Namdar R, Ardakani MT. Errors in preparation and administration of intravenous medications in the intensive care unit of a teaching hospital: an observational study. *Australian critical care*. 2008;21(2):110-16.
- [39] Gorgich EAC, Barfroshan S, Ghoreishi G, Yaghoobi M. Investigating the causes of medication errors and strategies to prevention of them from nurses and nursing student viewpoint. *Global journal of health science*. 2016;8(8):220.

[40] Salmasi S, Khan TM, Hong YH, Ming LC, Wong TW. Medication errors in the Southeast Asian countries: a systematic review. *PLoS One*. 2015;10(9):e0136545.

[41] Kang J-H, Kim C-W, Lee S-Y .Nurse-Perceived Patient Adverse Events depend on Nursing Workload. *Osong public health and research perspectives*. 2016;7(1):56-62.

[42] Yousefi M, Abed Saeedi Z, Maleki M, Sarbakhsh P. Frequency and causes of medication errors of nurses in different shift works in educational hospitals affiliated to Shahid Beheshti University of Medical Sciences. *Journal of Shahid Beheshti School of Nursing & Midwifery*. 2014;24(86):27-34.