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Evaluation of Medication Errors in Preparation and Administration of Intravenous Medicines in Intensive Care Units in Imam Reza and Shohada Hospitals in Tabriz

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ABSTRACT

Background: Studies have shown that medication errors and adverse drug reactions are among the main causes of adverse events in hospitals leading to disability and death. Errors occur in the process of drug prescribing, dispensing, and administration. errors are most often made on the patient care units with various risk factors. The aim of the study was to evaluate medication errors in preparation and administration of intravenous medications in two Intensive Care Units of two university hospitals in Tabriz.

Methods: An observational and single-blinded study was carried out in the pulmonary ICU of Imam Reza hospital and the ICU of Shohada hospital using general and mono-drug checklists of error-prone situations. 14 different error categories were studied.

Results: Total of 367 administrations for 26 different drugs were observed. among 4558 opportunities for errors, 640 errors were identified. Error rate of 15.99 % and 10.96 % were reported in Imam Reza and Shohada hospital, respectively. Wrong rate error and controls during administration had the highest rate of errors in Imam Reza and Shohada hospitals, respectively. Streptokinase in Imam Reza hospital and ceftazidime in Shohada hospital were the drugs with highest error rate. Midnight and 10 PM administration rounds had the highest error rate in Imam Reza and Shohada hospitals, respectively. Error rate in Imam Reza hospital was significantly higher.

Conclusion: It is concluded that medication errors occur in all stages like preparation and administration mostly related to rate of administration and controls needed while administration; Strict controlling, training programs, and presence of clinical pharmacists are highly recommended.

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Introduction

Studies have shown that medication errors (MEs) and adverse drug reactions (ADRs) are among the main causes of adverse events in hospitals leading to disability and death in up to 6.5% of hospital admissions (1–5). Application of appropriate methods for identifying medication errors and assessing potential adverse drug events are important. Errors can occur in the process of drug prescribing, dispensing, and administration. Medication administration errors in hospitals are most often made by nurses preparing and administering medications on the patient care units with various risk factors (6).

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Intravenous therapy usually needs to be prepared immediately before administration. These processes present multiple opportunities for errors (7). Most patients hospitalized in intensive care units (ICUs) suffer from severe and complicated illnesses, and this critical status need multi-drugs therapy. Therefore, prescribing different medications for treating these patients may increase the incidence of medication errors.

Existence of controlling systems of therapeutic management seems to be necessary in health care systems such as ICUs. There have been studies examining MEs in different settings. Thirty five years ago Breckenridge investigated preparation and administration of intravenous (IV) medication on hospital wards in the United Kingdom (9). In his report it was summarized that there was a lack of information and guidelines, as well as inadequate prescribing, which resulted into poor quality of care. Following this report few studies have been performed on the use of IV drugs and related medication errors. There were also studies which investigated only IV medication errors: one found 84.4% errors in 179 observed drug administration, while the other reported an error rate of 24.7% for 320 observed preparations and administrations (10). The objective of this study was to determine frequency, and types of errors which occur in preparation and administration of commonly used IV medications in two ICUs of two teaching hospitals. Types of errors include: Storage Prior to Preparation, Type of Diluent, Volume of Diluent, Wrong Dose, Wrong Rate, Wrong Time, physicochemical incompatibilities, omission, wrong route, controls during administration, controls after administration, wrong drug, wrong patient.

Methods

This study was an observational and single-blinded study which was carried out in two intensive care units in Tabriz including the pulmonary ICU of Imam Reza hospital and the ICU of Shohada hospital. Both general and mono-drug checklists of error-prone situations for each drug was prepared prior to study. This was prospective study. In these wards, all IV medication preparation and administrations are performed by ICU nurses. IV observation shifts was selected randomly in the studied period. Each nurse was observed twice in the study. A researcher familiar with the techniques of IV drug preparation and administrations accompanied the nurses during the IV rounds; following the process of preparing and administering the drug products. On each day of the study, preparation and administration of IV drugs performed by one nurse was observed. Duration of each observation depended on nurses' work load on that day and continued until all preparation and administration stages were completed.

A general and mono-drug check-list was prepared based on reference books and manufacturers' leaflets. Information was collected from direct observation and talking informally to the staff. The researcher only intervened in a discreet and non-judgmental manner when he became aware of a potentially serious error; however, these incidents were still included as an error. Nurses were told that this is part of a clinical pharmacy training program. The study also included weekends and all times of drug rounds on each ward.

Physician orders were reviewed at least 1 hour before each IV preparation rounds. Personal information of the nurses was asked from the head-nurses of each ward prior to the study. This information was about nurses' age, gender, type of employment, educational status, work experience, type of contract (permanent or temporary) and having a second job. These data were collected to determine if these factors have any effect in the incidence of errors.

Each nurse was given a code number and they were all be blinded to the study. It is anticipated after a few days of observations, the ward staff will forget the study and behaved normally. It is demonstrated that such observations will not affect the error rate significantly. Nurses' information was kept confidential. Since the study is single-blind, none of nurses will be aware of the aim of the study, and only the head-nurses of the wards were aware of the study.

The first ICU was pulmonary ICU of Imam Reza hospital consisted of 31 nurses 1 head-nurse, 13 beds and 1 general drug stock. Nurse-patient ratio was 1 to 2, and the schedules of administration were 9 AM, Noon, 5 PM, 9 PM, and midnight. The second ward was neurosurgery and trauma ICU of Shohada hospital which consisted of 17 nurses 1 head-nurse, 8 beds and 1 general drug stock of drugs. Nurse-patient ratio was 1 to 2 and the schedule of administration was 10 AM, 2 PM, and 10 PM.

The study was not an interventional one, and the results will be reported without mentioning nurses' names. Confidential aspects are fully considered during all stages of the study.

Types of errors studied are defined as: A wrong time error is defined as the administration of drugs 1 hour before or after the scheduled time. Wrong dose is defined as the administration of doses ±10% or more of the original prescribed dose. Incorrect drug included the administration of a drug to the wrong patient but not the administration

of a wrong medication. Some drug administration errors would lead to subsequent errors. For example, incorrect drug preparation would result in incorrect dose; and wrong patient error would result in wrong drug error and both errors were considered as error. Data analysis was performed using software SPSS version 18 and Excel 2007. Tests used in the study included Chi-Square, Pearson correlation and T-test. A significance level of $P<0.05$ was considered.

Results

In Imam Reza ICU, the mean of nurses' ages was 32.45 ± 4.80 years. The age range was 26-41. The mean work experience was 6.27 ± 3.53 years. Half had the 5-year work experience. 27 (87.09%) were formally employed and 4 (12.91%) were contract workers. None had a second job. In the ICU of Shohada hospital

The mean of nurses' age was 32.00 ± 5.70 years. The age range was 25-45. Half of them had the experience for 3 years. 5 (29.41%) were tenure and 12 (70.58%) were contract workers. Two (11.76%) had a second job.

An important difference between the study sites is the service provided by the clinical pharmacist in Shohada hospital. All drugs with their error rate, percentage of total, factor correction, corrected percentage, and corrected percentage of total in the pulmonary ICU of Imam Reza hospital and the ICU of Shohada hospital are seen in Tables 1 and 2, respectively.

Table 1. Frequencies and error rate of intravenous products administrated in the pulmonary intensive care unit of Imam Reza hospital.

Table 1. Frequencies and error rate of intravenous products administrated in the pulmonary intensive care unit of Imam Reza hospital.

Intravenous Medication	Number of Administration(%)	Number of Errors	Percentage of Total	Factor Correction*	Corrected Percentage	Corrected Percentage of Total %
Ciprofloxacin	71 (31.69)	114	25.56	852	13.38	3.72
Streptokinase	1 (0.44)	4	0.89	13	30.77	8.56
Metronidazole	12 (5.35)	25	5.60	132	18.94	5.26
Clindamycin	10 (4.46)	11	2.46	130	8.46	2.35
Vancomycin	13 (5.80)	45	10.08	169	26.63	7.40
Imipenem / Cilastatin	24 (10.71)	42	9.41	312	13.46	3.74
Meropenem	14 (6.25)	25	5.60	168	14.88	4.14
Magnesium Sulfate	12 (5.35)	33	7.39	168	19.64	5.46
Pantoprazole	14 (6.25)	33	7.39	196	16.84	4.68
Albumin	23 (10.26)	52	11.65	276	18.84	5.24
Heparin	1 (0.44)	1	0.22	13	7.69	2.13
Ceftriaxone	6 (2.67)	17	3.81	78	21.79	6.06
Ceftazidime	4 (1.78)	13	2.91	52	25.00	6.95
Valproate Sodium	4 (1.78)	6	1.34	52	11.54	3.21
Calcium Gluconate	2 (0.89)	3	0.67	24	12.50	3.47
Octreotide	1 (0.44)	0	0.00	10	0.00	0.00
Phenytoin	1 (0.44)	4	0.89	14	28.57	7.94
Piperacillin/Tazobactam Sodium	2 (0.89)	5	1.12	26	19.23	5.35
Amikacin	3 (1.34)	4	0.89	36	11.11	3.09
Fat Emulsion	2 (0.89)	4	0.89	22	18.18	5.05
Insulin Regular	2 (0.89)	2	0.44	24	8.33	2.31
Sodium Bicarbonate	2 (0.89)	3	0.67	22	13.64	3.79
Total	224 (100)	446	100.00	2789	359.42	100.00

* Number of observations multiplied by the number of opportunities for errors

There was no error observed for "storage before infusion" and "storage during administration". So, these two categories are excluded from evaluation. Other fourteen different types of error considering error rate, percentage of total, factor correction, corrected percentage, and corrected percentage of total in the pulmonary ICU of Imam Reza hospital and the ICU of Shohada hospital are seen in Table 3 and 4, respectively. In Imam Reza hospital the most frequent error considering both frequency and the corrected percentage was wrong rate error; and in Shohada hospital the most frequent error considering both the frequency and the corrected percentage was controls during administration errors.

Table 2. Frequencies and error rate of IV products administrated in Shohada hospital intensive care unit.

Intravenous Medication	Number of Administration (%)	Number of Errors	Percentage of Total	Factor Correction*	Corrected Percentage	Corrected Percentage of Total %
Ciprofloxacin	32 (22.37)	39	20.10	384	10.16	5.46
Clindamycin	8 (5.59)	2	1.03	24	8.33	4.48
Vancomycin	5 (3.49)	12	6.18	65	18.46	9.93
Imipenem/Cilastatin	14 (9.79)	5	2.57	104	4.81	2.58
Meropenem	2 (1.39)	26	13.40	182	14.29	7.68
Pantoprazole	9 (6.29)	0	0.00	28	0.00	0.00
Albumin	4 (2.79)	15	7.73	210	7.14	3.84
Ceftriaxone	3 (2.09)	34	17.52	280	12.14	6.53
Ceftazidime	2 (1.39)	11	5.67	48	22.92	12.33
Valproate Sodium	6 (4.19)	10	5.15	55	18.18	9.78
Phenytoin	20 (13.98)	4	2.06	48	8.33	4.48
Amikacin	4 (2.79)	4	2.06	39	10.26	5.51
Fat Emulsion	5 (3.49)	1	0.51	36	2.78	1.49
Nitroglycerin	2 (1.39)	14	7.21	126	11.11	5.97
Amino Acid Solution	21 (14.68)	3	1.54	26	11.54	6.20
Potassium Chloride	3 (2.09)	5	2.57	36	13.89	7.47
Cefepime	3 (2.09)	9	4.63	78	11.54	6.20
Total	143 (100)	194	100.00	1769	185.88	100.00

* Number of observations multiplied by the number of opportunities for error

Number of errors in different rounds is shown in Table 5. Most of errors occurred at 9AM in Imam Reza hospital but, when the corrected percentage of total is considered, midnight was the IV round with the highest error incidence. The same parameter in Shohada hospital was 10 AM and 10 PM, respectively.

Table3. Distribution of different categories of errors in the pulmonary intensive care unit of Imam Reza hospital.

Type of Error	Number of Errors	Percentage of Total	Factor Correction*	Corrected Percentage	Corrected Percentage of Total %
Storage Prior to Preparation	0	00.00	224	0.00	0.00
Type of Diluent	0	00.00	113	0.00	0.00
Volume of Diluent	30	6.73	92	32.60	13.79
Wrong Dose	18	4.04	224	8.03	3.40
Wrong Rate	175	39.24	224	78.12	33.05
Wrong Time	35	7.85	224	15.62	6.61
Physicochemical Incompatibilities	8	1.79	224	3.57	1.51
Omission	0	00.00	224	0.00	0.00
Wrong Route	0	00.00	224	0.00	0.00
Controls During Administration	82	18.39	224	37.94	16.05
Controls After Administration	45	10.09	217	20.73	8.77
Wrong Drug	3	0.67	224	1.33	0.56
Wrong Patient	3	0.67	224	1.33	0.56
Not Classified	47	10.54	127	37.00	15.65
Total	446	100.00	2789	236.33	100.00

* Number of observations multiplied by the number of opportunities for errors

Vancomycin and imipenem/cilastatin had the highest rate in wrong volume of diluent error in Imam Reza hospital. Imipenem/cilastatin and vancomycin were the drugs of the highest rate in the same error category in Shohada hospital. Among drugs which had wrong dose error ciprofloxacin and metronidazole had the highest rate in Imam Reza hospital. Ciprofloxacin and imipenem/cilastatin in Imam Reza hospital had and ciprofloxacin and phenytoin in Shohada hospital had the highest rate in wrong rate error. Among medications which led to wrong time error ciprofloxacin and albumin had the highest in Imam Reza. In Shohada hospital amino acids solution and ciprofloxacin were responsible for this type of error. Meropenem had the highest rate in physicochemical incompatibilities error in Imam Reza hospital. Vancomycin had the highest rate in controls during administration error in Imam Reza hospital while in Shohada hospital phenytoin and amino acids solution had the highest error rate. Ciprofloxacin and albumin had the highest rate in controls after administration error in Imam Reza hospital. Ciprofloxacin and phenytoin equally have the highest rate in controls after administration error in Shohada hospital. Albumin and pantoprazole had the highest rate in unclassified errors in Imam Reza hospital, while in Shoda hospital phenytoin had the highest rate.

Possible significant relationship between incidence of errors and nurses' characteristics was also studied. No significant relationship was found between number of errors and nurses' age in Imam Reza hospital or Shohada hospital ($P>0.05$).

Chi- square test showed that frequency of errors was significantly high in the nurses with tenure contracts in Imam Reza hospital; while temporarily contract workers in Shohada hospital had significantly higher error rates ($P<0.05$).

Table4. Distribution of different categories of errors in Shohada hospital intensive care unit.

Type of Error	Number of Errors	Percentage of Total	Factor Correction*	Corrected Percentage	Corrected Percentage of Total %
Storage Prior to Preparation	0	0.00	143	0.00	0.00
Type of Diluent	0	0.00	81	0.00	0.00
Volume of Diluent	19	9.79	72	26.38	15.71
Wrong Dose	0	0.00	143	0.00	0.00
Wrong Rate	56	28.86	143	39.16	23.32
Wrong Time	15	7.73	143	10.48	6.24
Physicochemical Incompatibilities	0	0.00	143	0.00	0.00
Omission	0	0.00	143	0.00	0.00
Wrong Route	0	0.00	143	0.00	0.00
Controls During Administration	57	29.38	143	39.86	23.74
Controls After Administration	26	13.40	114	22.80	13.58
Wrong Drug	0	0.00	143	0.00	0.00
Wrong Patient	0	0.00	143	0.00	0.00
Not Classified	21	10.82	72	29.16	17.37
Total	194	100.00	1769	167.87	100.00

* Number of observations multiplied by the number of opportunities for errors

Table5. Different intravenous rounds considering their frequency and error-prone situations.

	IV Administration Rounds	Number of Errors	Percentage of Total	Factor Correction*	Corrected Percentage	Corrected Percentage of Total%
Shohada Hospital	9AM	154	34.52	997	15.44	18.80
	Noon	102	22.86	665	15.33	18.66
	5 PM	61	13.67	402	15.17	18.46
	9 PM	80	17.93	469	17.05	20.76
	Mid night	49	10.98	256	19.14	23.29
	Total	446	100.00	2789		
Imam Reza Hospital	10AM	103	53.10	954	10.79	31.67
	2 PM	65	33.50	609	10.67	31.30
	10 PM	26	13.40	206	12.62	37.03
	Total	194	100.00	1769	34.09	100.00

* Number of observations multiplied by the number of opportunities for errors

Discussion

Over all in both ICUs, 640 medication errors in different stages of IV preparation and administration were observed. Among those, 446 occurred in Imam Reza hospital and 194 occurred in Shohada hospital. The overall error rates were 16% and 11% in Imam Reza hospital and Shohada hospital, respectively.

The outcome in Shohada hospital is very similar and close to the incidence of error (9.4%) reported by Fahimi et al., in a study that took place in Masih Daneshvari hospital in Tehran, Iran in 2006. The lower error rate observed in Masih Daneshvari and Shohada hospitals compared to Imam Reza hospital may be related to presence of clinical pharmacists and stricter cares and precise controls recommended in two

former hospitals. The error rate in Shohada hospital was significantly (P<0.05) lower than the rate seen in Imam Reza hospital, and very close to Masih Daneshvari hospital error rate (16). The error rates found in both ICUs are very low compared with the 43% error rate reported by Lsiby et al., in a Danish hospital (17).

Taxis et al., found a global error rate of 48% in IV medications, including a 19% error rate in the preparation phase and a 23% error rate in the administration phase (18). In another study, same authors found a 49% global rate of errors (19).

In the current study, among fourteen error categories, "Controls during Administration", "Wrong Rate", "Unclassified", and "Wrong Volume of Diluent" errors had the highest incidence in Shohada hospital. In Imam Reza hospital, "Wrong Rate", "Controls during Administration", "Unclassified", and "Wrong Volume of Diluent" errors had the highest rate. It was noticed that these four types of errors were more common than the rest of error types, all together. Regardless of their corrected percentage of total, they were frequently repeated.

No error of "Storage Prior to Preparation" was seen in the current study. Furthermore, "Type of Diluent" errors did not occur in this study which is indicative of the fact that all nurses were highly informed about the incompatibilities and the aspects of selecting the right diluents for reconstituting the IV medications while in the study performed by Fahimi et al., 11.2% of errors were usage of wrong diluents (16).

Wrong volume of diluents was responsible for 13.8% and 15.7% of errors in Imam Reza Hospital and Shohada Hospital, respectively. For instance, Concentration of vancomycin admixture should not exceed 5 mg/ml; unfortunately, it was not obeyed even in one case in none of the hospitals. All in Shohada hospital and 8 out of 24 administrations in Imam Reza hospital, imipenem administration had the concentration higher than 5mg/ml and; the recommended concentration in guidelines. Similar error was for pantoprazole and ceftriaxone administration; of which concentrations should not exceed 0.4mg/ml, and 10-40 mg/ml, respectively.

It was observed no error in omission category in Imam Reza hospital, neither was observed in Shohada hospital. "Wrong dose" was rated 3.4% in Imam Reza hospital while it was not observed in Shohada hospital. The error in Imam Reza hospital was related to low dose preparation and administration. For example, ciprofloxacin in 11 cases was discontinued while in the vial, considerable amount of liquid was remained. The same error was seen during metronidazole preparation. In a study in three Brazilian hospitals, the rate of wrong dose error in the preparation of medications varied between 0.9% and 7.4%; and the rate of omission dose varied from 2.9% and 11%. In medication administration category, errors in wrong dose was the most frequent type of errors seen (20). In another study, Han et al., identified an 11.9% rate of omission of doses and 1.6% of wrong patient in three surgical units of a hospital in Australia. In Shohada hospital, no error was observed for wrong patient but this error was seen in 0.56% of IV administrations in Imam Reza hospital (21). This error was observed when a nurse was going to administer vancomycin of patient A to patient B; and clindamycin of patient B to patient A Although the researcher notified this nurse, it was counted as two errors. This was also reported as "Wrong Drug" error, too.

Cousins et al., studied the errors in the preparation and administration of IV therapy in four UK general hospitals, three units of one hospital in Germany and one hospital department in France, and found an omission doses related errors of 29% in Germany, 8% in France and 0% in the UK; while for wrong dose errors the results were, 1%, 2%, and 5% respectively (22).

Wirtz et al., verified the most frequent medication preparation errors at the three hospitals in the UK and Germany; including wrong dose and omission of dose (23). In this study, the most common error in administration of medications was "Wrong Rate of Administration". This is similar to our study in Imam Reza hospital, while it is the second common type of error in Shohada hospital.

In the current study 1.5% error of physicochemical incompatibilities was observed. Streptokinase which must not be mixed with other drugs, but ceftriaxone was added to its bag. Clindamycin and imipenem were administered with magnesium sulfate and clindamycin, respectively. In three separate administrations meropenem was wrongly mixed with vancomycin, furosemide or sodium valproate. In one occasion phenytoin was given in the same bag of regular insulin.

Wrong rate errors were more frequent in Imam Reza hospital (33.1%) but was similar to Shohada hospital compared to Fahimi et al., study (23.3% vs 23.1%) (16). Ciprofloxacin which should be administered in 60 minutes, but was administered in only 6 to 23 minutes in all 71 cases in Imam Reza hospital. It should be administered slowly in order to reduce the risk of venous irritation such as burning, pain, erythema, and swelling. Besides, metronidazole was administered in less than accepted 1 hour in all cases. Except in 2 cases, vancomycin was wrongly administered in less than 60 minutes; the recommended duration by guidelines. Hypotension, shock, and cardiac arrest have been reported with too rapid infusion of vancomycin. In one case, fat emulsion was accurately administered in approximately 8 hours, but in one case was given in less than 5 hours. 10 cases of 'Wrong Rate" category belonged to fast bolus administration. In 8 cases, pantoprazole was injected in 2-3 seconds rather than recommended 2 minutes. Direct injection of ceftriaxone should be done in 2-4 minutes, but in 2 cases it was injected in only 10 to 14 seconds. Instead of 15-30 minutes, imipenem was administered in only few minutes in 21 cases. Rapid infusion of imipenem may cause nausea and/or vomiting during administration. It is clear that too rapid infusion may have different side effects. Extravasation of medication during IV therapy is an adverse event related to therapy which depends on the medication, amount of exposure, and location, and can potentially cause serious injury and permanent harm, such as tissue necrosis. In Shohada hospital, out of 143 drugs, 56 cases had high

rate administration error.

High workload, preparing, and administration of many drugs at the prescription schedule are the reasons for wrong rate error, although in some cases nurses knew the accurate rate of infusions but when asked about it, they told that they did not follow the guidelines despite awareness. Error rate of 75% was reported in Calabrese et al study in USA which was much higher than current findings. In the same study, 26% errors in the time of administrations were observed whereas in current study 6.6% and 6.2% error rate for this type were observed in Imam Reza and Shohada hospitals, respectively. Reasons given above can be important in this category, too, that is wrong time error. In the same study, 27% of errors were dose omission while no error for omission was observed here. In neither of studies errors of "Wrong Route" were seen (24). Controls during and after administrations were lacking and caused relatively high incidence of errors.

Examples of unclassified errors are: The diluent for streptokinase was added rapidly and the mixture was shake vigorously; and in-line filter was not used. When administering pantoprazole, in about one third of administrations in Imam Reza hospital and more than half of administrations in Shohada hospital, the IV line was not flushed prior and after administration. Prior to administration, patients were not checked for any possibility of hypersensitivity reactions when receiving albumin. In one case of piperacillin/tazobactam, the primary infusion was not discontinued. Patients receiving fat emulsion were not checked for allergic reactions; which may occur at the onset of therapy. Patients should be observed for any immediate allergic reactions such as dyspnea, cyanosis, and fever. IV tubing was not flushed when administrating phenytoin in few cases in Shohada hospital.

Streptokinase and ceftazidime were drugs of the highest incidence of errors in Imam Reza hospital and Shohada hospital, respectively. In the studied wards, the majority of errors occurred in night shifts in both hospitals midnight and 10 PM for Imam Reza hospital and Shohada hospital, respectively. Results were completely different from Fahimi et al., study that indicated IV rounds conducted at 9 AM had the highest error rate (19.8%) (16).

Incidence of errors was high in those with the higher experience. It seems that chronic fatigue, lack of stimulation and concentration due to out of ward problems can be reasons for this relationship. The tenure and contract workers showed significantly higher mistakes in Imam Reza hospital and Shohada hospital, respectively. Complexity of patients' illness in the pulmonary ICU, the high challenge required in dealing with them, and also absence of pharmacists, particularly clinical pharmacists may be the reasons for significantly high error rate in this ward.

The study was conducted in two ICUs of two university hospitals, and therefore, the results are not to be generalized to other wards and hospitals. However, many of outcomes are in accordance with other studies. Bias prevention and maintaining the study single-blindness; although we believe that nurses were unaware of the aim of the study, they might have guessed and, this could influence the rate of error, nevertheless, the error rate was still relatively high; although on the last day of the study head-nurse of Imam Reza hospital told that nurses guessed that the observer was from a pharmaceutical company evaluating industrial aspects of medications rather than errors they have made. In Shohada hospital, nurses thought that the researcher was one of students spending internship not evaluating their work.

Results of current study showed that medication errors occur in stages of preparation and administration. This matter is a great concern for patients hospitalized in ICUs since these patients suffer from multi-organ and various difficulties and receive various and numerous drugs; and interactions among them are likely. Importance of controlling errors and the necessity of dealing seems more outstanding in these wards.

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