

Assessment of the rate and etiology of pharmacological errors by nurses of two major teaching hospitals in Shiraz

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Abstract

Medication errors have serious consequences for patients, their families and care givers. Reduction of these faults by care givers such as nurses can increase the safety of patients. The goal of study was to assess the rate and etiology of medication error in pediatric and medical wards. This cross-sectional-analytic study is done on 101 registered nurses who had the duty of drug administration in medical pediatric and adults' wards. Data was collected by a questionnaire including demographic information, self report faults, etiology of medication error and researcher observations. The results showed that nurses' faults in pediatric wards were 51/6% and in adults wards were 47/4%. The most common faults in adults wards were later or sooner drug administration (48/6%), and administration of drugs without prescription and administering wrong drugs were the most common medication errors in pediatric wards (each one 49/2%). According to researchers' observations, the medication error rate of 57/9% was rated low in adults wards and the rate of 69/4% in pediatric wards was rated moderate. The most frequent medication errors in both adults and pediatric wards were that nurses didn't explain the reason and type of drug they were going to administer to patients. Independent T-test showed a significant change in faults observations in pediatric wards ($p=0.000$) and in adults wards ($p=0.000$). Several studies have shown medication errors all over the world, especially in pediatric wards. However, by designing a suitable report system and use a multi disciplinary approach, we can be reduced the occurrence of medication errors and its negative consequences.

Keyword: Etiology, Teaching hospital, Pharmacological error, Medication errors, Nurse.

1. Introduction

Medical error is an important challenge menacing the health system all over the world. One of the most common of these errors is pharmacological errors (1) defined as any predictable incident leading to inappropriate usage of medication, causing a danger for the patient and the con-

sumer (2). It is estimated that seven thousand cases of death occur annually as a result of pharmacological errors in the US (3). According to audit commission in 2001, page refers to the extent of problem and states that pharmacological errors are responsible for one-fifth of the death cases because of all types of unwanted incidences at the hospitals imposing annually 500 million pounds on National Health Service. Also, any incidence leads to an extra 8.5 days of hospitalization on average (4). The

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patients' safety is a main concern for the organs providing health-care. Drug prescription errors can threaten the patients and may be directly in close connection with nursing care as an aspect of the patient's safety leading to a big gap in the quality of health care (5).

Accurate statistics from the rate of pharmacological errors in developing and developed countries are not available because of a fault in report systems and incorrect registration of information; however, the evidence such as increasing the number of complaints of people from doctors and nurses is indicative of this high rate (6). In a study carried out using three methods including direct observation, examining the patients' cases, and using error reports from drug prescriptions in 2577 drug doses, only 476 cases of errors occurred during direct observation, 24 errors via reviewing the file and one case of error report was filled (7).

According to the study carried out by Rose *et al.* in England, the rate of the occurrence of pharmacological errors was about 15% or, in other words, one case in every 662 accepted patients and the highest rate of pharmacological errors was detected in intensive care, internal and, infant wards and in 56% of the cases, the nurses were responsible for the occurrences of these errors (8). According to Ferranti *et al.*, pharmacological errors in infants are thrice as much as adults. Different factors such as the availability of different forms of a drug, incorrect calculation of the dose and the multi-formulation of drugs cause the children to be more vulnerable to pharmacological errors and adverse effects resulting from them (9). Because of the serious and harmful consequences resulting from the errors in patients, families and health-care providers, nowadays, reducing pharmacological errors and recovering a patient's safety is more preferable than any decree in the working program of health-care providers(4). This study was carried out with the aim of investigating the rate, type and causes of pharmacological errors by nurses at internal and pediatrics wards in Shiraz, southwest of Iran.

2. Material and methods

The samples of this cross sectional study were 101 employed nurses at internal and pedi-

atrics wards of Namazi and Shahid Faghihi educational hospitals, Shiraz University of Medical Sciences, Shiraz, Iran. Study was conducted from June 2012 to June 2013. All of the employed nurses working at Shahid Faghihi and Namazi internal wards and three pediatrics wards at Namazi hospital were chosen as the samples of the study. The criteria for recruiting these nurses were their employment at the hospital for more than three months and their willingness to participate in this study. Their participation was not obligatory. All stages of research performed under supervision research vice-chancellor and Deputy for Food and Drug Administration, Shiraz University of Medical Sciences, Shiraz, Iran.

For collecting the data, a four-section questionnaire was used and the validity of each part was specified with content validity and reliability method was affirmed by Kronbach alpha coefficient ($\alpha=80$). The first section of the questionnaire was about the demographic characteristics of the sample including age, sex, education, the type of ward, job background in the field of nursing, job background at the current ward, the type of working shift, the type of employment, employment somewhere else except nursing, employment at several hospitals, the consumption of special drugs, and history of education about medication errors. The second part of the questionnaire consisted of 21 cases of pharmacological errors in which the nurses were asked to complete by self report. The nurses were asked to mark the occurrence of any of the errors in the past three months. The score in this section for the occurrence of errors ranged from zero to twenty one. The scores 0-10 were defined as few errors, scores 11-15 were determined as moderate errors and the scores 16-21 were considered as high errors. The third section of the questionnaire was about the conditions in a ward which would lead to pharmacological errors. In this section, twenty questions were marked "yes" or "no" about wards situation which can cause pharmacological errors were answered by the nurses (10). The fourth section of the questionnaire was a check list of 33 items about pharmacological errors completed by the researcher. The score in this section varied between 0-33. The scores below 15, between 16-25, and 26-33 were

considered as few, moderate, and high number of errors, respectively. The researcher obtained the required permits from the university and Namazi and Shahid Faghihi hospitals, referred to the wards, introduced himself/herself, stated the aims of the research, and gave the questionnaires to the nurses. Except for the last section of the questionnaire, the other sections were completed by the nurses. The last section was completed by the researcher during the preparation and administration of drugs by the nurses. The independent t-test and Chi-square, using SPSS software, version 16. P values less than 0.05 were considered statistically significant.

3. Results

The average age of the nurses in the adults ward was 28 years (ranged between 23 and 36 years of age $SD \pm 3.8$), and at the pediatric ward was 29 years (ranged between 20 and 50 $SD \pm 5.9$). The majority of the study population (97%) was female at the adults ward. The majority of the samples had a bachelor degree in nursing (97.1% at the adults ward and 98.4% at the pediatrics ward). The average duration of working experience at the present ward among the nurses at the adults ward was 3.9 years (at least 3 months up to 22 years) and among the nurses at the pediatric ward was about 3.4 years (at least 3 months up to 25 years). Ninety one point four percent of the nurses in adults ward and 98.4% of those in the pediatric ward had passed at least one specialized course in the domain of "correct methods of drug prescribing and preventing pharmacological errors". The majority of the case (94.7% at the adults ward and 95.2% at the pediatrics ward) was working on a shift basis. More than one-third (36.1%) of the nurses at adults ward were employed on a contract basis; however, at the pediatrics ward, 36.8% of the nurses were permanent government employees. Twenty two percent of the nurses at adults ward and 12.1% of them at the pediatric ward expressed that they worked extra shift hours either at their hospital or other hospitals. Majority of the nurses (91.4% and 98.4% in adults and pediatrics ward, respectively) had no record of administering special drugs which would affect their alertness or cognitive abilities. Table 1 shows the demographic and working characteris-

tics of the nurses in terms of their ward.

As regards the first section of the questionnaire filled by the nurses themselves pharmacological errors (Mean $13.4 \pm SD-3$, Mean $13 \pm SD+3$) at the adults and pediatrics ward retrospectively; clinical significance and its relevant reference. At the adults ward, the rate of few errors was 34.2%, moderate errors 47.4% and the high number of errors 18.4%, and at the pediatrics wards it was 33.9%, 51.6% and 14.5%, respectively. Chi-square test shown significant statistical differences between adult and pediatric ward ($p=0.01$, $df=13$). The statistical results within ward not significant.

The most common reported errors at the adult wards were administering the drugs earlier or later than its due time (48.6%), quick pharmacological injection to be injected very slowly (47.4%), giving the drug to the wrong patient (42.9%), and giving a sedative agent without a doctor's prescription (38.2%). At the pediatric ward, the common errors comprised, respectively, of administering a sedative with the doctor's prescription (49.2%), giving the drug to the wrong patient (49.2%), and administering the drug earlier or later than its due time (39.5%). Table 2 shows the frequency distribution of pharmacological errors, based on a self-report, at two adults and pediatrics wards.

In the next section of the questionnaire, the nurses were asked "what conditions at the ward would lead to the development of pharmacological errors?". The low number ratio of nurses to patients (97% and 100% in the adults and the pediatric ward, respectively), and heavy work load (97% and 100% in the adults and the pediatric ward, respectively) at the two wards were mentioned by the nurses as major factors of pharmacological errors development. But, in most cases, some differences were observed and the statistical test of Chi-square (except for illegible and tampered-with prescriptions of the doctor, a reproaching encounter of the coworkers in case of the report of pharmacological errors and the reproaching encounter of the manager in case of a report of pharmacological errors), in other cases, showed a significant statistical relationship ($p < 0.05$ to $p < 0.00$). In fact, it was shown that the conditions of adults and pediatrics wards were different concerning the development of

Table 1. Comparison of demographic characteristics and work experience between nurse in adults and children wards.

Variables		Adult wards	Children wards
Sex	men	8.1%	0%
	women	91.9%	100%
Work experience	Less than 10 years	76.6%	67.4%
	10-15 years	17.5%	26.1%
	Over 15 years	5.9%	6.5%
Education	Bachelor	97.1%	98.4%
	Higher than BA	2.9%	1.6%
History of education about medication errors	yes	91.4%	98.4%
	no	8.1%	1.6%
Kind of shift	Rotational shifts	91.7%	89.8%
	Constant shift	8.3%	10.2%
	formal	11.1%	36.8%
Type of Employment	Contractual	36.1%	21.1%
	commitments	25.2%	42.1%
Extra shifts at their hospital or other hospitals	yes	22.2%	12.1%
	no	77.8%	87.9%
History of special drug use	yes	8.6%	1.6%
	no	91.4%	98.4%

pharmacological errors. Table 3 displays the comparison of the causes of effective conditions on the development of pharmacological errors from the viewpoint of the nurses at the adults and the pediatrics wards. The last section of the questionnaire was a check-list of the pharmacological errors observed by the researcher. The score for the pharmacological errors observed at the adults wards was between 18-32 and at the pediatrics wards between 16-23. Independent statistical t-test showed a significant statistical difference ($p < 0.001$) between the number of detected pharmacological errors by the researcher at the adults ($M = 1 \pm 3.2$) and pediatrics ($M = 2 \pm 4.2$) wards.

At the adults wards, 57.9% and 42.1% of pharmacological errors detected by the researcher were few and moderate, respectively. No high rate error was observed in this ward. At the pediatrics wards, the observed rate of few, moderate, and high pharmacological errors was 9.7%, 69.4%, and 20.9%, respectively. The most observed errors by the researcher at the adults wards were respectively, lack of explanation of the aim and the way

of drug administration to the patients and families (88.6%), lack of examination of the patients during and after the injection as regards unsuitable drug reactions (81.2%), and lack of examination of angiocatheter regarding injection site reactions (e.g. phlebitis) in 63.9% of the cases. At the pediatrics wards, the most observed pharmacological errors were as follows: lack of explanation of the aim and the way of drug administration to the patients or their families (72.1%), no medication at the right time 33.9% and And failure to take consideration regarding drug 24.6%. Issues such as not considering the sterility technique at the time of parenteral administering of medications, not checking the drug identity at the time of its preparation, lack of knowledge about the appropriate method of drug administration, and the injection of subcutaneous drugs were not observed in any of the studied wards.

No statistically significant association was observed between the job background of the nursing staff or the ward circumstances and the number of reported pharmacological errors.

Table 2. Comparison of medication error on the ward of adults and children based on adult self report.

No	Item	Children		Adult	
		no	yes	no	yes
1	Un giving prescription to patient	71%	29%	71.1%	26.3
2	Giving medication to a patient without a doctor prescription	76.3%	23.7%	61.8%	38.2%
3	prescribed medication Later or earlier than the time	57.9%	39.5%	48.6 %	48.6%
4	Not suitable dilution of the drug must be diluted	90.3%	9.7%	71%	29%
5	Non-compliance with medication right time (before or after a meal)	82.3%	17.7%	68.4 %	21.6%
6	Lack of necessary measures of drugs that require special attention. (The pulse, checking tests ...)	53.2%	46.8%	63.2%	36.8%
7	Mixing two or more drugs regardless of drug interactions in microset	71%	29%	71.1%	28.9%
8	The rapid injection of a drug that must be injected slowly	75.5%	24.2%	52.6%	47.4%
9	Intravenous drug must be injected subcutaneously	88.7%	11.3%	73.7%	26.3%
10	Subcutaneous injection of a drug that must be injected intravenously	83.9%	16.1%	71.7%	28.9%
11	Muscular injected with a drug that must be injected intravenously	87.1%	12.9%	71.7 %	28.6%
12	Intravenous drug must be injected intramuscular	85.5%	14.5%	65.8 %	34.2%
13	Administration PO instead sublingual or chewing	74.2%	25.8%	65.8 %	34.2%
14	Putting together several oral drugs	66%	33%	67.6 %	32.4%
15	Giving analgesic without doctor prescribing	50.8%	49.2%	57.1%	42.9%
16	Giving drug to wrong patient	50.8%	49.2%	57.1 %	42.9%
17	More or less medication than the amount prescribed	100%	0 %	88.9 %	11.1%
18	A prescription drug without having to specify way	100%	0 %	77.8%	22.2%
19	Failure to observe proper status of patients according to the type of drug (position or severity of illness)	100%	0 %	87.5%	12.5%
20	Lack of knowledge about how to calculate the correct medications	95.2 %	4.8 %	87.5 %	12 %

Sixty one percent of the nurses who participated in this study stated that their first source for obtaining information about the prescribed drugs was the physicians, followed by the assistants and interns (20.7%), other co-workers (9.8%) , clinical or hospital pharmacists (1.2%), and referring to nursing or drug information textbooks (1.2%).

About one-third (28.3%) of the studied nursing staff stated that they were the witness of the occurrence of at least one clinically significant pharmacological error leading to serious or permanent injuries. Furthermore, 5.3% of the cohort declared that at least one fatal pharmacological error has been occurred during their length of working experience as a nurse.

4. Discussion

Based on the results of this study, the most common pharmacological errors of the nurses at the adults and pediatrics wards were, to some extent, different. Giving the drug later or earlier than

the due time, quick injection of drugs that should be injected very slowly, giving sedatives without a doctor's prescription, and giving the drug to the wrong patient were common pharmacological errors and the nurses at the pediatric ward reported more errors than those in adults wards. This may be due to the complex process of preparing and administrating drugs in pediatric ward.

The researcher detected the most common pharmacological errors to be related to lack of explanation of the aim and the way of drug administration to the patients and families, lack of examination of the patients during and after the injection as regards unsuitable drug reactions, and lack of examination of angiocath regarding injection site reactions. It should be noted that the number of errors observed by the researcher at the pediatrics wards were more than in the adult wards.

A study by Seidi and Zardosht carried out at the pediatrics wards of Mashad hospitals, showed that the most common pharmacological

Table 3. The conditions that caused the errors in wards based on nursing viewpoints..

No	Item	Adult		Children		P
		no	yes	no	yes	
1	Low ratio of nurses to patients	97%	3%	100%	0%	0.000
2	Workload of nurses	97.1%	2.9%	100%	0%	0.000
3	Poor communication between health care team members	50%	50%	78%	22%	0.001
4	Poor communication with head nurse and staff	75.8%	24.2%	90%	10%	0.001
5	Poor physical environment (light, temperature, etc.)	82.9%	17.1%	59.2%	40.8%	0.00
6	Environmental conditions conducive to distraction (noise, traffic, etc.)	64.7%	35.3%	66%	34%	0.000
7	Patients visitors	88.2%	11.8%	66.7%	33.3%	0.05
8	Many poor condition patient in ward	88.2%	11.8%	66%	34%	0.000
9	Wide variety of drugs in the ward	88.6%	11.4%	66%	34%	0.000
10	Improper labeling or packaging medications or serum	66.7%	33.3%	70%	30%	0.05
11	absence of drug information in ward	77.4%	22.6%	70%	30%	0.001
12	Inappropriate medication shelf location and lack of space	33.3%	66.7%	64%	36%	0.001
13	Distorted and illegible doctor's orders	60.6%	39.4%	42%	58%	0.09
14	Lack of supervision of medication administration process by the responsible departments and supervisors	17.6%	82.4%	16.3%	83.7%	0.000
15	Lack of information about how to record and report medication errors	29.4%	70.6%	10.2%	89.8%	0.001
16	Inappropriate manager behavior if medication error reporting	54.4%	45.5%	30.6%	69.4%	0.07
17	Colleagues inappropriate behavior if medication error reporting	54.4%	45.5%	34%	66%	0.08
18	Labeling Incompetency if reported medication error	51.5%	48.5%	71.4%	28.6%	0.05
19	lack of emphasis on the importance of recording and reporting of medication errors by manager	55.9%	44.1%	18.4%	81.6%	0.001
20	Lack of knowledge of all the colleagues from the definition of medical error	55.9%	44.1%	66.7%	33.3%	0.001

errors of the nurses were transferring pharmacological orders from the file to medication Kardex (73.9%), and incorrect initiation and adjustment of infusion (64.1%)(11).

A study by Heidari and Aziz Pirzadeh at Lorestan hospitals introduced the following as the most common pharmacological errors: not checking the name of the patient with the registered drug, the illegibility of the doctors' prescriptions, and the name similarity of two drugs (12). Taheri *et al.*, in a study, at infant wards, have reported the common observed errors of intravenous injection drugs including error at the time of drug prescription, error at calculations, ignoring drug contradictions (each 51-60%), and wrong dosages (41-50%) (13). Shamsi and Bagherieh during their investi-

gation at Khui hospitals found that the most observed pharmacological error were administering several oral drugs simultaneously that contradict with each other (57.7%), quick injection of drugs that should be injected very slowly (46.36%) and giving anti-pain drugs without the permission or prescription of physicians (44.39%)(14).

A literature review by Mansuri *et al.* on 18 Persian or English language articles from Iran showed the prevalence of errors at administration stage to be between 14.3% and 70% (15).

The results of studies in other countries are somewhat different. Judd introduced communicative problems between the nurses and patients as the most common reason for pharmacological errors of the nurses (16). Fleming *et al.* and Wright

Table 4. Medication error checklist in adult and children wards..

No	Item	Adult		Children	
		no	yes	no	yes
1	Check drug cards with medication kardex(5R)	27.8%	72.2%	11.3%	88.7%
2	Failure to comply with sterility points during drug preparation (hand washing, wearing gloves, etc.	0%	100%	0%	100%
3	Lack of knowledge about drug calculations	0%	100%	0%	100%
4	not checked drugs in time to prepare (for the label, shake before picking, packing healthy, dry, and date, etc.)	0%	100%	0%	100%
5	Absence of drug at the right time	25.7%	74.3%	33.9%	74.3%
6	Non-compliance with medication right time (before or after a meal	20%	80%	6.6%	93.4%
7	No tag on serum drug	6.1%	93.9%	3.3%	96.7%
8	Lack of identification labels on the drug was given	42.9%	57.1%	15%	85%
9	Lack of identification of patient before administration drugs	25.7%	74.3%	11.3%	88.7%
10	Do not explain the purpose and use of the drug to the patient and family	88.6%	11.4%	72.1%	27.9%
11	Don't giving prescription to patient	8.6%	91.4%	1.6%	98.4%
12	Giving medication to a patient without a doctor prescription	0%	100%	1.6%	98.4%
13	not considering angio for Working properly	63.9%	36.1%	24.2%	75.8%
14	(subcutaneous phlebitis, injection, etc.)	27.3%	63.2%	11.3%	88.7%
15	Later or earlier than the time prescribed medication	0%	100%	1.6%	98.4%
16	undiluted drug must be diluted	0%	100%	1.6%	98.4%
17	Drugs are not diluted with an appropriate solution	25%	75%	24.6%	75.4%
18	Lack of necessary consideration of drugs that require special justification (pulse, blood pressure, study results, etc.	8.8%	91.2%	3.2%	96.8%
19	Mixing two or more drugs regardless of drug interactions in microset	47.2%	52.8%	6.5%	93.5%
20	Insufficient to establish the Iv of patients during dosing and lack of proper time	0%	100%	0%	100%
21	Intravenous drug must be injected subcutaneously	0%	100%	1.6%	98.4%
22	Intravenous drug must be injected intramuscular	0%	100%	1.6%	98.4%
23	Muscular injected with a drug that must be injected intravenously	2.8%	97.2%	0%	100%
24	Injection in the wrong place	0%	100%	0%	100%
25	Administration PO instead sublingual or chewing	3%	97%	1.6%	98.4%
26	Putting together several oral drugs	11.4%	88.6%	24.2%	75.8%
27	Prescribe The wrong drugs,(eye drop, ear, spraying ...)	20%	80%	0%	100%
28	Giving analgesic without doctor prescribing	25.7%	74.3%	11.3%	88.7%
29	Giving drug to wrong patient	5.7%	94.3%	0%	100%
30	More or less medication than the amount prescribed	5.7%	94.3%	0%	100%

determined computational errors and, especially, perceptual errors as the most common errors (17,18). Ching Long et al. have introduced non-observance of the standards (the right patient, the right dose, etc.) as the main cause of pharmacological errors (19). Westbrook et al. demonstrated "delay and absent-mindedness" of the nurses as the most important clinical and pharmacological errors (20).

The rate and degree of errors was differ-

ent in the one (self report) and forth (observational check list) section of "questionnaire". The reason of this difference could researcher presence during the preparation of medicines in the fourth section of the questionnaire. Biron et al., in a study by observing the way nurses administered drugs, found out that forgetting the drug or necessary tools were responsible for 22.8% of errors and "delay" and the "absent-mindedness" of the nurses at the preparation stage of drugs was responsible for 26.8%

of errors (21). In a systematic review by Gonzales, the most common reasons for pharmacological errors were determined to be the doctors' illegibility, the low nurses to patients ratio, and the high volume of drugs (22). All these studies, in Iran and other parts of the world, show that the observed pharmacological errors by nurses are different; however, they exist everywhere (22-24). These differences can be a result of the wards' diverse situations, variation in the knowledge, attitude, and practice of nursing staff about pharmacological errors, method and source of detecting errors. Different systems for drug delivery and monitoring process issues raised in this study as the highest causes of medication errors have been mentioned with a different importance in other studies.

Cooperation between health team specially nurses and clinical pharmacist has an important role in prevention and detection of medication errors in hospital and causing protect the rights of patients and reduce the cost resulted from these errors (25).

5. Conclusion

Pharmacological errors are inevitable when nursing cares are offered as other professions and cannot be completely prevented; however, by designing a suitable system, the possibility of the occurrence of pharmacological errors can be

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reduced, and its negative effects can be decreased. Since pharmacological errors are one of the threatening factors of a patient's immunity, for this reason, the rate of pharmacological errors can be used as an index for determining the rate of a patient's immunity. Considering the high rate of errors, effective strategies should be designed in education and treatment for preventing, and in case of occurrence, detecting the errors and developing a safe environment for the patients' care and treatment. We need a teamwork with doctors, nurses and clinical pharmacists for designing strategic planning to solve or decreased this dangerous problems.

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Conflict of Interest:

None declared.

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