

Frequency, Type and Causes of Medication Errors in Pediatric Wards of Hospitals in Yazd, the Central of Iran

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Abstract

Background

Medication errors are among the most common medical errors which are used as an indicator to assess patients' safety in hospitals. Thereby the aim of this study was to investigate the frequency, type and causes of medication errors in children's ward at hospitals in Yazd- Iran.

Materials and Methods

This descriptive-analytical study was conducted during 6 months from Jan to Jun 2015. A total number of 63 nurses working in the pediatric ward of the hospitals in Yazd city were enrolled in this study using census method. Data collection tools included demographic questionnaire and "Wakefield medication administration errors" questionnaire. Data were analyzed using SPSS-18.

Results

Medication errors had been made by 44.4% of the nurses once to twice in the 6 months preceding the study. 30.2% of the errors had occurred on the night shift. Errors with high incidence in non-injectable medication included wrong patient (1.6%), wrong dosage (7.9%), drug administration without doctors order (1.6%) and in injectable medication included wrong dosage (7.9%), mistake in medication calculation (6.4%) and wrong infusion rate (9.5%). The most common causes were communication, packaging, transcription, working conditions and pharmacy conditions respectively.

Conclusion

Considering the frequency of errors on the night shift, dosage calculation and administration as well as the identified causes, it is necessary that nursing managers to negotiate with medical and pharmaceutical professionals in order to design and implement operational guidelines for preventing medication errors.

Key Words: Medication errors, Nurses, Pediatric ward

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1- INTRODUCTION

Today, patient safety is deemed a very important issue for our healthcare system and health care providers(1) and in this regard medication errors are used as the index to assess patient safety in hospitals. Medication errors are one of the most common medical errors(2) and its incidence rate have been reported 5.6 cases per 1000 patient in adults and 14.8 cases per 1000 patients in children's ward(3). In fact, the incidence of medication errors in children is three-fold higher than adults(4). A study in Canada showed that every year 5,000 children admitted to the hospital experience medication errors and of these, 2,500 children due to the occurred medication errors suffer from moderate to severe complications(5). Because the medication dose is calculated and prescribed according to a child's weight(6) and as most available medication forms are produced and marketed for use by adults, therefore, the dose should be broken down to prepare and administer the required dose and this step can potentially increase the percentage of errors(7). On the other hand, children have immature physiology and thereby have evolutionary constraint in responsibility towards self-care and self-management at the time of medication administration(8).

In addition, pharmacokinetic parameters of drugs that constantly changes along with different clinical situations can provide a set of conditions that increases the risk of medication errors in children(9). The drug therapy is considered one of the most important duties of nurses(10) and they spend 40% of their time for medication administration(11). In fact, nurses are an essential part of the health care team and are responsible for the safety of pediatric patients(12) but unfortunately, the increase in complaints by parents from nurses and physicians in the past few years is an evidence of increased incidence of errors and not providing the safety of pediatric

patients(13). Medication errors have several direct and indirect consequences. The direct consequences includes(14) harm to the patient, prolonged hospitalization, increased costs, (15) and increased risk of death(16). The indirect consequences include damage to the nurses in terms of professional and personal situations, reduced self-confidence(14), increased stress and conflicts at work, unreliability of the patient's family to nurse(17). Therefore, the need to raise awareness and understanding of the nature and causes of errors is essential and can help nursing managers to identify plans for improving the quality of care and interventions, increasing the safety and for reducing the additional cost(18). So far several studies have been carried out. For instance, heavy workload and illegible physician order has been reported by Tissot et al.(19) as the main causes of medication error while the study by Tang et al.(12) showed that the heavy workload and lack of experienced nurses per shift are the main cause of medication errors by nurses. In other relevant studied a large number of patients, fatigue, excessive workload and shortage of nurses(20) along with weak pharmacological knowledge and poor arithmetic skills in nurses(21) were indicated as the main causes of medication errors incidence. Moreover, there is discrepancy in the type of reported errors among different studies. For example in the study by Salmani et al., mistakes in medication calculation, wrong dose, wrong drug or the wrong route of administration(20) were the most frequent types of medication errors while in the study by Miladinia et al., wrong dosage, wrong preparation(21), in the study by Taheri et al., wrong timing of administration, pharmaceutical calculations and lack of attention to drug interactions (22), in the study by Raja Lope et al., wrong timing of administration(23), Chedoe et al., wrong

dosage(24) and in the study by Suresh et al., wrong identification of the patient(25) were regarded as the most common type of errors. Close examination of the findings both in terms of the type of errors and effective factors on the incidence of medication errors indicated that the conditions in the context of business, decision making strategies in organizations(26) management policy, work culture prevailing in the organization, physical environment, the ability of nurses (computational knowledge, pharmacologic knowledge, work experience, etc.), workload and shift are the factors that affect the results of the studies in the field of medication errors(27). On the other hand, the report on the incidence rate of medication error, type and effective factors in any context is important, because the report of an error is the main and primary step in preventing the future errors in that context(10). This can also lead to the better acceptance of error-prevention methods by nurses(28). Hence, the aim of this study was to determine the frequency, type and causes of medication errors in children's wards of hospitals in city of Yazd- Iran.

2- MATERIALS AND METHODS

This descriptive-analytical study was conducted on all nurses working in the pediatric ward of the hospitals including private, university-affiliated and Social Security affiliated hospitals in Yazd city. First, a list of the names including all the nurses who were eligible to enroll in the study was prepared. The inclusion criteria were working in the pediatric ward, having at least 1 year work experience in the children's ward and having a bachelor's degree. According to the census a total of 68 people were selected. In this study, for data collection two questionnaires including "demographic information" and "drug administration error" questionnaire was used. The former questionnaire included questions about demographic

characteristics of the participants such as age, marital status, education level and work experience, and the latter questionnaire was based on the questionnaire designed by Wakefield and colleagues in 2005 (29).

This questionnaire has three parts; in the first part, the participants are asked to estimate the number of their medication errors in the last 6 months then the participant are asked the shift where the most mistakes happened. The second part included questions about the type of medication errors and the participant are asked to estimate the specific types of medication errors that occurred for injectable and non-injectable drugs in their unit. The total number of phrases in the questionnaire is 21 which 9 phrases are related to non-injectable drugs and 11 are related to injection drugs. The participants show their agreement with each statement on a spectrum ranges from very low to very high.

The third part contains questions related to factors associated with medication errors and consists of 5 subscales of communicating factors, factors relating to the packaging, transcription, factors related to working conditions and factors related to pharmacy. In this part the participants show their agreement with each of the items using the Likert scale ranging from 1 = strongly disagree to 6 = strongly agree. The total number of questions was 29 with the mean scores of 1 to 5 for each of the questions. This tool was translated by Taheri et al. (2011) (22) and the content validity of the questionnaire established by opinions of experts (the opinions of the ten faculty members at School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences and Health Services, 3 nurses working in neonatal units and intensive care and two pediatrician). Cronbach's alpha was used to determine the reliability of the questionnaire and was calculated 0.71 for the questions related to

non-injectable drugs and 0.82 for questions related to injectable drugs. This coefficient for communicating factors related to medication errors was $\alpha = 0.76$, factors related to packaging $\alpha = 0.80$, factors related to drug instruction $\alpha = 0.77$, the factors related to working conditions $\alpha = 0.66$ and factors related to pharmacies was $\alpha = 0.66$ (22).

In the present study, Cronbach's alpha coefficient was used to determine the reliability of the second questionnaire. The coefficient for questions related to non-injectable drugs was 0.78, 0.75 for questions related to injectable drugs, 0.70 for communicating factors related to medication errors, 0.66 for packaging factors, 0.89 for transcription, 0.75 for factors related to working conditions and 0.85 for factors related to pharmacy. In order to perform this study, after obtaining the permission of the hospital administration, the researcher introduced himself to the ward's matron.

Then the researcher met the nurses, who had the inclusion criteria and explained them the items including optional participation, aim of the study, questionnaires and how it should be completed, the confidentiality of the provided information, and adherence to the ethical issues during the study.

After obtaining oral and written consent from nurses for participation, the envelopes containing a questionnaire delivered to the matron or secretary of the ward. The participants were asked to put the completed questionnaire into the same sealed envelope to be collected by the researcher after 24 hours. A total of 68 nurses had the inclusion criteria and 63 nurses consented to participate and completed and returned the questionnaires. The data was analyzed using descriptive statistics (frequency, percentage, mean and standard deviation) and ANOVA test in SPSS -18 software. $P < 0.05$ were considered statistically significant.

3- RESULTS

In this study, the mean age of the nurses was 32.72 ± 7.05 years old. Most nurses were married (88.9%) and had bachelor's degree in nursing (98.4%). In addition, 36.5% were in formal employment status, 42.9% had less than one year (12 months) work experience in pediatric ward and 88.9% had rotational shift work. In terms of errors incidence in the 6 months preceding the study, 44.4% of nurses had committed medication errors once or twice, and 30.2% of the errors had occurred on the night shift. Regarding the errors related to injectable drugs, the errors with high incidence included: incorrect dosage (7.9%), mistake in medication calculation (6.4%) and wrong infusion rate (9.5%). In relation to non-injectable medication errors, the high incidence was associated with wrong patient (1.6%), incorrect dosage (7.9%), drug administration without having the doctors order (1.6%)

In examining the causes of errors (communicating factors - factors related to the medication packaging - transcription - factors related to working conditions - factors related to pharmacy) average factors related to medication errors were as follows: the mean communicating factors was 4.04 ± 1.07 , the mean factors in terms of packaging was 3.84 ± 1.46 , transcription 3.57 ± 1.42 and the mean pharmacy related factors was 3.15 ± 1.38 . Thus factors affecting the incidence of medication errors in terms of the mean included communicating factors, factors related to the packaging, transcription, factors related to working conditions and factors related to the pharmacy.

In communication category, the illegible orders of doctors was considered by 88.9% of the nurses (56 person) as the main factor of medication errors; in the packaging category similar drug name by 65.5% (41 person); in the categories of transcription 66.6% (42 person) not entering the correct

drug order in Kardex; in the categories of factors related to the working conditions lack of ward personnel by 73% of the nurses (46 cases), in the category of factors related to pharmacy 24-hour unavailability of specialist pharmacist by 66.7% of nurses (n = 42) were deemed the main factors affecting the incidence of medication errors.

Comparison of the mean score of the factors leading to the errors in terms of demographic variables using ANOVA revealed that there was a significant difference between the mean score of communicating factors, the mean score of factors related to working conditions in terms of shifts and employment status ($P < 0.05$). So that the mean score of

communication and the mean score of the factors related to the working conditions of nurses who worked in rotating shifts was higher than those who worked fixed shifts in the morning and in the morning - evening (Long) ($P = 0.038$ and $P = 0.034$ respectively). The average score of factors related to transcription in nurses with recruitment plan was higher compared to nurses who had formal status, treaty and contract employment ($P = 0.036$). According to ANOVA analysis results, there was no statistically significant difference between the mean score of effective factors in the incidence of medication errors in terms of other demographic variables ($P > 0.05$).

Table-1: The frequency distribution of demographic variables of participants nurses

Variables		Number (%)
Age groups (year)	19-30	28 (45.9)
	31-41	25 (41)
	42-51	10 (15.9)
Academic degree	Bachelor	62 (98.4)
	Master	1 (1.6)
Marital status	Married	7 (11.1)
	Single	56 (88.9)
Employment status	Formal	23 (36.5)
	Treaty	14 (22.2)
	Contract	19 (30.2)
	Recruiting plan	7 (11.1)
Work experience (month)	<12	9 (14.3)
	13-60	27 (42.9)
	61-120	14 (22.2)
	121-180	2 (3.2)
	>180	8 (12.7)
Working shift	Fixed morning	5 (7.9)
	Fixed morning-evening	2 (3.2)
	Rotational	56 (88.9)

Table-2: The frequency distribution of medication errors in the last 6 months

Frequency (%)	The number of errors
18 (28.6)	0
28 (44.4)	2-1
15 (23.8)	4-3
2 (3.2)	>5

Table-3: The frequency distribution of non-injectable medication errors

The type of non-injectable medication errors	Very high		High		Moderate		Low		Very low	
	%	N	%	N	%	N	%	N	%	N
Wrong route of medication administration	0	0	0	0	1.6	1	4.8	3	95.4	59
Wrong timing	0	0	0	0	0	0	15.9	10	84.1	53
Wrong patient	0	0	1.6	1	4.8	3	11.1	7	82.6	52
Wrong dosage	0	0	7.9	5	0	0	23.8	15	68.2	43
Mistakes in medication calculation	0	0	0	0	4.8	3	19	12	76.2	48
Wrong medicine	0	0	0	0	0	0	15.9	10	84.1	53
Drug administration without doctor's order	0	0	1.6	1	3.2	2	12.7	8	82.5	52
Medication administration after stopping the order	0	0	0	0	1.6	1	7.9	5	90.4	57
Giving the drug to patients with a known hypersensitivity	0	0	0	0	0	0	6.4	4	95.4	59

Table-4: frequency distribution of injectable medication errors

The type of injectable medication errors	Very low		Low		Moderate		High		Very high	
	N	%	N	%	N	%	N	%	N	%
wrong way of medication administration	56	88.9	4	6.4	3	4.8	0	0	0	0
wrong timing	51	80.9	9	14.3	3	4.8	0	0	0	0
Wrong patient	52	82.5	10	15.9	1	1.6	0	0	0	0
Wrong medication	53	84.1	10	15.9	0	0	0	0	0	0
Wrong dosage	46	73	11	17.5	1	1.6	5	7.9	0	0
mistakes in medication calculation	41	65	17	27	1	1.6	4	6.4	0	0
Medication administration without doctor's order	60	95.2	3	4.8	0	0	0	0	0	0
Medication administration after stopping the order	57	90.4	5	7.9	1	1.6	0	0	0	0
Giving medication to patients with a known hypersensitivity	61	96.8	2	3.2	0	0	0	0	0	0
The use of inappropriate solutions for drug dilution	59	93.6	4	6.4	0	0	0	0	0	0
Wrong infusion rate	39	61.9	17	26.9	1	1.6	6	9.5	0	0
Lack of attention to drugs interactions in coadministration	53	84.1	10	15.9	0	0	0	0	0	0

4- DISCUSSION

According to the results of this study, 44.4% of nurses committed once or twice error over the 6 months preceding this study. In the study by Miladinia et al., the frequency of medication errors by nurses in the pediatric ward at 5 hospitals was

examined and the results showed that 58.49% of the nurses had committed at least one medication error within 3 months(21). Stratton et al. also indicated a high prevalence of medication errors in children's ward and that 67% of the nurses under study reported that they had experienced medication errors(2). Ross et

al. showed that 67% of the pediatric nurses have experienced at least one error during a monthly working over the course of their career(28). The differences in the reported rates of medication errors can make it difficult to compare the results of studies and such differences have been also observed in other studies(17) which can be caused by variation in definitions of medication errors and variability in data collection methods (observation, interview, questionnaire) (30). But what matters is that medication errors is common and can be potentially dangerous for children (31) which is highlighted the need for paying more attention to prevent the occurrence of the errors (32).

In terms of shifts, most errors had occurred on the night shift. Shahrokhi et al. reported that working in the night shift is an effective factor in the incidence of medication errors (33). In the study by Johnson et al., 56% of nurses participating in the study stated that they are suffering from sleep deprivation and they noted that this factor is the main cause of medication errors (34). In fact, sleep deprivation during the night shift not only causes cognitive and behavioral damage to the nurses but also can lead to emotional and physiological problems, whereas having enough sleep during the night shift can improve the ability of the nurses to adapt with work stress along with quality of care (35). Thus providing interventions to increase the quality and quantity of sleep in nurses during night shift are needed in order to improve sleep in nurses, and subsequently to reduce the effects of sleep deprivation on health care errors (36).

Different types of errors identified in this study including items such as wrong medication calculations, wrong dosage and wrong infusion rate, wrong patient and the medication administration without a physician's order. Taheri et al.(22) reported that wrong medication calculations and not considering drug interactions in

coadministration, are the most frequent type of medication errors. Miladinia et al. introduced the wrong dosage and wrong preparation of the drug as the main cause of medication errors(21). In the study by Shams et al. coadministration and intervention of some drugs as well as rapid infusion rate have been reported the most common type of medication mistakes (37). In other studies by Pelliciotti et al. (29) and Nawwara et al.(38) error in frequency of drug administration and errors in drug administration techniques have been regarded as the most common type of medication errors respectively. In fact, these findings suggest that in most cases, medication errors by nurses can happen at the time of medication preparation and administration to the patient. So that the nurses' preparedness in terms of pharmacological knowledge (how to calculate the dose of a medication, medication dose determination and being aware of medication administration and drug interactions with each other) alongside the performance of nurses during drug administration can determine the type of errors. Thus, there should be more focus on developing educational programs based on these factors in order to further prepare nurses working in pediatric wards for medication practices.

In assessing the factors affecting medication errors, the first factor was communicating factors, and in this category, doctor's illegible handwriting was regarded as the main communicating factor by majority of the nurses. In Saudi Arabia, Dibbi et al. showed that the communicating factors are the second cause of medication errors, so that incorrect medication orders and the use of verbal orders stated as the most effective communicating factors in medication errors(39). Zahmatkesh et al. reported the doctor's illegible handwriting as the important factor causing medication errors(40). In the study by Compinovilgas

et al., 59.3% of the nurses stated the doctor's illegible handwriting as the first and most effective factor in the incidence of medication errors(41). In fact, illegible physician order is very important in the incidence of medication errors(42) and causes misreading drug name, dosage and the administration instruction(43). Since legibility in writing of medical orders is one of the requirements of order writing, and illegibility is one of the problems in manual documentation, therefore developing electronic medical records can help overcome these shortcomings(44).

Packaging is the second factor affecting the incidence of medication errors. In this category, similar drug packing or drug names has been mentioned by nurses as the main factor which impacts the incidence of medication errors. Classen and Metzger also reported that the similarity in form and packaging of the medicines in 36.7% of the cases can lead to medication errors(45). The results of the study by Heydari et al. also confirmed the importance of drug names similarity in the incidence of medication errors(46). In the study by Berman, similar drug names accounted for 25% and drug packaging and confusing labels accounted for 33% of all medication errors(47). So the similarity of drug names, medicinal tags and pharmaceutical packaging color can play an important role in medication errors(48). Therefore, by using some strategies including the use of Typography signs (e.g. bolding or highlighting the name of the medication), the use of bright colors, the use of standard icons in packaging to display alerts, and the use of sans serif fonts, medication errors can considerably be reduced(49).

Another factor alongside the other two mentioned factors is transcriptional errors which may lead to medication errors. In this category, not entering the correct medication orders in Kardex has been indicated by nurses as the most effective

factor in medication errors. Studies by Shahrokhi et al.(32), Taheri et al.(22), Seydi and Zardasht (50) also showed that the mistakes of the nurses in transferring the medication orders from patient medical record to the Kardex has the highest impact on the incidence of medication errors. Since manual documentations are considered as legal documents in healthcare system, hence the precise recording of the documents can be an important factor in reducing such errors(51). Besides, verifying designed Kardex for recording the medication orders is of the importance because multiple narrow columns of the Kardex for transferring orders as well as not fully completing the columns can be the source of the errors(52).

Another factor involved in the occurrence of medication errors was related to the working condition, so that shortage of ward's personnel has been stated by 73% of the nurses as the main factor in this category. This report is in line with the results of studies by Nikpeyma and Gholami (53), Tang et al.(12) and Salmani and Hasanvand(20).The findings suggested that working condition play a constructive role in the incidence of errors and that the number of staff who are employed in the sector can increase or decrease the rate of error incidence. Staffing shortages in the sector leads to increased workload, fatigue, decreased concentration and attention of nurses and subsequently increases the risk of medication errors. These findings should be of interest to nursing managers in the pediatric ward for assessing and meeting the required workforce and to take effective steps in order to reduce medication errors. Last risk factor in medication errors was associated with pharmacy errors. In this category 66.7% of nurses introduced the lack of 24-hour availability of clinical pharmacist as an important factor in the incidence of medication errors. McBride- henry and

Foureur in their study stated that the presence of a pharmacologist at clinical rounds significantly reduces medication errors (54). Similar to the present study, Taheri et al. had identified this factor as the last effective factor in medication errors(22). In other words, drug therapy is a process including several rings; each ring has an important role and nurses as the last ring in this process deliver medication to the patients. The presence of professional pharmacist in the sectors can provide necessary advice for nurses in relation to the drugs and help identify errors before they occur and reduce the incidence of errors.

In terms of shifts, nurses with rotating shifts compared to the nurses with fixed shifts reported higher agreement with the factors associated with working conditions and communication as the effective factors in medication errors. Nurses with fixed working shift, have approximately a constant and predictable workload in the morning or evening shift and they normally work with fixed physicians in that shift that this leads to familiarity with routine therapeutics and commonly prescribed drugs by doctors. While nurses with rotating shifts work with different doctors who have different and unfamiliar handwriting that this can increase the frequency of errors. Besides, in different shifts they experience different workload. However, in the literature review, findings that clearly to be in accordance with these results have not been found. But in the study by Fatehi et al. it has been stated that nurses working in rotating shifts are more prone to make errors than nurses working in fixed shift(55). Landrigan et al. also introduced working in rotating and long shifts as the risk factor for reduced performance which results in increased incidence of medication errors(56). The employment status of nurses in the study also had an impact on the selection of factors affecting medication errors. So that the nurses with recruitment plan compared

to other nurses obtained the highest mean score of agreement related to the transcription factors. Miladinia et al. indicated that the newly graduated nurses are more likely to commit medication errors and there is a significant relationship between job status and incidence rate of errors(21). In fact, novice nurses have limited knowledge and experience(57) and are unaware of situations that create errors(58). Therefore, the errors associated with transcription can be the results of being a novice nurse, thereby providing ongoing training and encouragement for beginners to learn from experienced nurses can be effective in reducing medication errors(59).

4-1. Limitations of the study

It should be noted that nurses participating in this study were from different private hospitals, and hospitals affiliated with the University and social security organization. Considering that the situation in these hospitals is somewhat different from each other and that self-report questionnaires were used for data collection, hence, these two issues were the limitations of this study and therefore the results should be generalized with caution.

5. CONCLUSION

Generally, according to results of this study, medication errors in pediatric ward are common, whereas the nurses are responsible for the safety of children hospitalized in the pediatric ward. As mentioned before the medication miscalculation, wrong dose, wrong infusion rate, wrong patient and the medication administration without doctor's order were the common types of medication errors. Also, influencing factors in terms of priorities were communicating factors, factors related to: packaging, transcription, working conditions and pharmacies. Given the importance of medication error in health

care system, it seems essential that all the rings in the medication process, including nursing managers, nurses, doctors and pharmacologists who are involved in this process should act in line with each other and evidence-based interventions should also be considered.

To improve the quality of care, several approaches can be considered such as 1) training courses for nurses before entering the children's ward in order to improve pharmacology and computational knowledge of nurses, 2) holding seminar sessions for nurses, doctors and pharmaceutical professionals in order to improve the cooperation among health care providers, 3) identifying effective strategies to reduce medication errors based on the identified reasons, and 4) planning by nurse managers for providing adequate nursing workforce and reducing their operational workload caused by workforce shortage.

6- CONFLICT OF INTEREST: None.

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