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The Study of Type and Amount of Medication Errors in Neonatal Intensive Care Units and Neonatal units

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ABSTRACT

Aims: One of the common medical errors is medication errors. Since medication errors are doubly important in neonatal units and neonatal intensive care units, prevention of these errors are very important and necessary. The aim of this study has been determining the level and the type of medication errors in neonatal units and neonatal care units.

Methods: The present research was a descriptive-correlative study. The method of sampling was census and included 119 nurses working in the neonatal units and neonatal intensive care units in 5 educational hospitals of Shahid Beheshti University of Medical Sciences. The data collection tool was questionnaire. The first questionnaire contained the demographic data. The second questionnaire was "Medication Administration Error" in order to determine the level and types of medication errors) and they were used after that their validity and reliability were examined. The collected data were analyzed by SPSS 18 software.

Results: 11.8 percent of the nurses indicated that during the last 6 months they did not commit medication errors and 37.8 percent of them had between 1 to 2 medication errors. Medication errors in injectable drugs respectively included; error in time of administration of medication (51 to 60 percent), errors in pharmaceutical calculations (51 to 60 percent), neglecting the drug interaction in simultaneous prescription of drugs (51 to 60 percent), wrong dose of a drug (41 to 50 percent) and medication errors in non-injectable medications included respectively in medication calculations (51 to 60 percent) and after that error in medication dose (41 to 50 percent). Correlation between injectable and non-injectable medication showed that error is mostly in injectable drugs and nurses who have error in injectable medication also have errors in non-injectable medications.

Conclusion: Identification of types and level of medication errors can lead to steps towards prevention of these errors and advancement in the increase of quality of neonatal care and safety.

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1. Introduction

The patient's safety is one of the most important aspects of health care and hurting the patient or someone who is seeking health is contrary to the philosophy of health care [1]. In the era when pharmaceutical products are produced in large amounts and there are numerous reports on poisonous effects of drugs on the hospitalized patients, the process of correct use of drugs is the base of the patient's safety [2]. In the recent years, medication errors are known to be one of the most important reasons for death of the in patents and outpatients [3]. Medication errors are one of the seven groups of important and preventable medical errors [4]. A preventable event is the one which occurs in any phase of the pharmacotherapy process and may lead to using unsuitable drugs or hurting the patient [5].

Pharmacotherapy is particularly important for the children, especially newborns. This group of patients in compare with the adults does not have the ability of metabolism of drugs due to incompleteness of the functions of the kidneys and liver. Therefore, the outcomes of medication errors are more serious in this group of patients in comparison to other groups. Based on this fact, the breast-fed babies and newborns are exposed to the side effects of medication errors more than others [6]. The hospitalized patients are more vulnerable due to vast encounter with the pharmaceuticals, shortage of information resources of the health care personnel in relation to pharmacotherapy, shortage of special pharmaceutical products for newborns, long-term stay in the hospital and incapability of verbal communication [7].

The annual cost of death resulting from medication in the U.S. has been estimated to be about 1.56 to 5.6 billion dollars [8]. Gillian et al wrote in 2001: "in spite of increase of people's awareness of medication errors and medication achievement safety from 1998 to 2001, 127 cases of medication error have occurred in the U.S. and U.K., 93.7% of which have been real errors and led to deplorable outcomes.'' [9] In Iran, the patients' complaints have been growing and medication errors are one of their major reasons. Fifty five thousand medication errors are annually reported in Iran and 10500 cases lead to death and 23000 cases cause organ defect [5]. In Iran, 8% of hospital treatments lead to medication errors which is more than the U.S. (2.4% to 5.6%) [10]. Twenty percent of the total medical errors is related to medication errors while 39% is related to the physicians' errors in prescription, 38% is related to the nurses in preparation and administration of medication, 12% is related to the pharmacists and 11% is related to transfer of the physician's orders from the file into the kardex [5].

In nursing care of newborns, the need to continuous and organized care for prevention of medication errors is felt. Observation of the quintuple rules in administration of drugs (right time, right patient, right dose, right method and right medication) provides a framework to improve safety in the profession of nursing and four items have been added recently which include the right reason, medication levels, and date of expiry and right medication record [7]. Few studies have been performed in relation to the amount and type of medication errors in the neonatal units and neonatal intensive care units. Tisdal et al, in their research in the U.S. reported the nurses' medication errors in the neonatal intensive care units and pediatric intensive care units as 17.4% and 38%, respectively [11].

Since the newborns form a vulnerable group and the process of pharmacotherapy is complicated in them and requires multiple steps, a minor error in the process of pharmacotherapy may have noticeable effects in the newborns [12]. Taking the necessary measures to prevent and reduce medication errors in the neonatal units requires the awareness of the health-treatment personnel about the amount and type of medication errors in these units. The present study is aimed at determination of the amount and type of

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medication errors in the neonatal units and neonatal intensive care units in the hospitals affiliated to Shahid Beheshti University of Medical Sciences.

2. Methods

This research is a descriptive-correlative study which was performed in 2011 in 5 educational hospitals of Shahid Beheshti University of Medical Sciences. The method of sampling was census and all of the nurses working in the neonatal units and neonatal intensive care units in these hospitals voluntarily participated in the study and included 119 nurses.

The data collection tool was two questionnaires. The first questionnaire contained the demographic characteristics including the information about age, work experience, marital status, and number of newborns for each nurse in each shift and type of work shifts. The second questionnaire was a two-part questionnaire which was based on the "Medication Administration Error" questionnaire. This questionnaire was design by Wakefield et al in 2005 which was studied and prepared from 1994 in the hospitals affiliated to the Medical University of Iowa and its reliability and validity were assessed in 1998, 1996, 1994 and 2001 and this tool was completed and presented in 2005 after adding phrases and questions to the questionnaire .The reliability of the tool was studied by retesting in which the questionnaire was distributed among a group of nursing students in the B.Sc. program with an interval of 3 weeks and the Pearson correlative coefficient indicated a range of 0.53 to 0.78 [13). The first part of the medication administration error questionnaire provides information about the amount of medication errors made by the patients during the past 6 months and the shift in which more medication errors has been occurred. The second part of the questionnaire includes questions related to the type of medication errors and categorizes the medication errors to two general groups of non-injection medication errors (9 questions) and injection medication errors (12 questions). The studied units state the occurrence of each of these types at 100%. The questionnaires were distributed among the nurses totally confidentially in closed envelopes in different work shifts and they were collected in closed envelopes as well.

In this research, the method of determination of content-related validity index and study of the face validity has been used to determine the validity of the data collection tool. The questionnaire was given to 10 Faculty Members of the Faculty of Nursing and Midwifery at Shahid Beheshti University of Medical Sciences, 3 nurses working in the neonatal and neonatal intensive care units and 2 neonatologists and the content-related validity was studied in terms of simplicity, clarity and relevance.

The validity of the phrases of the questionnaire included a range of 75% to 100%. Therefore, none of the phrases of the questionnaire was omitted and this tool was used after applying the modifications. For determination of the reliability of the tool, the method of determination of internal consistency (calculation of Cronbach's alpha) was used. The Cronbach's alpha is equal to 0.712 for different types of non-injection medication errors and 0.841 for different types of injection medication errors.

3. Results

The average of the age group of the studied units was 31.92 years old and 59.66% of them were married. Most of the studied units (65.5%) were working in the neonatal intensive care unit and 55.5% of them had a work experience between 1 to 5 years. 95.8% of them held a bachelor's degree and most of the nurses (75.6%) worked in alternative shifts. 74.8% of the nurses stated that 1 to 5 newborns are entrusted to them in each shift and 97.5% of them were working in only one hospital.

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Table 1: Frequency of errors in the past 6 months in the nurses working in the neonatal units and neonatal intensive care units in the hospital affiliated to Shahid Beheshti University of Medical Sciences in 2011

Frequency Error	Number	Percentage	Descriptive Statistics		
			Standard Deviation	Median	Mean
0 Error	14	11.8	5.36	3	5.45
1-2	59	37.8			
3-5	14	11.8			
6-8	7	5.9			
9-11	16	13.4			
More than 12	23	19.3			
Total	119	100			

As to the amount of medication errors in the past 6 months, 11.8% of the nurses declared that they had not made any medication errors and 37.6% of them made 1 or 2 medication errors (table 1). 41.2% of the studied units stated that most of the medication errors occur during the night shift.

As to the types of medication errors, the research results indicated that the most frequent type of non-injection medication errors which occurs in the neonatal unit and neonatal intensive care unit is the error in pharmaceutical calculations (51% to 60%) and after that is the error in medication dose (41% to 50%). Furthermore, the most frequent errors in injection medication included the error in time of administration of medication (51% to 60%), error in pharmaceutical calculations (51% to 60%), neglecting the drug interaction in simultaneous prescription of drugs (51% to 60%), error in medication dose (41% to 50%) and error in the speed of drug injection (41% to 50%) (Table 2).

The results of the present study with using Pearson correlation coefficient indicated that there was a direct correlation between different types of injection and non-injection medication errors. In addition, the statistical t-test with the significance level of 0.05 indicated that there is a significant difference between different types of errors and since the average of injection medications is 2.44 and non-injection medications is 1.99, the percentage of occurrence of different types of errors in injection medications is higher than non-injection medications (table 3).

4. Discussion

Pharmacotherapy is discussed as the most common procedure in the health care area [14]. At the same time, the intensive care unit is particularly known as an environment with a high risk for medication error occurrence [15]. This issue makes the health care individuals think to look for a way to provide safe care of newborns, increase the quality of the care and minimize the period of stay in the hospital with minimum damages resulting from medical treatment. In the study performed by Lisby et al (2005) in Denmark, the average medication error occurrence in the treating personnel was reported as 43% [16]. Furthermore, in the study performed by July et al (2009), the average medication error occurrence within 3 months in the studied units (internal medicine, surgery, orthopedics, gynecology and obstetrics) was 19.5 cases for each nurse [4]. In the study by Ross et al (2000), the report of medication errors in nurses was 32.7% and in the study by Grissinger and Kelly (2005), 67% of the nurses working in the pediatric unit reported that they had made at least one error during the work period [17 , 18].

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Table 2: Distribution of frequency of different types of injection and non-injection medication errors in the nurses working in the neonatal units and neonatal intensive care units in the hospital affiliated to Shahid Beheshti University of Medical Sciences in 2011

Types of Errors		Percentage of Occurrence of Different Types of Non-Injection Medication Errors										Percentage of Occurrence of Different Types of Injection Medication Errors									
N=Number P=Percentage		0%- 20%	21%- 30%	31%- 40%	41%-50%	51%-60%	61%-70%	71%- 80%	81%-90%	91%-99%	100%	0%- 20%	21%- 30%	31%- 40%	41%-50%	51%-60%	61%-70%	71%- 80%	81%-90%	91%-99%	100%
Wrong Method in Medication Administration	N *	52	20	11	26	7	1	2	0	0	0	45	24	11	34	2	1	0	1	0	1
	P *	43.7	16.8	9.2	21.8	5.9	0.8	1.7	0	0	0	37.8	20.2	9.2	28.6	1.7	0.8	0	0.8	0	0.8
Error in Time of Medication Administration	N	33	31	12	14	26	2	0	0	0	1	27	19	20	21	30	0	0	0	0	1
	P	27.7	26.1	10.1	11.8	21.8	1.7	0	0	0	0.8	22.7	16	16.8	17.6	25.2	0	0	0	0	0.8
Wrong Patient	N	98	14	3	3	0	1	0	0	0	0	93	20	2	2	0	2	0	0	0	0
	P	82.4	11.8	2.5	2.5	0	0.8	0	0	0	0	78.2	16.8	1.7	1.7	0	1.7	0	0	0	0
Wrong Medication	N	86	19	8	3	2	0	1	0	0	0	72	38	4	3	1	1	0	0	0	0
	P	72.3	16	6.7	2.5	1.7	0	0.8	0	0	0	60.5	31.9	3.4	2.5	0.8	0.8	0	0	0	0
Error in Medication Dose	N	28	24	22	36	6	1	1	0	1	0	27	18	22	36	11	4	0	1	0	0
	P	23.5	20.2	18.5	30.3	5	0.8	0.8	0	0.8	0	22.7	15.1	18.5	30.3	9.2	3.4	0	0.8	0	0
Error in Pharmaceutical Calculations	N	21	24	23	19	25	4	2	0	1	0	17	22	20	21	28	10	0	1	0	0
	P	17.6	20.2	19.3	16	*21	3.4	1.7	0	0.8	0	14.3	18.5	16.8	17.6	23.5	8.4	0	0.8	0	0
Medication Administration without the Physician's Prescription	N	85	25	2	1	1	3	2	0	0	0	55	53	4	2	3	2	0	0	0	0
	P	71.4	21	1.7	0.8	0.8	2.5	1.7	0	0	0	46.2	44.5	3.4	1.7	2.5	1.7	0	0	0	0
Medication Administration after the Physician's Ceasing Order	N	102	13	1	0	1	1	1	0	0	0	94	22	1	2	0	0	0	0	0	0
	P	85.7	10.9	0.8	0	0.8	0.8	0.8	0	0	0	79	18.5	0.8	1.7	0	0	0	0	0	0
Medication Administration to a Newborn with a Recognized Allergy	N	112	5	1	0	0	0	0	0	0	0	109	9	0	1	0	0	0	0	0	0
	P	94.1	5	0.8	0	0	0	0	0	0	0	91.6	7.9	0	0.8	0	0	0	0	0	0
Use of an Unsuitable Solution for the Drug Dilution	N	0	0	0	0	0	0	0	0	0	0	68	16	7	5	9	7	4	2	0	1
	P	0	0	0	0	0	0	0	0	0	0	57.1	13.4	5.9	4.2	7.6	5.9	3.4	1.7	0	0.8
Error in Speed of Drug Injection	N	0	0	0	0	0	0	0	0	0	0	20	19	23	25	12	9	5	4	1	1
	P	0	0	0	0	0	0	0	0	0	0	16.8	16	19.3	21	10.1	7.6	4.2	3.4	0.8	0.8
Neglecting the drug interaction in simultaneous prescription of drugs	N	0	0	0	0	0	0	0	0	0	0	14	16	15	20	23	12	7	8	3	1
	P	0	0	0	0	0	0	0	0	0	0	11.8	13.4	12.6	16.8	19.3	10.1	5.9	6.7	2.5	0.8

* Note: The total is not 100% in some rows due to rounding off.

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Table 3: Study of the correlation between different types of medication errors in the nurses working in the neonatal units and neonatal intensive care units in the hospiteal affiliated to Shahid Beheshti University of Medical Sciences in 2011

Types of Errors	Mean	Standard Deviation	Pearson's Correlative Coefficient	Paired t-Test	Test Result
Different Types of Non-Injection Medication Errors	1.99	0.69	r=0.74 p<0.001	t= 0.27 p<0.000	The difference is significant.
Different Types of Injection Medication Errors	2.44	0.89			

Cheodo et al (2006) investigated 11 studies performed in the neonatal intensive care unit in England. In their investigation, the amount of medication errors varied in different studies. This varying is the result of the difference in definition of a medication error and the method by which the error is identified. The highest amount of error in these studies was 5.5 cases of error per 100 physician's prescription [19].

As to the type of medication errors, according to the findings of the present study, medication errors occurred more in injection medication than non-injection medication and the nurses who make errors in non-injection medication make errors in injection medication as well. This finding is concordant to the findings of the research performed by Simpson et al (2005) which reported 63% errors in the venous medication, 39% in edible drugs and one case of error in topical medications. The findings are also similar to the results of the research of Mansfield (2001) and Kaushal et al (2001) in which the medication errors were related to venous injections [15, 20, 21] while in the research performed by Gillian et al (2001), the results showed that the medication errors occur in the edible methods 46% more than the venous injection [9].

As to the type of medication errors, in the study by Prot et al (2005), in studying the administration of 719 medications to 336 patients with 485 errors made by nurses, it was revealed that errors occurred 36% at the time of medication administration, 19% in the method of medication administration, 15% in the medication dose, 10% in the prescription without order and 8% in the unsuitable form of medication. The results of the fore-said study are almost similar to the present study [22] and are approximately concordant to the results of the present study.

Furthermore, in the study by Lope et al (2009), the medication errors occur in the neonatal intensive care unit more than the adults' units. In their study, the most frequent type of medication error in this unit is in the time of medication administration and one of its reasons can be the crowdedness of the intensive care unit which is nearly similar to the results of the present study. In this study, the most important factor in medication error occurrence was low knowledge of the nurses and holding a retraining course can be effective in reduction of these errors to some extent [23].

As to the type of medication errors, there was not much difference in various studies. Perhaps the case which gets the first rank in one study receives the second rank in another study because the neonatal unit and neonatal intensive care unit have common characteristics. Therefore, the type of medication errors is almost the same in these units.

According to the results achieved, the medication errors occur more in the night shift which is similar to the results of the study performed by Wilkins and Sheids (2008) [24] while in the study by Panjouyee, Booker and Roseman (1995) and Tisdal (1986), it was revealed that most of the errors occur in the morning shift [11, 21 , 20]. This difference in various studies may be due to the reason that the number of nurses in the night shift may be low in some of the hospitals.

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5. Conclusion

Based on the results obtained from this research, the medication errors are prevalent in the neonatal unit and neonatal intensive care unit. Most of these errors occur in the night shift and medication errors in injection medication occur more than non-injection errors. The type of errors occurred in injection and non-injection medications are different with each other and have been reported separately. Since the patients hospitalized in the neonatal unit and neonatal intensive care unit are very vulnerable, it is necessary to make constant attempts to enhance their safety. In order to do this, we can overcome the occurrence of medication errors to some extent by increasing the number of efficient and specialized manpower, especially in the night shift and standardizing the conditions of the intensive care unit. In addition, the increase of the nurses' knowledge and awareness about the medications, process of pharmacotherapy, side effects of drugs and figuring the method of performance of pharmacotherapy is considered necessary and essential.

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