

## Original Article

### Factors effective on medication errors: A nursing view

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#### ABSTRACT

**Objective:** Medication errors are the most common medical errors, which may result in some complications for patients. This study was carried out to investigate what influence medication errors by nurses from their viewpoint.

**Methods:** In this descriptive study, 150 nurses who were working in Qazvin Medical University teaching hospitals were selected by proportional random sampling, and data were collected by means of a researcher-made questionnaire including demographic attributes (age, gender, working experience,...), and contributing factors in medication errors (in three categories including nurse-related, management-related, and environment-related factors).

**Findings:** The mean age of the participant nurses was  $30.7 \pm 6.5$  years. Most of them (87.1%) were female with a Bachelor of Sciences degree (86.7%) in nursing. The mean of their overtime working was  $64.8 \pm 38$  h/month. The results showed that the nurse-related factors are the most effective factors ( $55.44 \pm 9.14$ ) while the factors related to the management system ( $52.84 \pm 11.24$ ) and the ward environment ( $44.0 \pm 10.89$ ) are respectively less effective. The difference between these three groups was significant ( $P = 0.000$ ). In each aforementioned category, the most effective factor on medication error (ranked from the most effective to the least effective) were as follow: The nurse's inadequate attention (98.7%), the errors occurring in the transfer of medication orders from the patient's file to kardex (96.6%) and the ward's heavy workload (86.7%).

**Conclusion:** In this study nurse-related factors were the most effective factors on medication errors, but nurses are one of the members of health-care providing team, so their performance must be considered in the context of the health-care system like work force condition, rules and regulations, drug manufacturing that might impact nurses performance, so it could not be possible to prevent medication errors without paying attention to our health-care system in a holistic approach.

**Keywords:** Medication error; nurse; nursing workload

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## INTRODUCTION

Medication error is one of the most common medical errors.<sup>[1]</sup> Moreover, the medication error means a disorder in the treatment process, which is followed by a potential or actual risk of hazard for patient.<sup>[2]</sup>

Nowadays, medication errors have attracted more attention because of the complications like higher mortality rate and cost of health-care.<sup>[3]</sup> In the USA, the medication error-related deaths have been more than the deaths related to the car accidents, breast cancer and human immunodeficiency virus/acquired immune deficiency syndrome.<sup>[4]</sup> The first reports related to medication errors have been published since 1940 that attracted the authors' attention for preventing them.<sup>[5]</sup> A recent report by the Institute of Medicine estimated that the medication errors cause between 44,000-98,000 deaths each year in USA hospitals and it costs between \$6-29 billion to compensate for the adverse effects of such errors.<sup>[6]</sup> In general, the errors can be happened in different steps

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of the medication process, but a considerable number of errors occur during medication administration that registered nurses play a vital role in it because of their responsibility for administering drugs in the hospitals.<sup>[7]</sup> Nurse-related medical errors like other medical staffs' errors may cause reversible and irreversible complications which result in higher cost and even increasing mortality.<sup>[8]</sup> Studies show that some factors such as medication miscalculations, lack of knowledge and proficiency as well as neglecting the hospital's medication protocol due to lack of time, extreme tiredness, inadequate work experience and inappropriate work environment may all be related to the medication errors made by the nurses.<sup>[9]</sup> Hend and Barber (2000) classified the causes for medication errors into three categories of personal, contextual and knowledge-based factors, personal factors include, stress, tiredness, confusion, the physician prescription, errors of orders implementation, inadequate attention to details, lack of job-satisfaction, unpleasant workplace, decreased sense of commitment and career conscience and so on. Some examples of contextual factors are the lack of competent and skilled staffs, heavy overtime work, long work days, a crowded ward, necessity of intensive cares, and etc., and some of the knowledge-based causes include, inadequate pharmaceutical knowledge and experience, no awareness about patients' and drug mathematical calculations.<sup>[4]</sup> Although, a severe shortage in the nursing workforce in Iran's hospitals may increase the probability of medication errors occurrence, it can be undoubtedly said that it isn't the only reason for the medication errors. It should be therefore, investigated to find out which factors may lead to the medication errors in hospitals. Since, the medication errors made by a health-care team including physicians and nurses may affect the outcome and quality of health-care, in addition to the fact that the nursing personnel are more involved in medication administration activities than other health-care workers, identifying the factors contributing to medication errors occurrence from the viewpoint of nurses will help reduce the medication errors to a minimum and enhance the quality of nursing services. Accordingly, this study was conducted to determine contributing factors of medication errors from viewpoint of nurses in affiliated teaching hospitals in Qazvin university of medical sciences.

## METHODS

In this descriptive cross-sectional study, 150 registered nurses who work in different wards of four teaching hospitals of Qazvin University of Medical Sciences in 2010 were selected through proportional random sampling and completed a researcher-made

questionnaire. The questionnaire was made by using the different resources related to the medication subject and aforementioned common errors.<sup>[10-12]</sup> The questionnaire was sent to 10 faculties of Qazvin nursing and midwifery school of Qazvin University of Medical Sciences for ensuring its face and content validity, all 10 faculties replied, then necessary corrections were made according to their comments; revised questionnaire was sent to two of these faculties for final confirmation that they both verified it. The questionnaire was assessed using the Cronbach's alpha ( $r = 0.86$ ) to measure internal consistency (the higher cronbach's alpha, the more consistency between inter-items of the questionnaire). The first part of the questionnaire asked for demographic information such as age, gender, income, working experience, educational level, and working ward. The second part asked for the nurses' viewpoint about what influence on medication errors in three categories including, the nurse-related factors (10 items including: Inadequate attention, tiredness due to excessive overtime work, inadequate pharmacologic knowledge, no minute for assessment before drug administration, shortage of time, inadequate experience, nurses' affective and mood problems, personal, and familial problems, no interest for job, financial/economical problems), the ward environment-related factors (15 items including: Heavy workload in the ward, lack of required equipment, Similar drug name and label, similar drug packing, drug arrangements on shelves, ward's medication protocol, noisy ward environment, arrangement of devices, and equipment's in the treatment room, variety of drugs used by the patient, the ward type (Surgery, Emergency, Pediatric,...), overcrowding of the treatment room, inadequate lighting of the treatment room, drug administration route, instability of patient's physiological condition, small treatment room), and the management-related factors (11 items including: Incorrect transfer of medication orders from the patient's file to kardex, incorrect transfer of medication orders from kardex to medicine card, illegibility of physician's order in patient's file, illegibility of drug card, illegibility of kardex, low nurse/patient ratio, inadequate staffs in each working shift, leadership style in the ward, working in night shift, working in evening shift, working in the morning shift). Nurses were asked to answer in a likert scale rating: "Ineffective," "moderately effective," "effective," and "highly effective." In order to facilitate the possibility of comparing these three categories, each section was scored out of 100 points. Ineffective answers were considered as zero score, and by increasing the effect the scores 1, 2, 3 were considered respectively; then the total score changed to 100 for comparing them with each other. The researchers attended in the

above mentioned teaching hospitals during different work shifts and after obtaining the nurses' consent, they distributed the questionnaire and collected them after 24 h. The SPSS (v. 13) software was used for data analysis through ANOVA for comparing the means of effect score of the items in three group's factors, and also Freidman tests for one-way repeated measures analysis of variance between ranks of three different groups of factors. Significance level of statistical differences was considered at 0.05.

## RESULTS

The mean age of the nurses was  $30.7 \pm 6.5$  years. Most of them (87.1%) were female with a Bachelor of Sciences degree (86.7%) in nursing. Their average monthly overtime work was  $64.8 \pm 38$  h. The results totally showed that the nurse-related factors with the mean score of  $55.44 \pm 9.14$  are the most effective factors in medication errors occurrence and the factors related to the management and the ward environment with mean scores of  $52.84 \pm 11.24$  and  $44.0 \pm 10.89$ , respectively were less effective. This difference was statistically significant ( $P = 0.000$ ) [Table 1]. Table 2 shows the frequency of the above-mentioned factors from the most effective to the least effective (considering the total amount of two columns of "highly effective" and "effective" for ranking). In the personal factors category, from the nurses' point of view, factors such as nurse's carelessness, tiredness caused by excessive overtime work, inadequate knowledge in pharmacology and insufficient experience are the most effective factors; and factors such as financial problems and lack of interest in nursing job are the least effective factors [Table 2]. Among management-related factors, the most effective factors are the transfer incorrect of medication orders from the patients' file into their kardex, and from kardex into the medicine card, the illegibility of physician's order in patient's file, the illegibility of patient's medicine card and kardex. The least effective factor in this category is working in different shifts [Table 2]. The most effective

environment-related factor is ward's heavy workload; the size of the treatment room and the instability of patient's condition are the least effective factors [Table 2]. There was seen no significant difference between the demography of nurses (age, gender, working experience...) and the contributing factors of medication errors ( $P > 0.05$ ).

## DISCUSSION

According to findings of this study, among three categories of factors contributing in medication errors occurrence, the nurse-related factors are the most effective and the factors related to managerial and environment are respectively less effective. Investigations on the correlation between the condition of nursing human resources and the occurrence of medication errors show that the organizational context (environment as well as the internal and external technology) and the organizational structure (condition of the nursing workforce) are effective on medication errors, but there is no sufficient evidence yet to prove such a correlation, so more studies are required.<sup>[13]</sup> Besides, in a conducted research in Iran (2010) nurses believed there are so many factors that contribute in committing the errors by nurses, additionally they pointed out to management-related (84.2%) and patient-related factors (50.5%) as the most important factors.<sup>[14]</sup>

In this research, the top contributing factor among nurse-related factors was careless performance of the nurses which is mentioned as one of the most effective factor by other researches too.<sup>[4,15-18]</sup> Tiredness is the second most effective factor in medication errors from the viewpoint of nurses participating in this research and many other researchers have also referred to tiredness as an effective factor.<sup>[15-17,19]</sup> Inadequate knowledge in pharmacology (administration routes, drug incompatibilities, drug side-effects and the way of preventing them and even some dosage calculations) is another very important factor involved in medication errors occurrence, according to the present research as well as some other researches.<sup>[11,20]</sup> In some other studies, the insufficient pharmacological knowledge is referred to as one of the three most important reasons in occurrence of medication errors.<sup>[21,22]</sup> Although, all nursing students should pass pharmacology course at university, some periodic continuing education programs are needed for nurses to improve their pharmacological knowledge particularly because of continuous supply of new drugs to the drug market and the necessity of learning the new indications of old drugs.

Insufficient work experience is also an effective factor leading to medication errors, which is mentioned, and

**Table 1: Comparison between mean of effect score of the influencing factors in medication errors from nurses' viewpoint (n=150)**

The factors	Mean of effect score (of 100)	SD	df	F	P value
Nurse-related factors	55.44	9.14	2	107.15	0.000
Management-related factors	52.80	11.24			
Environment-related factors	44.00	10.89			

SD=Standard deviation; df=degree of freedom

**Table 2: The frequency of nurse-related, management-related, and environment-related factors of medication errors from nurses' viewpoint (n=150)**

The factors	Highly effective		Effective		Moderately effective		Ineffective	
	n	%	n	%	n	%	n	%
Nurse-related factors								
Inadequate attention	118	78.7	30	20	2	1.3	0	0
Tiredness due to excessive overtime work	94	62.6	48	32	7	4.8	1	0.6
Inadequate pharmacologic knowledge	88	58.4	54	36.2	8	5.4	0	0
No assessment before drug administration	48	31.8	82	54.7	18	12.1	2	1.4
Shortage of time	62	41	59	39.6	26	17.4	3	2
Inadequate experience	50	33.2	57	37.8	32	21.6	11	7.4
Nurses' affective and mood problems	50	33.3	75	50.3	21	13.7	4	2.7
Personal and familial problems	40	26.5	78	52.4	28	18.4	4	2.7
No Interest for job	50	33.3	57	37.8	32	21.5	11	7.4
Financial/economical problems	50	33.3	57	37.8	32	21.5	11	7.4
Management-related factors								
Incorrect transfer of medication orders from the patient's file to kardex	104	69.7	40	26.9	6	3.4	0	0
Incorrect transfer of medication orders from kardex to medicine card	106	70.8	35	23.6	8	4.9	1	0.7
Illegibility of physician's order in patient's file	90	60	51	33.8	9	6.2	0	0
Illegibility of drug card	87	57.9	54	35.9	8	5.5	1	0.7
Illegibility of kardex	80	53.1	61	40.7	9	6.2	0	0
Low nurse-patient ratio	71	47.5	58	38.5	15	9.8	6	4.2
Inadequate number of staffs in each working shift	71	47.5	58	38.5	15	9.8	6	4.2
Leadership style in the ward	43	28.5	82	54.9	21	13.8	4	2.8
Working in night shift	33	22	48	32.6	47	29.8	22	15.6
Working in evening shift	9	6.3	35	23.4	64	42.6	42	27.7
Working in morning shift	13	8.5	30	20	64	42.9	43	28.6
Ward environment-related factors								
Heavy workload in the ward	63	42.3	67	44.4	19	12.6	1	0.7
Lack of required equipment	28	18.7	72	47.9	41	27.1	9	6.3
Similar drug name and label	44	29.1	82	54.6	19	12.8	5	3.5
Similar drug packing	55	36.4	71	47.1	19	12.9	5	3.6
Drug arrangements on shelves	50	32.9	65	43.5	30	20	5	3.6
Ward's medication protocols	15	10.2	89	59.1	40	26.3	6	4.4
A noisy ward environment	28	18.9	70	46.2	45	30.1	7	4.8
Arrangement of equipments in treatment room	28	18.6	66	44.2	49	32.4	7	4.8
Variety of drugs used by patient	20	13.4	71	47.2	49	32.4	10	7
The ward type (surgery, emergency, pediatric...)	28	18.7	56	37.5	45	29.9	21	13.9
Overcrowding of treatment room	26	17.5	72	47.6	43	28.6	9	6.3
Inadequate lighting of treatment room	19	12.5	65	43.1	55	36.8	11	7.6
Drug administration route	13	8.6	62	41.4	58	38.6	17	11.4
Instability of patient's physiological condition	11	7.2	61	40.7	55	36.4	23	15.7
Small treatment room	12	8.3	56	37.5	59	38.9	23	15.3

so in the present study and other researches.<sup>[16,17,20]</sup> Grandell-Neimi *et al.*, have pointed out to a linear relationship between education level and professional experience of nurses and medication errors.<sup>[22]</sup> Nursing is considered as a stressful job, however, various factors such as heavy workload, sleeping disorders, and so on will even intensify this stress, so it can affect the mental and emotional condition of nurses as well as their professional performance. There are so many studies, which have referred to

the correlation between some medication errors and mental-emotional problems of the nurses<sup>[16,17]</sup> and health-related quality of life of Nursing staffs.<sup>[23]</sup> Being required to handle many tasks and activities even what is irrelevant to their duties at the same time, in addition, overcrowding of some wards like a pediatric ward; nurses face to a heavy workload and increased responsibility, which is considered as an important factor in increasing medication errors. Among the personal factors, the nurse's lack of

interest and financial problems have been mentioned as effective factor in occurrence of medication errors but in this study, they have shown less effective than the other factors. In some other studies, they are not considerable factors as well.<sup>[15-17]</sup>

Among the management-related factors, the participant nurses believed the factors such as incorrect transferring of medication orders from patients' file into their kardex or from kardex into the medicine card, the illegibility of physician's order in patient's file, the illegibility of patient's medicine card and kardex as the most effective factors contributing to the medication errors. Besides the physician's prescription errors, which are an important medication errors.<sup>[24,25]</sup> The illegibility of physician's handwriting is one of the most effective factors in medication errors occurrence according to Harding.<sup>[15]</sup> The illegibility of physician's orders, the frequent changes in the physician's orders, giving verbal orders instead of written orders, and using some uncommon abbreviations in medical orders will increase the possibility of error occurrence while transfer and an implementation of drug orders. Some studies have even pointed out the role of interaction between health-care team members as an important factor in preventing the medication errors, so as the most precise medication orders may be inexpressive and ineffective without a good interaction between nursing team.<sup>[12]</sup> Certainly, using the information technology for computerizing the medical orders can improve the patients' health due to preventing the medication errors which usually happen in prescription writing or reading. Another reason for medication errors is an inadequate nursing staff for different work shifts, the reason, which is mentioned in all studies conducted about the reasons of medication errors.<sup>[13]</sup> From the viewpoint of nurses participating in this study, just working the night-shift may relatively be contributing to the medication errors occurrence and other work shifts are almost ineffective. Nurses usually should organize priorities based on changing the clinical situation for different patients, in addition, they have to carry out several tasks simultaneously, so it is more likely to do tasks in a hurry and commit an error.<sup>[26]</sup>

Among the ward environment-related factors, the ward heavy workload is the most effective factor in medication errors. Eslamian, *et al.*, showed in their study that the shortage in nursing work force and consequently high workload and overtime working of nurses are common reasons for making errors; whereas in some other studies, patient-related, individual and professional factors have been more significant.<sup>[14]</sup> Heavy workload is actually the consequence of insufficient nurse staffing, hence appropriate nurse staffing by employing new personnel, or moderating

the working hours, and eliminating the irrelevant tasks and activities can be beneficial for improving the working condition of the nursing personnel. Factors such as drug name and label similarities, similar packing, and the way of drugs arrangement on shelves have also pointed out as effective factors in this research. Unfortunately, such factors are sometimes ignored of course, these factors are not in control of the clinical care team, so they cannot solve the problems relating to similar drug names, labels and packing, but they can at least prevent some medication errors by an appropriate arrangement of drugs in the treatment room. The type of ward (intensive care, emergency, pediatric) has been mentioned as a rather effective factor involved in medication errors while some studies show that the possibility of medication errors occurrence increases in intensive care unit<sup>[21]</sup> and emergency ward due to the acute, crowded, and fast-paced nature of care.<sup>[27]</sup> Study on medication errors in four hospitals in the Pacific Northwest region of the United States showed that the factors related to the physical condition of the hospitals are influencing factors in medication errors that they are: Inadequate room for charting and documenting, longer walk from nurse station to the patients' rooms, insufficient patient monitoring possibility or lack of visibility of different corners of the nursing station, small size of the treatment room, inappropriate arrangement of medical devices, noisy environment of nursing unit, inadequate lighting, and no privacy in the nursing station.<sup>[28]</sup>

In this study, nurses believed that the nurse-related factors are the most effective factors in occurrence medication errors. Of course, there were some limitation for this study such as limited data collection environment (only in teaching governmental hospitals and not in private hospitals), and small sample size; but we cannot ignore the fact that occurrence of medication errors is a multi-factorial phenomenon, which must be seen from organizational, and managerial aspects, particularly, it is necessary to pay attention to human resources, which might be the most important factor.<sup>[29]</sup> Yon kyong and Barbara believe that human errors are impossible to be completely prevented.<sup>[30]</sup> However, it is obviously practical that improve the quality of health-care services through proper managerial and organizational preparations by means of moderating the work hours and overtime work, eliminating the tasks and activities irrelevant to a nursing career, increasing the job motivations, improving nurses' professional knowledge, and enhancing the work environment standards.

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## AUTHORS' CONTRIBUTION

Akram Shahrokhi has contributed in study design, statistical analysis and manuscript editing. Fatemeh Ebrahimpour has contributed in study design, data collection and manuscript preparation. Arash Ghodousi has done statistical analysis of the data and manuscript editing.

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