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Medication Errors and Its Relationship with Patient Safety Culture: Evidence from Nurses' Viewpoint During COVID-19 Pandemic

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Background: Medication errors can lead to damage to patients with various disabilities or death. This study aims to identify factors affecting the incidence of medication error and its association with patient safety culture from the nurse's perspective during the COVID-19 pandemic.

Materials and Methods: This cross-sectional study was conducted among 340 employed in the hospitals affiliated with Shiraz University of Medical Sciences in 2021. Data were collected by applying a questionnaire for medication error and the standard questionnaire of the Hospital Survey on Patient Safety Culture. Descriptive statistics, the independent t-test, ANOVA, and Pearson correlation were applied using SPSS software version 23.

Results: The main reasons for medication errors were fatigue due to the workload (3.13±1.16 out of 5), method of supervision in the hospital units (3.06±0.98 out of 5), and massive pile-up of duties (3.00±1.19 out of 5). Other results indicated a significant negative association between factors affecting medication error and patient safety culture (r=-0.574, p=0.002). A significant correlation was observed among factors affecting medication error and patient safety culture with demographic determinants of age and years of working experience ($p<0.05$). Significant differences were also observed among the two main studied variables, the number of monthly work shifts, and the number of patients ($p<0.05$).

Conclusion: Applying strategies for the reduction of physical fatigue and mental exhaustion along with balancing work shifts and managing the accumulative duties and massive tasks can help decrease the rates of medication errors.

Keywords: Medication errors; Patient Safety; Culture; Nurses; COVID-19

INTRODUCTION

World Health Organization (WHO) announced COVID-19 as a pandemic on March 11, 2020. As an emerging infectious disease, the pandemic has affected many health systems globally (1). Among these challenges, factors affecting nurses' employment and duties were highlighted including emergency circumstances, workload, and fatigue (2). Some evidence is available emphasizing the relationship between the abovementioned factors and the incidence of medication errors (2).

Medication errors, frequently reported among nurses due to their main duty in the stage of medication, are

considered the cause of death and damage for patients as well as a threatening challenge for health systems around the globe. Medication errors account for 10-18 percent of all medical errors, and they can occur at all stages of the medication process including prescription, distribution, and monitoring (3). To the best of our knowledge, medication errors occur as a result of some predictable and preventable causes including inappropriate doses of medicine, inappropriate time of medicine intake, inappropriate approach of medicine transportation to patients, human errors, insufficient knowledge of medicine, and high workload (4). At the same time, these prevalent errors may lead to increasing hospitalization duration, increasing treatment costs, decreasing the patient's trust, and subsequent overall patient dissatisfaction with the healthcare providers and health systems (5). From the nursing perspective, medication errors can impose a huge burden of stress and ethical conflicts as well as damage the nursing profession and reduce the quality of nursing care (4, 5).

Based on global statistics, medication errors have a wide range of prevalence. For instance, the prevalence of medication errors is estimated at 53% in South Korea (3), 30.5% in Malaysia (2), and 50% in Iran (6). In addition, at least 1.5 million patients are damaged by medication errors annually in the US (2). According to the evidence, the prevalence of medication errors can be increased with a lack of consideration for patient safety concurrently (6), and the issue can be more highlighted during the pandemic.

Patient safety has a notable role in healthcare services and is addressed as a priority for all health systems with the aim of quality assurance and improvement (6,7). At the same time, patient safety is noted as the heart of healthcare services and defined as a "preventive mechanism to patient's damage" (7). In this regard, developing and improving a patient safety culture is recognized as an essential step for patient safety (7,8). Patient safety culture is simply stated as the values, beliefs, and norms of the healthcare organization's healthcare workers and managers and includes the patterns of behaviours among healthcare organization's members, attitudes, activities, processes, and procedures either appropriate or inappropriate through which the healthcare workers may promote or punish about patient safety (8).

As patient safety culture is not only dependent on clinical issues but also in a great deal related to other aspects of healthcare organizations, the present study was conducted to investigate the affecting factors on medication errors and their association with the patient safety culture from the nurses' viewpoint in the south of Iran. The results of this study can help health policymakers seek practical mechanisms for improving patient safety culture and reducing medication errors.

MATERIALS AND METHODS

Design and setting

This was a cross-sectional study conducted in public educational hospitals affiliated with Shiraz University of Medical Sciences (N=10), south of Iran from April to July 2021.

Participants

The study population included those nurses employed in one of the aforementioned hospitals. The study sample was estimated to be 340 nurses considering a=0.05 and according to the following formula:

$$n = \frac{\frac{z^2 pq}{d^2}}{1+\frac{1}{N}\left(\frac{z^2 pq}{d^2}-1\right)}$$

p= q= 0.5

d= 0.05

z= 1.96

N= 2943

A total of 340 samples were selected according to the appropriate portion of the nurses in each of the 10 hospitals. For this purpose, after identifying the total of

employed nurses, stratified sampling was done, and then nurses were included according to simple accidental sampling by their employee ID and applying an accidental number table in each hospital unit. Inclusion criteria were the tendency to participate in the study and employment in each of the clinical units of the hospital. Those nurses who have been working in non-clinical and official units were excluded due to a lack of engagement in medication errors or patient safety issues.

Instruments

The data collection tool was a three-sectional questionnaire. The first section includes demographic information about the nurses (age, work experience, marital status, education level, type of employment, number of work shifts per month, and number of patients under the nurse`s direct supervision). The second section was a researcher-made questionnaire including medication error causes adapted from the study of Karimi Tezerji et al. (4). Twenty questions were categorized into three dimensions: human factors (7 questions), environmental factors (6 questions), and managerial factors (7 questions). 5-point Likert scale was applied from very low (=1), low (=2), moderate (=3), to high (=4) and very high (=5). The validity and reliability (a=0.89) of the questionnaire were confirmed in the study of Karimi Tezerji et al. (4).

Finally, the last part of the present instrument was a standard Hospital survey on patient safety culture (HSOPSC) questionnaire that was designed by the American Agency for Healthcare Research and Quality (AHQR) in 2004 (10) and was applied and revised by many of the hospitals' experts all over the world. It contains 42 questions formatted in 12 dimensions as follows: Overall Perceptions of Patient Safety (4 questions), Supervisors' Expectations and Actions Promoting Patient Safety (4 questions), Organizational Learning (3 questions), Teamwork Within Units (4 questions), Communication Openness (3 questions), Feedback and Communication about Errors (3 questions), Non-punitive Response to Error (3 questions), Staffing (4 questions), Management Support for Patient Safety (3 questions), Teamwork across Units (4 questions), Frequency of Events Reported (3 questions), and Handoffs and Transitions (4 questions). A 5-point Likert scale was applied in a category of Strongly Disagree (=1), Disagree (=2), Neither Agree nor Disagree (=3), Agree (=4), Strongly Agree (=5). For those questions with negative concepts, reverse coding was applied. Those answers with positive points of more than 75% were labeled as an excellent category, those between 50-75% were categorized as acceptable, and those with positive points of less than 50% were identified as weak or unacceptable (11). HSOPSC's validity and reliability have been confirmed in the Persian language according to the previous literature, cognitive tests, and factor analysis of patient safety culture (12).

Procedure and statistical analysis

To collect the data, two of the research team members (EM and ND) referred to the studied hospitals during the week according to the study protocol. They cover all the working days and the weekends at all three work shifts of morning, evening, and night to distribute and collect the questionnaires. To decrease the probability of participants' attrition, all the questionnaires were distributed face-to-face and collected on the same day during each participant's work shift.

Collected data were entered into SPSS software version 23. Pearson correlation was applied to demonstrate the correlation between the determinants of medication errors and patient safety culture and their correlation with the participants' age and working experience. Independent t-test was used to show the mean difference between these two main variables according to the participant's sex and marital status and ANOVA was applied to differentiate the significance mean of the two main variables according to the participant's education level, type of employment, the number of work shifts and patients under the nurse's direct supervision at the significant level of 0.05.

Ethics

All the nurses were included to participate after a verbal comprehensive description of the aims of the study by the researchers (EM and ND) and assurance about the confidentiality of the data. They participated voluntarily and right after signing a written consent form. The study was approved by the Shiraz University of Medical Sciences Ethics Committee by the ID of IR.SUMS.REC.1398.447.

RESULTS

The average age of the participating nurses was 30.23±6.46 while more than half of them (52.65%) were categorized into the age group of under 30 years old. The average years of experience among the studied nurses were 7.23±6.45 and most of them (63.82%) were labeled in the category of fewer than 10 years of work experience. Other demographic results show that 60.88 % of the participants were female and others were male. Most of the participants have a bachelor's degree (86.18%), are employed under a compulsory medical service program (37.36%), and have more than 20 work shifts monthly (70%). For a large majority of the nurses, the number of patients under their direct supervision was more than 3 in each work shift (80.59%). Table 1 describes the study participants in detail.

According to the present results, among the three related dimensions of a medication error, the higher score was related to human factors (3.05±1.19 out of 5). Then in this dimension, the main reason for medication error was due to "fatigue because of workload" with a mean of 3.13±1.16 out of 5 while the less important factor was related to "disappointment and lack of interest in the nursing profession" with the mean of 3.01±0.83 out of 5 (Table 2).

The mean score related to managerial dimensions of the medication error was 2.72±0.86 out of 5. When considering the reasons for medication error in this dimension, "method of supervision" had the highest mean (3.06±0.98 out of 5) while the "unreadable physicians` orders" (2.12±0.64 out of 5) had the lowest mean (Table 2).

Regarding the environmental dimension of the medication error, the mean score of environmental factors is 2.37±0.74 out of 5. In this dimension, the main reason for medication error belongs to the "massive pile-up of duties" (3.00±1.19 out of 5), and the least important item was related to medicine cabinet arrangement (2.56±0.74 out of 5) (Table 2).

According to the present results as Table 3 implies, the total mean score of patient safety culture was 2.57±0.78 out of 5. The percentage of positive replies to 12 dimensions of patient safety culture was 61.71%, while the negative replies were 23.03% and the neuter answer percentage was 15.26%. This result implies the acceptable status of patient safety culture among the studied hospitals from the present nurses' perspective. At the same time, the highest score among positive replies to 12 dimensions of patient safety culture was related to organizational learning (85.69%) while the lowest score was for staffing (29.46%).

As Table 4 illustrates, there is a negative significant correlation between determinants of medication error and patient safety culture (r=-0.574, p=0.002). In other words, improving the status of patient safety culture by the nurses has a concurrent effect on decreasing medication error incidence in hospital units.

Finally, the present results show that the mean score of determinants affecting medication error has a statistically significant relationship with demographic variables of age (p=0.03) and years of working experience (p=0.01). In this regard, with increasing the age and working experience of the studies nurses, the mean score of determinants affecting medication error was decreased. Meanwhile, a statistically significant relationship was observed between the mean score of determinants affecting medication error according to the nurses' employment type (p= 0.04), the number of work shifts (p= 0.02), and the number of patients under direct supervision in each shift (p= 0.01). In other words, the mean score of determinants affecting medication error was higher among nurses under compulsory medical service programs as their type of employment (2.85±0.72 out of 5), nurses with more than 20

works shift monthly (2.98±0.76 out of 5), and those nurses with more than 3 patients under their direct supervision in each work shift (2.86±0.75 out of 5). Other results indicate that the mean score of patient safety culture was increased significantly with an increase in the studied nurses' age (p=0.002) and work experience (p=0.001). At the same time, the mean score of patient safety culture has statistical differences according to the studied nurses' sex (p=0.02), the number of work shifts (p= 0.04), and the number of patients under the direct supervision of the nurse in each shift (p=0.02). In this regard, the mean score of patient safety culture among female nurses (2.78±0.78 out of 5) was higher than male ones. The mean score also was higher among those nurses who cover less than 10 work shifts monthly (2.94±0.79 out of 5) and those with 2 patients under their direct supervision in each work shift (2.79±0.74 out of 5) compared with the other groups (Table 1).

Table 1. Association of demographic variables and determinants of medication errors and patient safety culture from the nurses' perspective

Variable	Category	Frequency (%)	Medication errors		Patient safety culture	
			Mean ± SD (out of 5)	P-value	Mean ± SD (out of 5)	P-value
Age (year)	<30	179 (52.65)	2.93 ± 0.79	**0.03***	2.49 ± 0.79	**0.002***
	30-40	117 (34.41)	2.72 ± 0.75		2.68 ± 0.74	
	>40	44 (12.94)	2.51 ± 0.81		2.96 ± 0.68	
Work experience (year)	<10	217 (63.82)	2.96 ± 0.78	**0.01***	2.56 ± 0.83	**0.001***
	10-20	101 (29.71)	2.75 ± 0.74		2.67 ± 0.76	
	>20	22 (6.47)	2.44 ± 0.65		2.91 ± 0.82	
Sex	Male	133 (39.12)	2.80 ± 0.79	0.05**	2.64 ± 0.76	**0.02****
	Female	207 (60.88)	2.64 ± 0.63		2.78 ± 0.78	
Marital status	Single	146 (42.94)	2.58 ± 0.67	0.06**	2.89 ± 0.74	0.07**
	Married	194 (57.06)	2.86 ± 0.81		2.53 ± 0.79	
Education level	Associates` degree	14 (4.12)	2.79 ± 0.81	0.06***	2.68 ± 0.71	0.05***
	Bachelor of Nursing	293 (86.18)	2.64 ± 0.67		2.74 ± 0.83	
	Master of Nursing	22 (6.76)	2.43 ± 0.41		2.84 ± 0.69	
	PhD	10 (2.94)	2.69 ± 0.62		2.82 ± 0.64	
Type of employment	Permanent	62 (18.23)	2.77 ± 0.83	**0.04*****	2.79 ± 0.79	0.10***
	Temporary to permanent	71 (20.88)	2.85 ± 0.72		2.45 ± 0.52	
	Contractual	54 (15.88)	2.82 ± 0.68		2.66 ± 0.65	
	Compulsory medical service program	127 (37.36)	2.40 ± 0.71		2.94 ± 0.79	
	Corporative	26 (7.65)	2.76 ± 0.68		2.81 ± 0.73	
Number of works shift	<10	55 (16.18)	2.98 ± 0.76	**0.02*****	2.39 ± 0.80	**0.04*****
	10-20	47 (13.82)	2.52 ± 0.66		2.79 ± 0.74	
	>20	238 (70.00)	2.75 ± 0.74		2.77 ± 0.76	
Patients under the nurse`s direct supervision	2	43 (12.65)	2.86 ± 0.75	**0.01*****	2.58 ± 0.79	**0.02*****
	3	23 (6.76)	2.93 ± 0.79		2.49 ± 0.79	
	>3	274 (80.59)	2.72 ± 0.75		2.68 ± 0.74	

* r Pearson Correlation Coefficient (Correlation is significant at the 0.05 level)

** t T-Test (Correlation is significant at the 0.05 level)

*** F Test ANOVA (Correlation is significant at the 0.05 level)

Table 2. Distribution of human, managerial, and environmental factors related to medication error from the nurses' perspective

Factors	Very high		High		Moderate		Low		Very low		Mean ± SD
	N	%	N	%	N	%	N	%	N	%	(out of 5)
Human											
Discouragement and lack of interest toward nursing	68	20	66	19.41	73	21.48	69	20.29	64	18.82	3.01 ± 0.83
Insufficient knowledge about medicines	77	22.65	69	20.29	66	19.41	67	19.70	61	17.95	3.10 ± 1.12
Economic problems	74	20.29	69	18.82	64	17.06	72	19.42	61	16.76	3.06 ± 1.13
Family problems	69	18.53	66	17.35	68	20.88	71	18.82	66	17.95	3.02 ± 0.87
Psychological/ mental problems	74	21.77	62	18.24	72	21.17	63	18.53	69	20.29	3.02 ± 1.06
Lack of sufficient time	72	21.18	69	20.29	65	19.12	71	20.88	63	18.53	3.04 ± 0.96
Fatigue due to workload	74	21.77	69	20.29	81	23.82	60	17.65	56	16.47	3.13 ± 1.16
Total											**3.05 ± 1.19**
Managerial											
Lack of number of nurses in the units	45	13.23	47	13.82	64	18.82	99	29.12	85	25.00	2.61 ± 0.69
More medication errors through the evening work shifts	46	13.53	55	16.18	69	20.29	86	25.29	84	24.71	2.68 ± 0.77
Medicine prescription method	66	19.41	69	20.29	63	18.53	74	21.77	68	20.0	2.97 ± 0.94
Unreadable physicians' orders	24	7.06	26	7.65	32	9.41	144	42.35	114	33.53	2.12 ± 0.64
Unreadable patient information card	43	12.65	46	13.53	86	25.29	83	24.42	82	24.11	2.66 ± 0.73
More medication errors through the morning work shifts	64	18.82	71	20.89	68	20.00	63	18.53	74	21.76	2.96 ± 0.87
Method of supervision in the unit	74	21.76	71	20.89	62	18.23	69	20.29	64	18.83	3.06 ± 0.98
Total											**2.72 ± 0.86**
Environmental											
Environmental noise	41	12.06	43	12.66	88	25.88	86	25.29	82	24.11	2.63 ± 0.74
Medication room condition (physical environment, light, ...)	44	12.94	49	14.41	72	21.18	91	26.76	84	24.71	2.65 ± 0.79
Type of unit	59	19.41	64	20.29	65	18.53	81	21.77	71	20.00	2.88 ± 0.86
Massive pile-up of duties	68	20.00	66	19.41	68	20.00	77	22.65	61	17.94	3.00 ± 1.19
Medicine cabinet arrangement	41	12.06	43	12.65	68	20.00	102	30.00	86	25.59	2.56 ± 0.74
Medicine protocols	59	17.35	64	18.82	74	21.76	67	19.71	76	22.36	2.89 ± 0.79
Total											**2.37 ± 0.74**

Table 3. Relative frequency and the mean of patient safety culture from the nurses' perspective

Dimensions of Patient Safety Culture	Frequency (%)			Mean ± SD	Status
	Positive	Neuter	Negative	(out of 5)	
Overall Perceptions of Patient Safety	59.08	11.56	29.36	2.49 ± 0.45	Acceptable
Supervisors' Expectations and Actions Promoting Patient Safety	74.84	9.60	15.56	2.85 ± 0.24	Acceptable
Organizational Learning	85.69	7.02	7.29	3.16 ± 0.36	Excellent
Teamwork Within Units	78.81	12.81	8.38	3.08 ± 0.41	Excellent
Communication Openness	66.42	16.44	17.14	2.67 ± 0.29	Acceptable
Feedback and Communication about Errors	74.86	10.74	14.40	2.90 ± 0.38	Acceptable
Non-punitive Response to Error	30.43	19.84	49.73	1.89 ± 0.71	Unacceptable
Staffing	29.46	20.64	49.90	1.78 ± 0.68	Unacceptable
Management Support for Patient Safety	55.05	21.08	23.87	2.36 ± 0.55	Acceptable
Teamwork across Units	54.79	19.67	25.54	2.28 ± 0.58	Acceptable
Handoffs and Transitions	63.17	18.88	17.95	2.61 ± 0.49	Acceptable
Frequency of Events Reported	67.95	14.91	17.14	2.73 ± 0.19	Acceptable
Total	**61.71**	**15.26**	**23.03**	**2.57 ± 0.78**	**Acceptable**

Table 4. Correlation between determinants of medication errors and patient safety culture from the nurses' perspective

Dimensions of Patient Safety Culture	Determinants of Medication Error			
	Human	Managerial	Environmental	Total
Overall Perceptions of Patient Safety	r=-0.361	r=-0.586	r=-0.368	r=-0.441
	p=0.04	p-0.004	p=0.03	p=0.02
Supervisors' Expectations and Actions Promoting Patient Safety	r= -0.343	r= -0.687	r= -0.413	r= -0.484
	p= 0.05	p<0.001	p= 0.02	p= 0.002
Organizational Learning	r= -0.375	r= -0.676	r= -0.648	r= -0.574
	p= 0.03	p= 0.001	p= 0.001	p= 0.01
Teamwork Within Units	r= -0.613	r= -0.683	r= -0.663	r= -0.654
	p= 0.001	p<0.001	p= 0.001	p= 0.001
Communication Openness	r= -0.628	r= -0.658	r= -0.659	r= -0.642
	p= 0.001	p= 0.002	p= 0.001	p= 0.001
Feedback and Communication about Errors	r= -0.561	r= -.0653	r= -0.371	r= -0.526
	p= 0.003	p= 0.002	p= 0.04	p= 0.002
Nonpunitive Response to Error	r= -0.386	r= -0.675	r= -0.316	r= -0.457
	p= 0.02	p= 0.001	p= 0.05	p= 0.02
Staffing	r= -0.339	r= -0.679	r= -0.372	r= -0.466
	p= 0.04	p<0.001	p= 0.04	p= 0.002
Management Support for Patient Safety	r= -0.566	r= -0.691	r= -0.619	r= -0.625
	p= 0.002	p<0.001	p= 0.002	p= 0.001
Teamwork across Units	r= -0.583	r= -0.665	r= -0.621	r= -0.621
	p= 0.002	p= 0.001	p= 0.002	p= 0.001
Handoffs and Transitions	r= -0.598	r= -0.646	r= -0.665	r= -0.636
	p= 0.001	p= 0.002	p= 0.001	p= 0.001
Frequency of Events Reported	r= -0.552	r= -0.632	r= -0.472	r= -0.554
	p= 0.003	p= 0.003	p= 0.002	p= 0.002
Total	r= -0.516	r= -0.661	r= -0.523	**r= -0.574***
	p= 0.003	p= 0.001	p= 0.002	**p= 0.002**

* r Pearson Correlation Coefficient (Correlation is significant at the 0.05 level)

DISCUSSION

According to the results, the highest mean score among determinant factors of medication error was related to human factors. Similarly, the results of Alsaleh et al. (13), Tang et al. (14), and Bizhani et al. (15) have confirmed that most of the medication errors are due to human mistakes during medication and medicine distribution. In contrast with the present result, Strube-Lahmann et al. (16) have reported that only less than half of the medication errors are due to human factors. Other results of the present study have demonstrated that "fatigue due to the workload" has the highest mean score among all other human reasons as the determinant factors of medication error. Similarly, Cheragi et al. (17), Tang et al. (14) and Bizhani et al (15) have noted "fatigue due to the workload" as the main factor of medication error related to human mistakes. Such a result was also confirmed in the study of Kakemam et al. during the COVID-19 pandemic which emphasizes a positive correlation between emotional exhaustion and medication errors. In this regard, nurses with less level of emotional exhaustion reported fewer numbers of medication errors and provided a better level of nursing care (18). Schakel et al. pointed out the economic and social impact of fatigue caused by work and visual impairment and the increase in economic and social costs (19).

Moreover, according to the results of Trockel et al. (20), fatigue is named as a potential factor that can increase the possibility of human mistakes with an observed significant relationship between mental exhaustion and the severity of

medical errors. It seems that long working hours along with workload and multiple massive pile-ups of duties as well as increasing environmental stimuli like disturbing noises during COVID-19 pandemic conditions could act as a potential determinant factor for nurses' fatigue and lead to medication errors.

Other results of the present study about managerial factors affecting medication error show that the "method of supervision in the hospital unit" has the highest mean score compared with the other items. The results of Bagaei et al. (21) have also emphasized the significant role of supervision as the main managerial factor affecting medication error. Warholak et al. (22) have similarly named "lack of supervision and education" as the main cause of errors. Such results emphasized the importance of an appropriate system for reporting medication errors more than before with the main concentration of errors' roots and reasons instead of those who made mistakes.

Elliott et al. examined the clinical and economic burden of medication errors in the National Health Service of England. The results showed that 237 million medication errors occur annually in one area of England. Side effects of medicines cost the NHS £98,462,582 each year, consumed 181,626 hospital bed days, and caused 1,708 deaths (23).

At the same time, emphasis on precise and scientific systems of control may lead to decreasing medication errors. Such a system should be reinforced and accompanied by a preventive approach in order to make a positive context of learning from previous errors and moving toward preventing future errors.

Results of the present study about the environmental factors affecting medication error demonstrate that "massive pile-up of duties" has the highest mean score among other items of this category. Cheragi et al. (17) and Bizhani et al. (15) have reported similar findings. Alsaleh et al. have pointed to a "large accumulation of tasks" as the main reason for medication errors so that more than half of the nurses claim that extensive workload and lack of time for rest are among the main reasons for medication errors (13).

In Caruso et al.'s study, the economic consequences and financial and social losses were caused by intensive workloads and long shifts caused by work (24). Kirwan et al. conducted a study on the effect of medication errors on reducing the quality of life and creating costs and financial losses that for each incident, a loss of 100,958 euros was created (25).

According to all, it should be noticed that there is a sensible expectation from a nurse to be capable of concurrent handling of multidisciplinary tasks and complicated roles, particularly during the COVID-19 pandemic. Such a circumstance could lead to increasing the responsibility and workload of the nurses and make them face more mistakes. Strategies for decreasing their workload and applying more staff related to number of the patients along with hiring experienced nurses for high-risk units may help control and reduce the rate of medication errors.

Based on the present results, the present status of patient safety culture was acceptable among the studied hospitals. In this area, a range of contradictory findings was reported in the available literature. For instance, while Alrabadi et al. (26) presented an acceptable level of patient safety culture only by 58% of the studied nurses, Najafi Ghezeljeh stated a fair status for patient safety culture in emergency wards by the studied nurses (27).

Macías Maroto et al. (28) have also claimed that the level of patient safety decreased during the COVID-19 pandemic. Such differences can be justified by the variety of the samples from the cultural and social aspects of the studied nurses and the organizational structure of the studied hospitals as well as different packages of patient safety education.

Among the present results, it was considered that the highest mean score was related to the dimension of "organizational learning "among all the 12 dimensions of HSOPSC. El-Jardali et al. (29) and Shariati and Amrollahi (30) have also declared that organizational learning has the highest mean score among all positive replies to HSOPSC. Such results are sensible and justifiable as in an

organization with a dominant culture of learning, staff can find the opportunity to learn from past experiences as well as mistakes to manage and develop the system. Continuous training in patient safety culture could be among one of the most fundamental approaches for improving the culture of patient safety and nursing development.

There was a negative significant correlation between those determinant factors affecting medication error and patient safety culture in the present study. This result shows that accompanied by improving the status of patient safety culture by the nurses, those determinant factors leading to medication error will be decreased. Yoon et al. similarly showed that an appropriate understanding of patient safety culture by the nurses is accompanied by a reduction in the rate of medication error in the hospital (31). It is mentioned in another study in Colombia that patient safety culture can be presented as a predictor of precautionary standards (32). Therefore, improving the patient safety culture could lead to reducing many medical errors as well as medication mistakes.

According to the present results, there was a negative correlation between determinant factors of medication errors and nurses' age and working experience that was confirmed by other findings of the available literature (5, 33), it can be concluded that increasing the nurses working experience and age could increase their comprehension of effective factors affecting medication error and as a result, reduce the probability of future such mistakes. Based on the present results other demographic variables such as type of employment, number of work shifts monthly, and number of patients under the direct supervision of the nurse in each shift had a significant relationship with the rate of medication errors. These results are similar to those of Strube-Lahmann et al. who mentioned the number of patients in each work shift and short time contract type of employment as two significant factors of medication errors (16). According to these results, it seems that those nurses with short-term contracts such as compulsory medical service program due to less working experience, and those nurses who cover fewer work shifts or those who work in crowded units with higher numbers of patients under their direct supervision may experience more pressure and workload as well as physical fatigue and mental exhaustion all can lead to medication errors.

Finally, the present results reveal that the mean score of patient safety culture has increased simultaneously with increasing the age and working experiences of the studied nurses. At the same time, the mean score of patient safety culture was higher among female nurses. Increasing the number of workers' shifts monthly and the number of patients under direct supervision was also accompanied by a significant decrease in the mean score of patient safety culture according to the studied nurses' perspective. Similar results are achieved from the available studies about the relationship between the scores as well as staffing young nurses under the supervision of experienced supervisors (27, 33).

Among the limitations of this study, we can refer to the cross-sectional nature of the study that restricts the generalization of the results and the possibility of determining the causality. Conducting the studies with a larger sample size and comparing the viewpoints of different nurses in non-public hospitals are strongly recommended.

CONCLUSION

According to the results, the most determinant factors of medication errors include fatigue due to workload, method of supervision, and massive pile-up of duties. Considering the impact these errors can have on controlling COVID-19, minimizing the factors affecting such errors seems vital. Applying strategies for the reduction of physical fatigue and mental exhaustion along with balancing work shifts and managing the accumulative duties and massive tasks can be helpful in decreasing the rates of medication errors. At the same time, interactive hands-on and practical workshops for supervision of the hospital units and managerial capabilities are recommended. Regarding the negative correlation between

determinant factors affecting medication errors and patient safety culture, applying mechanisms for empowering nurses in the area of patient safety culture can be beneficial.

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Conflict of interest

The authors declare that they have no competing interests.

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