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Original Article

The Relationship of Work Environment, Patient Safety Culture, and the Medication Errors among Nurses

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Abstract

Introduction: The quality of care consists of several factors, one of the most important of which is patient safety. Nursing error, which is an unintentional error, affects the safety and quality of patient care. This study aimed to determine the relationship between patient safety culture, work environment index, and medication errors.

Methods: This is a cross-sectional study in which 300 nurses were enrolled using stratified proportional sampling**.** The standard questionnaires of patient safety culture, work environment index, and self-made medication error were used to collect data. Data analysis was performed using Mann-Whitney, Kruskal-Wallis, and Spearman tests through SPSS software version 22.

Results: The mean scores of nurse work environment, patient safety culture, and medication error were 74.41±15.6, 144.94±14.82, and 38.96±6.04, respectively. A good relationship between physician and nurse, sufficient number of nurses, and good patient safety culture were directly related to reduction of medication errors.

Conclusion: The results of this study indicated that the high level of patient safety culture and improvement of the work environment of nurses can reduce medication errors. Therefore, by holding classes, workshops, and briefing programs, health managers can promote the patient safety culture in hospitals.

Keywords: Nurses, Patient safety, Medication error, Work environment, Nursing error, Care quality

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Introduction

Patient safety is a critical component of the quality of health (1). Safety culture, defined as a product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management (2). Over the past few decades, the importance of safety culture has been repeatedly emphasized to improve the quality and safety of health care because developing a culture of safety is believed to prevent adverse events or quickly correct mistakes before harm occurs (1). Nurses spend more time with patients than most other healthcare workers and play significant roles in medication management and improvement of patient safety (3). Medication error is one of the most important and preventable types of medical errors and is defined as any preventable event which may result in the misuse of drugs or patient injury (4).

Despite systemic changes to reduce the prevalence of errors, 1.5 million patients are injured in US hospitals each year (5), leading annually to 44000-98000 deaths in hospitals. In England, adverse events occurred in 10 percent of hospital admissions, and in Australia 16.6 percent of hospital admissions lead to adverse events (6). Injuries and deaths due to medical errors incur high costs for patients and the health care system. For example, the annual cost of preventable medical errors in the United States is estimated at $17 million to $29 million per year (7).

Many latent and active, individual, and systemic factors can endanger the patient's safety (8). Environmental factors such as the insufficient number

of professionals, excess work, exhausting working hours, lack of materials, high number of medications to be given, interruptions during preparation and administration of medications, precarious lighting, and excessive noise pave the way for the occurrence of errors and patient' lack of safety (9, 10).

In 2004, the Institute of Medicine published a report specifically addressing the importance of the nurses' healthy work environments for the safety and quality of patient care and described nursing as a critical factor in achieving better patient outcomes (11). Due to the importance of medication errors, it is important to be aware of the patient's safety culture in the health sector to change this culture and adapt it to improvements in the quality of care and factors affecting errors, including environmental indicators (12).

This study aimd to determine the incidence of medication errors in Khalkhal and Ardebil University of Medical Sciences and the factors affecting them. In the next steps, by correcting or eliminating these factors in this center, nurses and patients can provide a safe environment with the least errors.

Materials and Methods

This is a cross-sectional study that examines the work environment index, patient safety culture, incidence of medication errors from the viewpoint of nurses working in hospitals of Khalkhal and Ardebil University of Medical Sciences in 2021 and their relationship. Stratified sampling was performed between January and March 2021; using available and easy sampling methods in proportion to the share of each hospital and each unit, we selected the samples.

The instrument used in the present study was a four-part questionnaire. The first part included demographic and organizational variables such as age, gender, marital status, level of education, overall work experience, and work experience in the current unit and workplace unit. The second part was the Work Environment Index Questionnaire which was first designed by Lake in 2002 (13). This questionnaire was translated into Persian in Iran by Joolayi (14), and its validity was confirmed, and Cronbach's alpha coefficient was 0.89. It includes 25 questions in 5 dimensions: nurse participation in hospital performance, the nurse's role in improving hospital quality, management and leadership in nursing and nurse support, sufficient resources of nursing staff, and communication between physicians and nurses. The questionnaire was scored using 5-point Likert scale, and the scores ranged between 25-1The scores of 25-75 mean favorable work environment and those of 76-125 are considered as unfavorable working environment

In the third part, the standard questionnaire of Hospital Survey of Patient Safety Culture (HSOPSC) that was designed by the Health Services Research and Quality Agency in 2004 was used as a useful and comprehensive tool to assess the patient's safety culture in hospitals (15). It has 42 questions and 12 dimensions (overall perception of patient safety, organizational learning, supervisor expectation, and action promoting safety, staffing, being open of communication channels, feedback and communication about the error, transferring of important patient information between wards and work shifts, no punitive response to error, management support of patient safety, frequency of adverse events reported, teamwork across units, teamwork within units). The answers are scored using 5-point Likert scale; the minimum score is 42 and the maximum 210. In the fourth part of the questionnaire, a researcher-made tool including 11 questions about medication errors was used to examine the nursing errors.

According to the Joolayi et al. (14), the ratio of the work environment index in the community is equal to 0.52, and with d=0.06 and confidence of 0.95, the sample size with the following equation was estimated to be 276 people. With a probability of 10% drop, about 300 samples were considered.

$$n=z^2 p(1-p)/d^2$$

In the fourth part, the researcher-made questionnaire of medication errors was used. The content validity of the questionnaire was assessed by ten experts of Ardabil and Khalkhal School of Nursing and Midwifery who were sufficiently proficient in the field of ethics and nursing knowledge. The total CVI of the questionnaire was 0.72, the CVR was 0.79, and the Cronbach's alpha coefficient was 0.82. It has 11 questions and the answers include no errors occurred in the last three months (score 1), one to five errors (score 2), six to ten errors (score 3), and over than ten errors (score 4); the maximum score is 44 (high errors) and the minimum 11 (low errors). The collected data were analyzed using SPSS version 16. Descriptive results are presented using descriptive statistical indicators (mean, standard deviation, and percentage). After examining the normality of the data using Kolmogorov-Smirnov and having much skewness, the Mann-Whitney test was used to compare the means of the two groups, and the Kruskal Wallis test was used to evaluate the means in more than two groups. If the Kruskal-Wallis test was significant, the Mann-Whitney test was used for pairwise comparison. Linear regression was used to

examine the correlation between the dependent and independent variables. The significance level was considered P<0.05 in all tests.

Results

The study results showed that among 300 participants, 64.7% were female and 35.3% were male; their mean age was 33.37±6.31, and most of them (86.3%) had a bachelor's degree. Also, most of the participants (66%) were married, more than half of the participants had less than ten years of general experience (56.7%) and less than five years of experience in their current unit (68.3%), and most of them worked in the emergency department (Table 1).

The mean scores of nurse work environment, patient safety culture, and medication error was 74.41±15.6, 144±14.82, and 38.96±6.04, respectively. It means that the working environment condition has been favorable, patient safety culture was intermediate, and medication errors were high from the perspective of the nurses who participated in this study. There was a direct relationship between the nurses' work environment and medication errors.

The lowest rate of medication error occurred among nurses with overall work experience of more than 20 years. This difference was also seen between work experiences in the current unit, so that the nurses who had less than one year experience in the current unit had the highest average error (40.03±5.95). (Table 1).

The results showed an inverse relationship between age and incidence of error (P=0.001), as well as between marital status single people had a significantly lower incidence of error (P=0.019). There was a significant relationship between the overall experience (P=0.001) and the experience of the current unit (P=0.043) with the incidence of error, so that people with the overall experience of more than 15 years and experience in the current unit for over ten years had a lower error rate. Also, the rate of medication error in the staff who worked in the operating room was significantly lower than in other

Table 1: Results of descriptive statistics and mean comparison tests of demographic and organizational variables

Variables	Category	N (Percent)	Mean±SD	t/Kruskal-Wallis H, Mann Whitney	P value
Gender	Male	106(27.7%)	38.97±6.21	3.44	0.101
	Female	194(66.3%)	38.95±5.97		
Marital status	Single	89(27%)	40.20±5.94	9.95	0.019
	Married	198(86.3%)	38.48±6.03		
	Divorced	9(10.3%)	37.11±6.56		
	Widow	4(1.3%)	39±5.77		
Education level	Associate	8(2.7%)	35.50±6.11	4.55	0.208
	BSc	259(86.7%)	39.19±5.98		
	MSc	31(10.3%)	37.61±6.41		
	PHD	2(0.7%)	43±0		
Overall Work experience (year)	0-5	89(29.7%)	39.82±5.97	18.008	0.001
	6-10	81(27%)	40.16±5.08		
	11-15	77(25.7%)	39.10±5.15		
	16-20	39(13%)	35.89±7.02		
	>20	14(4.7%)	34.28±8.67		
Work experience in current unit (year)	<1	56(18.7%)	40.03±5.95	8.148	0.043
	1-5	149(49.7%)	39.89±5.53		
	6-10	49(16.3%)	38.89±5.57		
	>10	44(14.7%)	36.45±7.73		
Work unit	Women	34(11.3%)	39.23±6.33	15.5	0.06
	Parturition	14(%)4.7	37±7.68		
	Internal	37(12.3%)	38±8.03		
	Surgery	48(16%)	39.75±3.99		
	Surgery room	11(3.7%)	33.18±8.18		
	ICU	28(%)	37.42±6.50		
	CCU	29(9.7%)	41.24±3.54		
	Infants	12(4%)	41±4.34		
	Emergency	47(15.7%)	40.40±5.63		
	Dialysis	28(9.3%)	38.50±4.63		
	Children	12(4%)	37±6.12		

departments (P=0.0043), but there was no significant relationship between gender (P=0.907) and education with error (P=0.208) (Table 1).

Findings from Pearson and Spearman correlation showed that among the independent variables studied concerning the nurses' medication error, the subjects' age (r=-0.22, P=0.001), overall work experience (r=-0.21, P=0.001), marital status (r=-0.03, P=0.001), and the experience in the current section had the highest correlation; all these variables showed an inverse relationship with the rate of drug error. The correlation of other variables is also seen in Table 2.

The results of Pearson correlation between the environmental index and medication error rate did not show a significant relationship (r=0.092, p-value=0.112). However, after examining different dimensions of the environmental index and its relationship with a medication error rate, it was found that among the five dimensions, the dimension of collaborative relationship between physician and nurse and also the dimension of adequacy of nursing staff had a direct and significant relationship with the rate of medication error of nurses. However, other aspects of this index did not show a significant relationship (Table 3). Also, the linear regression test did not show a significant relationship between the independent variables (dimensions of the environmental index) and the dependent variable (Table 3).

Findings showed that patient safety culture was directly related to the nurses' medication error (r=32, P=0.001). After examining different dimensions of patient safety culture, the results showed that among various dimensions in this area, being open to communication channels showed the highest correlation (r=0.55, P=0.001) with drug error. After this domain, the frequency of adverse events reported (r=27, P=0.001) and important patient information between the wards and work shifts had the most direct and significant relationship with medication error (r=0.26, P=0.001), respectively. However, between different dimensions of patient safety culture, no punitive response to error, unlike other dimensions, showed a significant inverse relationship between the nurses' medication error. Other dimensions related to patient safety culture and their correlation with the nurses' medication error are listed in Table 4.

The significant variables at the borderline level were included in the multi-factor linear regression model. Also, being open to communication channels had the highest regression coefficient among different dimensions (β=0.49 P=0.001). The dimensions of transferring important patient information between the wards and work shifts, frequency of adverse events reported, and teamwork across the units showed to be correlated In addition to the mentioned dimensions, the overall perception of patient safety dimension, which was not significantly obtained in the correlation test, showed a negative and significant correlation in multivariate linear regression. The amount of regression coefficient and the significant value of other dimensions of safety culture are shown in Table 4.

Table 2: Results of the nurses' medication error correlation test with independent variables

Variable	r	P value
Age	-0.22	0.001
Gender	0.007	0.907
Marital status	-0.17	0.003
Education level	-0.015	0.791
overall work experience	-0.21	0.001
Work experience in current unit (year)	-0.13	0.018
Workplace unit	0.015	0.799
Work environment index	0.092	0.112

Table 3: Results of correlation test and multivariate linear regression of environmental index dimensions and its relationship with the nurses' medication error rate

	Dimensions of work environment index	Correlation	P value	Coefficients	P value
1	Nurse participation in hospital affairs	-0.02	0.702	-	-
2	Basics of improving the quality of nursing care	0.046	0.427	-	-
3	Ability of nursing managers to leadership and support nurses	0.080	0.168	0.112	0.321
4	Adequacy of nursing staff	0.135	0.019	0.211	0.113
5	Collaborative relationship between physician and nurse	0.121	0.036	0.116	0.162
6	Overall work environment index	0.092	0.112	-	-

Table 4: Results of correlation test and multivariate linear regression of safety culture dimensions with medication error by nurses

		Correlation	P value	Coefficients	P value
1	Overall perception of patient safety	0.083	0.153	-0.24	0.041
2	Organizational learning	0.088	0.129	0.032	0.814
3	Supervisor expectation and action promoting safety	0.068	0.241	-	-
4	Staffing	0.041	0.484	-	-
5	Being open of communication channels	0.55	0.001	0.49	0.001
6	Feedback and communication about error	-0.061	0.294	-	-
7	Transferring important patient information between wards and work shifts	0.26	0.001	0.32	0.001
8	No punitive response to error	-0.19	0.001	-0.42	0.004
9	Management support of patient safety	0.17	0.002	-0.20	0.356
10	Frequency of adverse events reported	0.27	0.001	0.41	0.043
11	Teamwork across units	0.18	0.001	0.44	0.003
12	Teamwork within units	0.18	0.001	0.13	0.747
13	Overall Patient Safety	0.32	0.001	-	-

Discussion

Assessing the patient safety culture, work environment index, and error rates is the beginning of creating a safe culture, optimal work environment, and error prevention as it helps the hospitals determine the strategies and educational planning. Therefore, this study aimed to investigate the relationship between the work environment index, patient safety culture, and nurses' medication error rate.

In our study, the total score of the work environment index was favorable. Consistent with our study, the study of Moosa in Saudi Arabia showed that the workplace index was favorable to nurses (16). Also, in Levin's study, the working environment conditions of nurses were reported to be favorable (17). Nevertheless, a study by Harica in Brazil showed that nurses' satisfaction with the work environment was unfavorable (18). The difference in the score of the environmental index in different centers can be due to different policies of health managers in different environments or due to errors in the self-reporting of the workplace questionnaire.

The results of the study showed that the patient safety culture score was intermediate as well. In the study carried out by Kumbi, the overall level of patient safety culture was 44%, indicating that the hospitals had poor/low patient safety culture and areas with the potential for improvement and some areas that require urgent improvements (19). Moreover, in Nadabi's study, none of the hospitals had the targeted score (20).

In this study, the medication error was reduced with increasing safety culture in nurses and increasing scores in some the dimensions of patient safety culture including openness of communication channels, transfer of important patient information between the wards and work shifts, no punitive response to errors, frequency of adverse events reported, and teamwork across units Also, in Yang Han's study in South Korea, the effect of supervising and management to improve the patient safety on medication errors was in the same direction (21). Moreover, a study by Amanda in Colombia suggests all dimensions of patient safety culture as predictors of standard precautions (22). Consistent with the present study, in the study of Khalid Asvar et al., increasing patient safety culture decreased the rate of reported medical errors (12). A study by Alquwez et al. conducted in 2018 in Saudi Arabia among nurses showed that the most important weaknesses of patient safety culture existed in the dimensions of open communication channels, exchange and transmission of information, and non-punitive response to errors (23).

In our study, nurses reported high medication error rates. Consistent with our study, in Yadhukrishnan's study, the incidence of medication errors was significantly high, and it is essential to establish a medication error reporting system; also, an educational program for drug prescribers and nurses concerning drug therapy is urgently needed to avoid medication errors and improve the patient safety by clinical pharmacists (24). In Mousavi's study, the mean score of medication error incidence was obtained high. According to the author's statement, the error rate may be even higher than their obtained value. However, it is impossible to accurately estimate the exact rate due to the fear of punishment and lack of a proper reporting system (25). At the same time, Zirpe's study showed that 6.11% of medication errors occurred in the hospital's critical care unit, which was low compared to a similar study. The major factor for low rates of medication error was underreporting, and self-reporting was not evident (26). In Alrabady's study, nurses reported low medication errors. It was most likely due to the fear

of losing their job, misjudgment of the seriousness of the incident that warrants reporting, and fear from coworkers' actions (27).

Regarding the relationship between work environment index and medication error, one of the dimensions directly related to medication error was the cooperative relationship between the physician and nurse. The higher the score of this dimension, the less the medication error rate. According to Sadia's study, the factors that caused medication errors to occur at the clinical site were environmental factors that lead to medication errors and burden (28), and in Chegini study, one of the most important reasons identified by the nurses for missed care were physician-nurse relationship. Physicians and nurses working together as a team towards a common goal are essential for better patient care, but interdisciplinary collaboration is often poor. Teamwork and collaboration among healthcare professionals may support better patient education and self-engagement including involvement in decision-making and self-care (29).

The results also showed that if the number of nursing staff is sufficient, medication errors are reduced. These findings are consistent with those of Huang's study indicating that the relationship between the physician and nurse and the adequacy of human resources has a positive effect on nurse-perceived quality of care and negative effects on turnover intention, which were both partly mediated by work engagement (30). According to Smith's study, positive perceptions of the nurse work environment were associated with lower frequencies of missed nursing care, and nurses who reported more adequate staffing and resources reported less frequent missed care (31). In recent years, the shortage of nursing staff due to increased turnover has been recognized as a significant challenge for healthcare systems (32).

The results of our study showed that among the demographic variables, being single, being in the older age group, and having more nursing experiences led to fewer medication errors. Similarly, in Jachan's study, nurses with an experience of more than 16 years had significantly fewer errors than nurses with less than 16 years of experience. Since errors have been indicated by the nurses, more experience in nursing may also increase awareness regarding mistakes, resulting in more precise error reports(32). In Blackman's study, the frequency and types of missed care scores were predicted by the direct actions of several variables. One of the variables was nurses with less clinical experience. Younger staff were specifically linked to increased incidence of treatment-related missed care, while there was an inverse relationship between the length of professional experience and overall missed care frequency (33).

Conclusion

The study results showed that improving work environment indicators and increasing the number of nursing staff can directly reduce nursing errors; therefore, to reduce unwanted accidents, nursing managers should improve working conditions and increase the number of nurses. The study results also showed that good relationship between physicians and nurses played a positive role in improving the quality of care and reducing unwanted accidents. In this regard, the role of communication skills workshops for physicians and nurses can be mentioned. Also, through higher patient safety culture levels, medication error will be less. Therefore, health officials and hospitals should try to promote a patient safety culture in the management system of hospitals and their staff, including physicians and nurses.

Ethics Approval and Consent to Participate

The study was approved by the Ethics Committee of Khalkhal University of Medical Sciences, Khalkhal, Iran. The ethics committee code was IR.KHALUMS. REC.1399.017.

Consent for publication: Not applicable.

Conflict of Interest: None declared.

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