

Examination of Factors Affecting the Tendency of Intensive Care Nurses Towards Medical Errors: A Multicenter Study in Turkey

Selma Tepehan Eraslan¹, Gülçin Bozkurt²

¹Trakya University, Keşan Hakkı Yörük School of Health, Department of Nursing, Edirne, Türkiye.

²Istanbul University-Cerrahpaşa, Faculty of Health Science, Department of Midwifery, İstanbul, Türkiye.

Correspondence Author: Selma Tepehan Eraslan

E-mail: selmatepehan@trakya.edu.tr

Received: 16.10.2022

Accepted: 21.03.2023

ABSTRACT

Objective: This study aimed to examine the factors affecting the tendency of intensive care nurses towards medical errors.

Methods: The data of this descriptive and cross-sectional were collected using a Personal Information Form and the Medical Error Trend Scale in Nursing. The population of the study consisted of a total of 647 intensive care unit nurses who worked at two research and training hospitals located in the province of İstanbul and one university hospital located in the province of Edirne. The inclusion criterion was being a registered nurse working in intensive care units for at least two months, and it was aimed to reach the entire population. The sample included 349 nurses (participation rate: 53.12%) who completed the questionnaire.

Results: While 76.5% of the participants were female, their mean age was 28.96±5.70 years, and 73.4% had graduated from universities. The order of significance of the four independent variables, which were determined to have significant effects on the Medical Error Trend Scale in Nursing scores of the participants, was satisfaction with working in the intensive care unit, the number of patients per nurse, having an intensive care nurse certificate, and weekly working hours.

Conclusion: The tendencies of the nurses who worked for 40 hours per week, those who were satisfied with working in the intensive care unit, those who provided care for 1 or 2 patients per day, and those who had an intensive care nurse certificate towards medical errors were lower in comparison to the others.

Keywords: Intensive care units, medical errors, nurses

1. INTRODUCTION

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) defines medical errors as the patient's being damaged due to inappropriate and unethical behavior, and inadequate and negligent actions of healthcare professionals (1). Medical errors are a serious public health problem and pose a threat to patient safety. Healthcare organizations need to establish a culture of safety that focuses on health system improvement by viewing medical errors as challenges that must be overcome (2).

In recent years, medical errors have become some of the most significant healthcare problems in countries experiencing transformations in their healthcare systems (3,4). Posing a threat to patient safety, medical errors are stated to be a major cause of morbidity and mortality and lead to economic losses (5). It is reported that medical errors, the third leading cause of death, lead to more than 250,000 deaths per year in the United States (6). It is seen that 6.7-21% of medical error cases are related to nurses in Turkey (7, 8).

Medical errors lower morale and reduce the motivation of healthcare professionals while causing patients and society

to distrust healthcare professionals and the system (9). The current literature focuses on studies in this field and the care environment to find problems with medical errors and develop a solution to these problems (3).

Since high-risk practices are performed more in intensive care units, medical errors may be seen more frequently, as well. It is reported that almost all intensive care patients experience a life-threatening medical error, and patients on average are exposed to 1.7 errors per day. A 10-bed ICU could be anticipated to produce more than 6,200 error reports per year (10).

It is stated that medical errors in intensive care units arise from the high-risk conditions of patients (e.g., age, sex, clinical status), the complex work environment, stress induced by alarm and other medical equipment sounds, workload, and excessive working hours (11,12). Factors such as the lack of experience of nurses, lack of communication skills, physical fatigue, increasing numbers of patients per nurse (above the recommended standards), lack of motivation, environmental factors, lack of attention, and educational factors also

contribute to medical errors and affect patient safety (13). Among medical errors that commonly occur during the provision of healthcare are adverse drug reactions, catheter-associated urinary tract infections, central line-associated bloodstream infections, injury from falls and immobility, obstetric adverse events, pressure ulcers, surgical site infections, venous thrombosis, ventilator-associated pneumonia, and the wrong site/wrong procedure in surgery (2,14,15). Nurses are responsible for preventing unintended consequences related to procedures and treatments to be performed on the patient and providing care for the patient in a safe environment (16). To prevent medical errors in intensive care, it is important to find the factors affecting tendencies towards medical errors (3).

This study aimed to examine the factors affecting the tendency of intensive care nurses towards medical errors.

The research question:

- What are the (professional and individual) factors affecting the tendency of intensive care nurses towards medical errors?

2. METHODS

2.1. Study Design and Participants

This descriptive and cross-sectional study was carried out in five hospitals with the most intensive care unit beds, located in the Istanbul and Edirne provinces of Turkey between May and December 2018.

The population of the study consisted of a total of 647 intensive care nurses who worked at two university hospitals (n:119 and n:110) and two research and training hospitals (affiliated with the Ministry of Health) (n:170 and n:145) located in the province of Istanbul and one university hospital located in the province of Edirne (n:103). The inclusion criterion was being a registered nurse working in intensive care units for at least two months, and it was aimed to reach the entire population. The sample included 349 nurses (participation rate: 53.12%) who completed the questionnaire.

According to the R^2 Value of 0.15, considered as the primary result of this study, which was obtained in the regression analysis, it was determined that five independent variables were effective on the tendency of nurses towards medical errors. The effect size was found as f^2 : 0.18 (moderate effect size), and the power of the sample to represent the population was found as 1.00 (100%) in the post hoc power analysis conducted with the G*Power (3.1.9.2) program. Thus, it was determined that the sample size in the study was sufficient.

2.2. Data Collection Tools

The data were collected using a Personal Information Form and the Medical Error Trend Scale in Nursing.

The *Personal Information Form* was prepared by the researchers in line with the literature, and it consisted of items questioning the descriptive characteristics (e.g., gender, age, educational background) and professional characteristics (e.g., weekly working hours, number of patients per nurse, willingness to work in intensive care units) of the participants.

Medical Error Trend Scale in Nursing (METSIN) was developed by Özata and Altunkan. It consists of 49 items and five subscales, including drug and transfusion applications (18 items), hospital infections (12 items), patient monitoring and material safety (9 items), falls (5 items), and communication (5 items). The scale has a 5-point Likert-type scoring system, and each item has the response options of 1 evaluated as "never", 2 evaluated as "rarely", 3 evaluated as "sometimes", 4 evaluated as "usually", and 5 evaluated as "always". The lowest and highest scores that can be obtained from the scale are 49 and 245. The total score is used in the evaluation of the scale. A higher total score is interpreted as a lower tendency of nurses to make medical errors. The Cronbach's alpha coefficient of the scale was reported as 0.95 by Özata and Altunkan. In this study, we found the Cronbach's alpha coefficient of the Medical Error Trend Scale in Nursing as 0.94 (0.89 for drug and transfusion applications, 0.83 for hospital infections, 0.80 for patient monitoring and material safety, 0.67 for falls, and 0.68 for communication).

2.3. Ethical Considerations

The study was approved by the ethics committee of Trakya University (No:2018/156). At the beginning of the study, the aim and method of the study were explained to the nurses who were reached, and their written informed consent was obtained. Ethical principles of the Declaration of Helsinki were taken into account in the study.

2.4. Data Analysis

The analysis of the data was performed using the "SPSS for Windows 21.0" software package, through parametric and nonparametric descriptive statistical analyses. In data analysis, in terms of descriptive statistics, frequencies and percentages were used for the categorical data, and means and standard deviations were used for the numeric data. Whether the numeric variable, METSIN scores, had a normal distribution was evaluated based on skewness (-1.12) and kurtosis (0.99) values, and the data were found to have a normal distribution. In the comparison of the mean METSIN scores of the participants based on the independent variables, the independent-samples t-test method was used for the variables that had two groups. For the variables that had three or more groups, one-way analysis of variance (ANOVA) (post hoc analysis: Tukey's HSD test) and Kruskal-Wallis test (post hoc analysis: Bonferroni-corrected Mann-Whitney U Test and Tukey's test) were used in independent groups. The independent variables that affected the scale scores of the participants in the primary analyses were evaluated by multiple regression (backward method) analysis. A post hoc

power analysis was conducted to test the adequacy of the sample size. The significance level was accepted as $p < 0.05$.

3. RESULTS

It was found that 76.5% of the participants were female, their mean age was 28.96 ± 5.70 years, and 73.4% had graduated from universities (Table 1). There was no statistically significant difference between the mean METSN scores of the participants based on their age group, gender, or level of education ($p > .05$, Table 1).

METSN mean scores were found to be significantly higher among the married participants in comparison to the participants ($p < .02$) and among the participants who had children in comparison to those without children ($p < .001$) (Table 1).

Table 1. Comparison of the Medical Error Trend Scale in Nursing mean scores of the participants based on their descriptive characteristics (N= 349)

Characteristics	n	%	METSN score $\bar{X} \pm SD$	Test	p
Age					
<30 years	225	64.5	227.81 \pm 14.95	t: 1.852	0.065
\geq 30 years	124	35.5	230.81 \pm 13.69		
Gender					
Female	267	76.5	229.78 \pm 14.03	t: 1.962	0.052
Male	82	23.5	225.94 \pm 15.93		
Level of education					
High school	28	8.0	227.54 \pm 15.24		
Undergraduate	27	7.7	235.41 \pm 11.09	KW: 7.644	0.054
Graduate	256	73.4	228.34 \pm 14.39		
Postgraduate	38	10.9	227.84 \pm 16.67		
Marital status					
Single	200	57.3	226.86 \pm 15.85	t: 3.149	0.002
Married	149	42.7	231.38 \pm 12.18		
Having children					
Yes	253	72.5	227.41 \pm 15.02	t: 3.347	0.001
No	96	27.5	232.74 \pm 12.56		

t: independent-samples t-test, df: 347

KW: Kruskal-Wallis test, df: 3

METSN: Medical Error Trend Scale in Nursing

The mean total experience of the participants in nursing was 6.32 ± 5.82 years, their mean experience in the ICU was 4.87 ± 5.00 years, their mean weekly working hours were 11.33 ± 4.30 hours, and their mean value of the average number of patients per nurse was 3.02 ± 1.14 .

METSN mean scores were found to be significantly higher in the participants who worked in the profession of nursing ($p < .001$) or in the ICU ($p < .05$) for more than five years in comparison to those who worked in the profession or the ICU for five years or shorter (Table 2).

Table 2. Comparison of the Medical Error Trend Scale in Nursing mean scores of the participants based on their work-related characteristics (N: 349)

Work-Related Characteristics of Nurses	n	%	METSN score $\bar{X} \pm SD$	Test	p
Type of hospital					
University Hospital	120	34.4	228.90 \pm 15.55	t: .022	0.983
Hospital affiliated to MoH	229	65.6	228.86 \pm 14.05		
Type of intensive care unit					
Reanimation	159	45.6	227.84 \pm 14.09	F: 1.942	0.122
CVS/Coronary ICU	38	10.9	233.66 \pm 11.66	(SD: 3/345/348)	
Internal/Surgical ICU	59	16.9	227.39 \pm 14.96		
Pediatric/Neonatal ICU	93	26.6	229.65 \pm 15.89		
Total number of years in nursing					
\leq 5 years ^a	199	57.0	226.38 \pm 15.89	F: 7.061	0.001
6-10 years ^b	84	24.1	232.11 \pm 10.49	(df: 2/346/348)	a < b, c
> 10 years ^c	66	18.9	232.30 \pm 13.48		
Number of years in ICU					
\leq 5 years ^a	241	69.1	227.20 \pm 15.29	F: 5.574	0.004
6-10 years ^b	74	21.2	231.97 \pm 12.71	(df: 2/346/348)	a < b, c
> 10 years ^c	34	9.7	234.06 \pm 10.44		
Hours worked per day					
\leq 8 hours	173	49.6	230.46 \pm 13.29	t: 1.760	0.079
> 8 hours	176	50.4	227.32 \pm 15.60		
Hours worked per week					
40 hours ^a	103	29.5	233.78 \pm 11.04	F: 10.466	0.000
41-50 hours ^b	159	45.6	228.08 \pm 14.84	(df: 2/346/348)	a > b, c
51-60 hours ^c	87	24.9	224.54 \pm 16.12		
Average number of patients per nurse					
1-2 patients ^a	116	33.2	231.43 \pm 12.17	F: 5.825	0.003
3 patients ^b	171	49.0	226.20 \pm 15.83	(df: 2/346/348)	a, c > b
\geq 4 patients ^c	62	17.8	231.48 \pm 13.89		
ICU Nurse Certification					
Yes	121	34.7	232.74 \pm 12.07	t: 3.947	0.000
No	228	65.3	226.83 \pm 15.36		
Satisfied with working in ICU?					
Yes	301	86.2	230.00 \pm 13.85	t: 3.683	0.000
No	48	13.8	221.81 \pm 16.93		
Thinking of leaving ICU					
Yes	89	25.5	224.63 \pm 16.36	t: 3.231	0.001
No	260	74.5	230.33 \pm 13.63		

F: Analysis of variance for independent groups, df: intergroup/intragroup/total degrees of freedom

t: Independent-samples t-test, df: 347

METSN: Medical Error Trend Scale in Nursing

METSN mean scores were found to be significantly higher in the participants who worked 40 hours per week in comparison to those who worked more than 40 hours per week ($p < .05$, Table 2). METSN mean scores were also found significantly higher in the participants with ICU nurse certification in comparison to those without ICU nurse certification ($p < .001$, Table 2). The mean METSN score of the participants who were satisfied with working in the ICU was significantly higher in comparison to those who were not satisfied ($p < .000$), and the mean score of those who did not think of leaving the ICU was significantly higher in comparison to those who thought of leaving the ICU ($p < .001$) (Table 2).

The METSN scores of the participants are given in Table 3.

Table 3. Medical Error Trend Scale in Nursing scores of the participants, N: 349

Scale and Subscales		Min-Max	$\bar{x} \pm SD$
Medical Error Trend Scale Overall Score		179-245	228.88 \pm 14.56
METSN Subscales	Drug and transfusion applications	63-90	85.27 \pm 5.40
	Hospital infections	38-60	56.32 \pm 4.10
	Patient monitoring and material safety	27-45	40.44 \pm 4.21
	Falls	11-25	23.11 \pm 2.23
	Communication	14-25	23.74 \pm 1.91

The effects of the 11 independent variables determined to be effective on the METSN scores of the participants in the primary analyses were evaluated together with multiple

regression analysis (backward method). According to the correlation analysis and multicollinearity statistics, there was no high-level autocorrelation between the independent variables included in the regression model (Table 4). Five independent variables (number of years in the ICU, willingness to work in the ICU, having children, intention to leave the ICU, and total number of years in nursing) among the variables included in the regression model were sequentially excluded from the regression model since they did not have a sufficient effect on the METSN scores of the participants.

The order of significance of the five independent variables, which were determined to have significant effects on the METSN scores of the participants according to the b coefficient, was as follows (from the most significant to the least significant): satisfaction with working in the ICU, the number of patients per nurse, having an ICU nurse certificate, weekly working hours, and marital status. These five independent variables explained 15% of the total variance in the Medical Error Trend Scale in Nursing scores of the participants (Table 4).

The METSN score of the participants who were satisfied with the ICU they worked at was 8.21 points higher than the score of those who were not satisfied. The METSN score of the participants who provided care for 1-2 patients or more than 4 patients per day increased by 6.33 points in comparison to the score of those who provided care for 3 patients per day. The METSN score of the participants with an ICU nurse certificate was 4.81 points higher than the score of those without a certificate. The METSN score of the participants who worked for 40 hours per week was 4.34 points higher than the score of those who worked for more than 40 hours per week. The mean Medical Error Trend Scale in Nursing score of the married participants was 4.04 points higher than the score of the single participants.

Table 4. Effects of the independent variables on the Medical Error Trend Scale in Nursing scores of the participants: Multiple regression analysis results, N: 349

Independent Variables	B	Std. Error	b	T	p	95% Confidence Interval for B		Collinearity statistics	
								Tolerance	VIF
(Constant)	213.89	2.29		93.386	0.000	209.39	218.40		
Number of patients cared for	6.33	1.47	0.22	4.299	0.000	3.44	9.23	0.956	1.046
Satisfaction with the unit	8.21	2.11	0.19	3.897	0.000	4.06	12.35	0.986	1.014
ICU nurse certification	4.81	1.59	0.16	3.029	0.003	1.69	7.94	0.907	1.103
Hours worked per week	4.34	1.64	0.14	2.647	0.008	1.11	7.56	0.929	1.077
Marital status	4.04	1.55	0.14	2.613	0.009	1.00	7.09	0.885	1.130
R: 0.40 Adjusted R2: 0.15 F: 12.99 p: 0.000 Durbin Watson: 2.05									

4. DISCUSSION

According to the primary results of the study, the medical error trend of the nurses who were satisfied with working in the ICU, those who provided care for one or two patients, those who had ICU nurse certification, and those who worked for 40 hours per week decreased. It has been determined that the risk of medical errors significantly increases in nurses who work for more than 40 hours per week (17,18), their medication errors, the fall-induced injuries of patients, and the nosocomial infections of patients increased (19), and there is a positive correlation between this variable and pressure ulcers, lack of communication skills, and patient complaints (20). Akin Korhan et al. did not find a significant correlation between METSN mean scores and weekly working hours (21). Zarea et al. did not find a significant correlation between medication errors and overtime (9). In their study examining the effects of shift duration (8-h/12-h shifts) on the quality of patient care, Estabrooks et al. (22) concluded that the evidence to determine the negative effect of shift duration was insufficient. However, evidence shows that the attention, alertness, and decision-making skills of nurses with longer shift durations are affected since their fatigue levels increase, and their sleep quality deteriorates (18,20,23,24). In our sample, we determined that daily working hours did not have a significant effect on the tendency of the participants to make medical errors. Our findings supported the results of previous studies regarding the fact that excessive weekly working hours increase the tendency of nurses to make medical errors. Conflicting results in the literature make it difficult for us to make clear inferences. Further studies are recommended for precise results.

Studies in the literature have pointed out that increasing numbers of years in nursing would enable nurses to make fewer medical errors as their professional knowledge and skills increase accordingly (25). In this study, it was found that the mean Medical Error Trend Scale in Nursing scores of the participants who had worked in nursing or in the ICU for more than five years were significantly higher than those who had worked for five years or shorter. Among the variables included in the regression model, it was determined that the independent variables including the number of years in nursing and the number of years in the ICU did not have a sufficient effect on the Medical Error Trend Scale in Nursing scores of the participants. Similarly, there are many studies revealing that the professional experience of nurses does not affect their medical error rates (21,26,27). On the other hand, there are also results showing that, as the professional experience of nurses decreases, their tendency towards medical errors and medication errors increases, as well (28-31). Further studies are required to reveal the effect of the number of years spent by nurses in the profession of nursing and in the ICU on medical errors and reach more precise judgments.

In the sample of our study, it was determined that the tendency of the participants who provided care for 1-2

patients to make medical errors was lower (higher METSN score by 6.33 points) than those who provided care for 3 patients. Inadequate nurse staffing leads unintended consequences to occur more frequently (32,33). It was reported that, thanks to reducing the number of patients per nurse, medical errors could decrease, patient outcomes could be improved, and the quality of nursing care could increase (34,35). Yüksel Koçak and Yaman (30) underlined that the higher the number of patients per nurse, the higher the rate of medical errors, while Uğurlu and Vural (27) stated that there was a significant correlation between the number of patients per nurse and medical errors. Zarea et al. (9) and Cheragi et al. (36) found significant correlations between the number of patients per nurse and medication errors. For the quality of patient care and patient safety in the ICU, the number of patients per nurse and the patient-to-nurse ratio should be determined by considering the level of care requirements. The patient-to-nurse ratio in a level 3 ICU is recommended to be 2:1. Moreover, for patients who receive supportive care like extracorporeal membrane oxygenation, as the number of organ support treatments increases, this ratio is recommended to be 1:1 and even 1:2 (37,38). In accordance with the literature, our results confirmed that an increase in the number of patients per nurse is associated with unintended consequences.

In our sample, we found that the tendency the participants with ICU nurse certification to make medical errors was lower than the tendency of those without certification. In the literature, it has been stated that nurses with inadequate professional knowledge make more medical errors (25,27,39). Hajibabae et al. (39) pointed out that nurses who attended training programs on drug applications made fewer medication errors. The finding that the tendency of the participants with certification to make medical errors was lower was an expected result in this study, which was consistent with the literature.

The tendency of the participants of this study who served at the ICU at their own request towards medical errors was found to be lower than those who worked unwillingly. Hajibabae et al. (39) and Bolandianbafghi et al. (40) revealed that as the job satisfaction levels of nurses increased, the rates of their medication errors decreased. The finding in our study indicated that voluntarily serving at the ICU improves motivation and might reduce the tendency nurses to make medical errors.

In our study, no significant relationship was found between the METSN scores of the participants and their age, gender, or level of education. Akin Korhan et al. (21) similarly did not find any significant relationship between the METSN scores of nurses and their age, gender, or level of education. Yiğitbaş et al. (5) determined no significant relationship between METSN scores and age or level of education, while tendency towards medical errors was higher in female nurses. Zarea et al. (9) stated that the gender of nurses and their level of education did not affect their medication errors, while Shahrokhi et al. (26) pointed out that age and

gender did not affect these error rates, and Cheragi et al. (36) and Uğurlu and Vural (27) determined that age did not affect these rates. Hajibabae et al. (39) underlined that as age and level of education increase, the rate of medication errors decreases. Bolandianbafghi et al. (40) reported that younger and inexperienced nurses make more medication errors. It is seen that the results of different studies on the topic in the relevant literature have been different.

Limitations of the study

The tendencies of the nurses towards medical errors were measured based on the self-reports of the participants. Therefore, the results may not always reflect their tendency towards medical errors. Further studies are recommended to reveal the correlation between demographic variables and tendencies towards medical errors and reach more precise judgments.

5. CONCLUSION

The tendencies of the nurses who worked for 40 hours per week, those who were satisfied with working in the intensive care units, those who provided care for 1 or 2 patients, and those who had intensive care nurse certificates towards medical errors were lower in comparison to the others.

To reduce the tendency of nurses towards medical errors in ICUs, reducing the number of patients per nurse (1 or 2 depending on the patient's care requirements), setting weekly working hours as 40 hours and below, and offering more intensive care certificate training programs may be recommended.

Funding: The author(s) received no financial support for the research.

Conflicts of interest: The authors declare that they have no conflict of interest.

Ethics Committee Approval: This study was approved by Trakya University (Approval Date: 2018 and number:156).

Peer-review: Externally peer-reviewed.

Author Contribution:

Research idea: STE, GB

Design of the study: STE, GB

Acquisition of data for the study: STE, GB

Analysis of data for the study: STE, GB

Interpretation of data for the study: STE, GB

Drafting the manuscript: STE, GB

Revising it critically for important intellectual content: STE, GB

Final approval of the version to be published: STE, GB

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How to cite this article: Tepehan Eraslan S, Bozkurt G. Examination of Factors Affecting the Tendency of Intensive Care Nurses towards Medical Errors: A Multicenter Study in Turkey. *Clin Exp Health Sci* 2023; 13: 732-738. DOI: 10.33808/clinexphealthsci.1190115