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Original Article

Relationship between Medication Safety Competence and Perception of Medication Administration Errors among Clinical Nurses: A Cross-sectional Study

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Abstract

Introduction: All nursing care must be performed without harming the patient. Medication errors pose a significant threat to patient safety. This study aimed to determine the relationship between medication safety competence (MSC) and clinical nurses' perceptions of medication administration errors (MAEs).

Methods: This descriptive-correlational study was conducted among 300 clinical nurses. Participants were selected using stratified random sampling in 2024. Data were collected using a demographic characteristics form, the Medication Safety Competence Scale (MSCS), and the Medication Administration Error Reporting Survey. Data were analyzed using SPSS version 13, employing descriptive and inferential statistics.

Results: The results indicated that the mean (SD) scores for MSC and MAEs were 294.22 (26.61) and 135.48 (15.14), respectively. Scores ranged from 36 to 185 for MSC and 65 to 425 for MAEs. Statistical analysis revealed significant correlations between MAEs and gender, marital status, Work experience, and participation in the MSC workshop. Simple linear regression analysis showed that the "Underreporting of MAEs" domain was the strongest predictor of MSC among the variables examined.

Conclusion: The nurses who participated in this study reported moderate levels of MSC and perceived a moderate frequency of MAEs. Healthcare policymakers and decision-makers should implement strategies such as conducting ideation sessions and practical workshops to reduce medication errors and enhance nurses' MSC.

Introduction

Healthcare systems worldwide prioritize patient safety by adhering to the principles and frameworks in relevant regulations.[1] Patient safety, a critical indicator of healthcare quality, involves preventing patient harm or injury during care.[2] A vital factor in patient safety is the effective management of medication errors. According to the World Health Organization (WHO) reports, medication errors account for 20% of medical errors.[3]

Medication errors are the fourth most common cause of death in the United States, so they are the most important factor that threatens patient safety. It is alarming that one in ten at-risk patients suffers harm because of these errors.[4-6] The reported incidence of medication errors in acute hospitals is approximately 6.5 per 100 admissions.[7] In two studies conducted in Iran, 66.7% of health care workers in intensive care units (ICUs) committed medication errors, and 40.6% reported at least one medication error.[8,9] Common factors that cause medication errors include incorrect diagnoses, prescription errors, dose miscalculations, poor drug distribution methods, drug and device-related problems, wrong drug administration, poor communication, and inadequate patient education.[10] Research identifies three main factors contributing to medication errors: Nursing practices, ward environment, and management factors.[11-14] Medication administration errors (MAEs) represent a global challenge, with 5% resulting in fatal consequences and approximately 50% being preventable in routine clinical settings.[15] Data suggests that MAEs are the most common type of severe medical error in pediatric wards, accounting for 76% of such incidents.[16]

Medical errors nurses commit can lead to several adverse effects, including treatment failure, prolonged

hospital stays, increased costs, erosion of patient trust, and potential legal liability for patients.[17-20] Medication safety competence (MSC) is essential for nurses to ensure safe patient care. A lack of this competence can lead to medication errors, jeopardizing patient safety and potentially resulting in fatal outcomes.[21] The goal of assessing safe nursing care and MSC is to identify areas for improvement, enhance patient safety, and protect society from preventable harm and adverse outcomes.[22] In Iran, a standardized instrument to assess nurses' MSC hinders accurate measurement. Consequently, managers often rely on reported medication errors, limiting the identification of nurses' strengths and weaknesses in this area. This lack of precise evaluation can contribute to an increase in medication errors.[23] To prevent medication errors, examining their root causes and preventing underreporting is essential. Given the significant challenge of optimizing nurse performance in preventing medication errors and the limited research in this area, this study aimed to determine the relationship between MSC and perception of MAEs among clinical nurses.

Materials and Methods

This descriptive correlational study included 300 clinical nurses working in various departments, including internal, surgical, ICUs, coronary care units, pediatrics, and others, in five hospitals affiliated with Ardabil University of Medical Sciences in northwest Iran. The study's inclusion criteria included having a minimum of a bachelor's degree in nursing and having at least one year of clinical nursing experience. A list of eligible nurses has been received from all nursing management offices. Questionnaires that had more than 20 unanswered questions were excluded. Participants were selected using a stratified random sampling method. Stratified random sampling was performed over all three shifts. Given the limited population, this revised Cochran formula was considered appropriate. The sample size was determined using Cochran's formula, with $P = 0.5$, $q = 0.5$, a statistical significance level 0.05, and a measurement error (d) of 0.05. Based on the target population ($N = 1500$), the sample size was calculated to be 300 participants. Data collection transpired from April to June 2024.

Data were collected using a three-section questionnaire: One, the demographic information included sex, age, marital status, work experience, education level, work shift, and participation in medication safety competency workshops.

Two, The Medication Safety Competence Scale (MSCS) was developed by Park and Seomun in 2021.[24] The translation and psychometric assessment of Persian version of the scale were conducted by Mohammadi et al.[25] The questionnaire measured six dimensions: Patient-centered medication management, improvement of safety problems, management of affecting factors, safety risk management, multidisciplinary collaboration, and responsibility in the nursing profession. These dimensions were assessed using 36 items, each rated on a 5-point Likert scale, ranging from "never" to "always." The total score range was 36 to 180. The original developers established the validity and reliability of the questionnaire, with a Cronbach's alpha of 0.7.[24] In this study, the reliability of the questionnaire was further confirmed, achieving a Cronbach's alpha of 0.9.

Three, The Medication Administration Error Reporting Survey was designed by Wakefield et al.[26] Permission to use the questionnaire was obtained from the developer. The questionnaire was assessed in three dimensions: Reasons for medication errors (29 items), underreporting of medication errors (16 items), and the percentage of medication errors (non-intravenous medication errors include nine items, and intravenous (IV) medication errors include 11 items). It consisted of 65 items rated on a 5-point Likert scale (for some items) and a 10-point Likert scale (for others). The total score range was 65 to 425. The original developers established the validity and reliability of the questionnaire, with a Cronbach's alpha ranging from 0.925 to 0.957.[26] In this study, the reliability of the questionnaire was further confirmed, achieving a Cronbach's alpha of 0.81. For this study, an expert translated the questionnaire into Persian and back-translated it into English. Ten university faculty members confirmed the face and content validity using the Walters and Bausell technique, with a content validity index (CVI) of 0.8 and a content validity ratio (CVR) of 0.85. The quartile method was employed to determine the level of MAE. The mean scores of questions related to MAE and their subcomponents were compared to a criterion score. This criterion score was calculated as follows: (maximum score - minimum score) / 2 + minimum score.[27,28]

This study was approved by the Student Research Committee of Ardabil University of Medical Sciences (ethics code: IR.ARUMS.REC.1402.184). After obtaining informed consent, participants independently completed the questionnaires under the researcher's guidance. Data collection starts upon receipt of informed consent.

The data was analyzed with SPSS version 13. Descriptive statistics were used to describe study variables. The Kolmogorov-Smirnov test was used to assess the normality of the data. Independent t-tests, one-way ANOVA, and Pearson correlation were employed to analyze the relationships between demographic characteristics and study factors and the link between MSC and perception of MAEs. Linear regression analysis was used to forecast MSC based on perception of MAEs and additional characteristics.

Results

The study sample consisted of 300 clinical nurses. The average age of the participants was 32.9 years, with a standard deviation of 6.18 years. The average work experience was 8.79 years, with a standard deviation

6.53. Demographics indicate that the majority of nurses were female (60%), married (70%), possessed a bachelor's degree (90%), and worked rotating shifts (54.7%) (Table 1).

Among nurses, 77% reported a moderate level of medication safety competency, and 96% reported a moderate level of MAEs. The mean score (SD) for medication safety competency was 294.22 (26.61), and the mean score (SD) for MAEs was 135.48 (15.14). Patient-centered medication management and MAEs are recognized as the two most significant components of MSC, with MAEs being a particular concern for nurses (Table 2).

The results revealed a positive and significant correlation between gender, marital status, participation in MSC workshops, and work experience, and the MAE ($P<0.05$). This suggests that married nurses who participated in MSC workshops had a higher mean absolute error MAE, potentially leading to a lower risk of mistakes in their nursing practice (Table 3).

Stepwise linear regression analysis identified "Underreporting of MAEs" as the strongest predictor of MSC ($\beta=0.38$). Also, perception of MAEs and subcomponents accounts for 3.6% of nurses' medication safety competency variance (Table 4). A positive and significant correlation was found between nurses' MSC and perception of MAE ($r=0.15$, $P=0.007$).

Table 1. Nurses' demographic characteristics

Gender	N (%)
Female	180 (60)
Male	120 (40)
Marital status	
Single	90 (30)
Married	210 (70)
Education	
BSc	270 (90)
MSc	30 (10)
Shift	
Morning	62 (20.7)
Evening	40 (13.3)
Night	34 (11.3)
Circus	164 (54.7)
Participation in the MSC workshop	
Yes	134 (44.7)
No	166 (55.3)
Age, mean (SD)	32.9 (6.18)
Work experience, mean (SD)	8.79 (6.53)

Discussion

The current study aimed to determine the relationship between MSC and the perception of MAEs among clinical nurses. Results showed a significant positive relationship between MSC and MAE, suggesting that nurses with higher levels of competence had a more comprehensive understanding of MAEs.

The study revealed that 77% of nurses reported a moderate level of MSC, and 96% reported a moderate level of MAE, suggesting a relatively high level of knowledge regarding medication safety among nurses. The results indicated a strong association among gender, marital status, participation in MSC workshops, and work experience with the MAE; however, no statistically significant relationship was observed between any demographic characteristics and MSC in nurses. The lack of an essential relationship between nurses' sociodemographic characteristics and MSC suggests that individual factors may not substantially influence competence levels. Instead, organizational elements such as safety culture, access to training, and managerial support may have a greater impact. These results suggest that enhancing MSC necessitates focusing on systemic and workplace-related factors rather than demographic characteristics.

Participants reported a moderate degree of MSC. Continuing education or enhancements in MSC among nurses should be prioritized. Similarly, Mohebi et al[29] also reported a moderate level of MSC in their study. However, the results of the current study are in contrast to those of Rashidi et al.[30] This discrepancy may be related to nurses' educational background and differences in nursing management practices.

According to Mohebi et al,[29] Aydinli and Cerit[31] and Yang et al[32] the dimension of "patient-centered medication management" had the highest MSC score. In contrast, the dimension of "responsibility in the nursing profession" was associated with the lowest score, which is consistent with the studies conducted by Mohebi et al[29] and Aydinli & Cerit.[31] However, this finding contrasts with the findings of Yang et al,[32] which showed that the lowest score was associated with "multidisciplinary collaboration».

MAEs are an essential indicator for patient safety in hospitals, as they pose a significant risk to patient safety. In this regard, the results of this study showed that nurses made moderate errors in medication administration. The results of an investigation conducted by Yousef et al[33] were similar. However, the results of research conducted by Feleke et al[34] were opposite to those of the present study. This discrepancy can be attributed to differences in the cultural factors and nursing management practices in different settings.

Results revealed positive relationship between MAE's score and "Reasons for Medication Error Occurrence" dimension, which is consistent with the findings of a study by Henry Basil et al.[35] However, this is in contrast to the result of Alzoubi et al.[27] In addition, the dimension of "Underreporting of MAEs" received the lowest score, which is contrary to the finding of Alzoubi et al.[27]

The current study demonstrated a significant association

Table 2. Status of distribution, average, and subcomponents of the medication safety competence score, and medication administration error in the studied groups

Variables	Distribution	N (%)	Mean (SD)
MSC	Weak	-	
	Middle	231 (77)	294.22 (26.61)
	Well	69 (23)	
	Subcomponents	Patient-centered medication management	35.31 (4.84)
		Improvement of safety problems	29.51 (4.51)
		Management of affecting factors	22.4 (3.28)
		Safety risk management	22.33 (3.74)
		Multidisciplinary collaboration	14.6 (2.97)
		Responsibility in the nursing profession	11.32 (2.14)
MAE	Weak	-	
	Middle	288 (96)	135.48 (15.14)
	Well	12 (4)	
	Subcomponents	Reasons	101.74 (13.35)
		Report	56.78 (7.85)
		Non-IV medication errors	61.43 (9.61)
		IV medication errors (IV)	74.26 (10.9)

Abbreviations: IV, intravenous; MSC, medication safety competence; MAE, medication administration error.

Table 3. Relationship between medication safety competence and Medication Administration Error with their demographic variables

Demographic variables	MSC				MAE			
	Mean (SD)	r/t	F	*P* value	Mean (SD)	r/t	F	*P* value
Gender								
Female	136.14 (16.99)	-1.005	13.27	0.31	289.72 (28.21)	3.86	11.54	P<0.001**
Male	134.47 (11.77)				301.06 (22.42)			
Marital status								
Single	134.27 (14.64)	-0.88	0.05	0.34	299.51 (24.44)	2.35	0.7	0.019*
Married	135.94 (15.35)				291.73 (27.23)			
Education								
BSc	135.36 (15.07)	-0.4	0.07	0.68	293.40 (26.91)	-1.54	0.74	0.12
MSc	136.5 (15.94)				310.06 (23.18)			
Participation in the MSC workshop								
Yes	135.98 (14.08)	-0.62	5.64	0.53	289.96 (29.72)	-2.45	10.58	0.015*
No	134.87 (16.38)				297.66 (23.34)			
Age		0.06		0.27		0.109		0.059
Work experience		0.059		0.311		0.127		0.028*

Abbreviations: IV, intravenous; MSC, medication safety competence; MAE, medication administration error.
Note. Correlation is significant at the *$P<0.05$ and **$P<0.01$ levels.

between gender and MAEs, with male nurses expressing a more favorable perception. This finding is consistent with the research done by Rezaiamin et al[36] which also revealed that men have a higher incidence of medication errors. However, the findings are in stark contrast to those of Baha et al.[37] These discrepancies may be attributed to variants in cultural and social contexts that affect nurse behavior and characteristics, as well as differences in research populations and organizational climates.

The study also showed that the MAE was positively influenced by work experience and participation in MSC workshops. Therefore, continuous staff education in this field enhances the MAE and reduces medication errors. The results of this study also indicated that the MAE was improved in all domains by work experience and participation in MSC workshops. Consequently, the MAE can be enhanced, and medication errors can be reduced by providing continual education to nurses. Alzoubi et al[27] and Wondmieneh et al[38] indicated a direct correlation between medication errors, work experience, and continuous education in safe medication administration. The results of these studies are consistent with those of the present study.

Furthermore, this study identified a statistically

Table 4. Predicting medication safety competence (MSC) based on medication administration error (MAE) and subscales

Predictor variable	R	R^2	F	Unstandardized β coefficient	SE	Standardized β coefficient	T	*P*
MAE	0.15	0.02	7.38	0.08	0.03	0.15	2.71	0.007
Underreporting	0.19	0.03	12.21	0.38	0.1	0.19	3.49	0.001
Reasons	0.17	0.03	9.65	0.2	0.06	0.17	3.1	0.002
Non-IV medication errors	0.01	0	0.06	-0.02	0.09	-0.01	-0.25	0.8
IV medication errors	0.03	0.001	0.31	0.04	0.08	0.03	0.56	0.5

Abbreviations: IV, intravenous.

significant relationship between marital status and MAEs, suggesting that marital status may influence how individuals perceive and identify MAEs. The research conducted by Jaam et al[39] revealed a notable correlation between marital status and MAEs, finding that single nurses made fewer mistakes than married nurses. However, the study conducted by Sharbaafchi Zadeh et al[40] did not reveal a significant correlation between marital status and MAEs.

A step-by-step multiple linear regression model revealed that "Underreporting of MAEs" was the strongest predictor of MSC among all variables. The perception of MAEs and subcomponents accounts for 3.6% of nurses' medication safety competency variance. This finding aligns with the results of Mohebi et al[29] studies. Therefore, a better perception of medication errors increases nurses' competence in medication safety.

Nurses' enhanced understanding of medication errors is expected to improve medication adherence. Although nurses are well-acquainted with the principles of medication errors through regular training, continuous reinforcement and the practical application of this knowledge in clinical settings are essential for advancing drug safety and reducing medication errors. Nursing educators and administrators are recommended to implement effective strategies to strengthen drug safety competencies and ensure the delivery of safe nursing care among nursing students, thereby promoting patient safety.

This study has some limitations. One of the limitations of this study was the use of the self-reporting method and not having enough time to complete the questionnaire. Accordingly, the researcher tried to solve the problem by selecting the right time, allocating enough time, explaining the importance of the study objectives, and emphasizing this issue. It is suggested that future research should examine safety competency and medication error rates separately for each department and then compare them.

Conclusion

The findings indicate moderate levels of MSC and MAEs among nurses. A significant positive correlation was observed between these variables. Notably, underreporting medication errors was the most crucial predictor of medication safety competence. So, to promote a culture of patient-centered medication management, healthcare institutions must prioritize educational activities and training programs that enhance nurses' knowledge and skills related to medication safety.

Research Highlights

What is the current knowledge?

- Medication safety competence (MSC) and medication administration errors (MAEs) are critical patient safety factors.
- Medication Safety Competence directly impacts the quality of nursing care, reduces medication errors among nurses, and improves medication perception.

What is new here?

- There was a positive and significant correlation between perception of MAEs and medication safety competence among clinical nurses.
- Underreporting MAEs was the strongest predictor of medication safety competence.

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The School of Nursing and Midwifery Student Research Committee approved the study affiliated with Ardabil University of Medical Sciences. The researchers would like to thank all nurses who participated in the study.

Authors' Contribution

Conceptualization: Mehdi Mahmoudzadeh.
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Writing–review & editing: Mehdi Mahmoudzadeh.

Competing Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical Approval

The study adhered to the principles of the Declaration of Helsinki. It was approved by the Student Research Committee of the School

of Nursing and Midwifery, Ardabil University of Medical Sciences, with the ethics code IR.ARUMS.REC. 1402. 184. All participants provided written informed consent before the commencement of the study. The consent form clearly outlined the study's purpose, methods, and confidentiality measures. Participants were also assured that their questions and concerns would be addressed.

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