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Clinical Audit of Nursing Medication Errors During the COVID-19 Pandemic

Leila Sepahvand[1], Shahin Raufi[2], Rasool Mohamadi[3], Khadijeh Heidarizadeh[4] *

[1] Student Research Committee, Nursing and Midwifery School, Lorestan University of Medical Sciences, Khorramabad, Iran
[2]Social Determinants of Health Research Centre, Shahid Rahimi Hospital, School of Nursing & Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran
[3] Nutritional Health Research Center, School of Health and Nutrition, Lorestan University of Medical Sciences, Khorramabad, Iran
[4]Critical Care and Emergency Nursing, Faculty of Nursing & Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran

ABSTRACT

Medication errors in nursing can adversely affect the quality of healthcare services and the public's perception of the healthcare system, potentially leading to increased treatment costs, severe injuries, and even patient fatalities. This quasi-experimental study, utilizing a before-after design with a comparison group based on a clinical audit approach, was conducted in 2022 at two teaching hospitals affiliated with Lorestan University of Medical Sciences. A total of 40 clinical nurses from the COVID-19 emergency departments of Shahid Rahimi Hospital (intervention group) and Shohadaye Ashayer Hospital (comparison group) were selected. Data collection was performed via direct observation using a researcher-developed checklist for correct medication administration principles. The data were analyzed using descriptive and inferential statistics with SPSS software version 25. In total, 240 medication rounds were observed. The highest mean error rates in both groups were observed in the administration of infusion medication (20.05-21.00), intramuscular injections (19.15–19.45), medication preparation (19.00–19.40), and intravenous injections (15.10-15.90). Prior to the intervention, no significant differences were noted between the control and intervention groups. However, post-intervention, the mean medication errors for all assessed factors were significantly reduced in the intervention group (P<0.001), while the comparison group showed no substantial changes. The findings indicate that medication education interventions based on clinical audits significantly reduce medication errors. It is recommended that nursing managers address human resource issues, conduct workshops, and provide in-service training on medication preparation, side effects, and pharmaceutical knowledge.

Keywords: Medication errors; COVID-19 patients; Clinical audit; Nursing staff

Introduction

Medication order implementation constitutes a critical component of patient treatment and care processes, representing a fundamental aspect of nursing responsibilities [1]. It is estimated that approximately 40% of nursing activities involve medication administration, necessitating the application of knowledge, techniques, and skills by nurses to ensure patient recovery and safety, thereby preventing harm or injury. Proper medication administration is a pivotal element in patient safety and healthcare services [2]. The American Institute of Medicine identifies medication errors as one of the most prevalent medical errors and one of the five major categories of errors that pose a threat to patient safety [3]. Research has documented a broad spectrum of medication errors, ranging from 1 to 96.5 incidents per 1,000 patients, or 3.1 to 21.1 per 100 hospital admissions, underscoring the sustained attention healthcare systems devote to medical errors [4]. The National Coordinating Council for Medication Error Reporting and Prevention (NCC-MERP)

* *Corresponding* author: Khadijeh Heidarizadeh, Critical care and Emergency Nursing, Faculty of Nursing & Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran. E-mail: heidari_khh@yahoo.com
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defines a medication error as any preventable event caused by healthcare professionals, patients, or caregivers that leads to inappropriate medication use or patient harm [5]. Medication errors can occur at any stage of the medication prescription process; however, the most common errors include incorrect medication prescription, failure to administer medication in a timely manner, errors in medication usage, overdose, administration of medication to the wrong patient, and miscalculations in medication dosage [2].

Several factors can influence the quality of care and timely provision of care during emergencies. Research has identified key contributors to organizational systems, workload, time constraints, teamwork, individual human factors, and case complexity. Before the COVID-19 pandemic, medical errors were a global priority. The World Health Organization (WHO) celebrated the first "World Patient Safety Day" with the objectives of promoting safer healthcare, raising global awareness about patient safety, and encouraging public commitment under the slogan "Speak up for patient safety" [8]. During the COVID-19 pandemic, factors such as stress, anxiety, workload, staff shortages, lack of time to prescribe medication, prolonged work hours, dealing with critically ill patients, the supportive role of nurses about patients, providing specialized care, and diminishing nurses' attention to maintaining patient safety were regarded as the fundamental principles of any healthcare system. These challenges increase the likelihood of nursing errors including medication errors [7]. COVID-19 has spread globally since 2019 [6]. Its high transmission rate, mortality in severe cases, and lack of specialized treatment have made this disease a considerable threat to public health, especially for healthcare workers in hospitals [7]. International and scientific standards should be employed to evaluate the quality of nursing services and to improve staff performance and quality of care. In addition to developing such standards, monitoring their implementation is crucial for improving service quality [9]. Accreditation serves as an effective mechanism for performance evaluation, quality enhancement, and ensuring the safety of healthcare systems using audit standards, which have become prevalent in developed and developing countries in recent years [10]. A clinical audit involves measuring performance and comparing it with established standards [11]. Clinical auditing was initially introduced as a medical audit to the British healthcare system in 1989. The term was revised to "clinical audit" by 1990 to encompass the activities of nurses and other healthcare providers [12].

A clinical audit constitutes a quality improvement process designed to enhance the quality of services and care provided to patients, thereby improving outcomes. This is achieved through a systematic review of the current status, compliance with explicit standards, implementation of interventions, and the enactment of changes [13]. Various resources delineate several components and stages for conducting a clinical audit process, including defining and developing standards, assessing the existing status, comparing results with standards, implementing interventions, modifying performance based on the comparison results, and re-auditing to ensure performance improvements [14]. Tabrizi et al. identified a significant gap between the existing status and standards for medication administration processes. However, these discrepancies were eliminated following the intervention, indicating a positive impact of clinical auditing on medication administration processes [15]. Similarly, a study in India demonstrated that clinical auditing improved the preparation and administration of intravenous medications, reduced medication errors, and ultimately enhanced the healthcare system, consistent with the results of the present study [16]. During the COVID-19 pandemic, nurses were susceptible to various mental and psychological disorders due to prolonged working hours, frequent interactions with critically ill patients, the supportive role required in patient care, and specialized care provision to specific patient groups, coupled with exhaustion caused by overwork, insufficient time, high environmental noise, and staff shortages. As

the crisis persisted, the likelihood of fatigue and burnout among healthcare workers increased, inevitably leading to a decline in service quality and an increase in medication errors [7]. Moreover, the most common causes of medication errors reported by NCC-MERP include staff performance deficiencies (39%), lack of knowledge (17%), and communication problems between physicians and healthcare staff (12%) [17]. Therefore, the present study aimed to conduct a clinical audit of medication errors among nurses in teaching hospitals in Khorramabad.

Materials and Methods

This quasi-experimental study employed a clinical audit approach and a pre- and post-study design, with a comparison group. A total of 40 clinical nurses were randomly selected through a total enumeration sampling method from the COVID-19 emergency departments of Rahimi Teaching Hospital (intervention group) and Shohada-e-Ashayer Teaching Hospital (comparison) affiliated with Lorestan University of Medical Sciences in 2022. The study applied direct observation to examine the preparation, administration, and injection of medications in patients in the selected wards. The method was structured according to the steps in the clinical audit process.

1.Establishing and developing standards

This step was conducted using the ministry-issued guidelines from the National Accreditation Standards for Iranian Hospitals and adherence to the seven principles of medication administration [18]. Accordingly, a two-part researcher-developed observational checklist was created and developed through a review of the literature and standards issued by the Ministry of Health, and subsequently reviewed by ten faculty members with experience in teaching "fundamental of nursing", as well as expertise in medication administration standards. After incorporating the experts' feedback, the checklist's validity was confirmed, and the final version was prepared. Two researchers systematically observed and documented the medication administration practices of five clinical nurses to establish a checklist for assessing the interrater reliability of medication administration. The correlation coefficient between the scores was 1, indicating perfect reliability.

2.Assessing the current situation

The researchers attended COVID-19 wards to observe nurses' performance during medication administration. They completed checklist comprising 146 items during various work shifts and spent three complete shifts with each participant on multiple days. During medication administration, the observer refrained from intervention unless a potential error was identified, in which case the observer informed the nurse and immediately recorded the incident as an error. A total of 240 medication rounds were observed, with each nurse being monitored during all medication rounds across the three work shifts. All nurses and head nurses were informed of the study's objectives.

3.Comparing results with standards

After evaluating the current situation, the observed criteria were compared with the Ministry of Health standards, and discrepancies were identified. The highest rates of errors and discrepancies with standards in both the intervention and control groups were observed in infusion medications, intramuscular injections, intravenous injections, preparation of intravenous fluids, medication preparation phase, oral medications, and inhalation medications. The results were used to guide the subsequent intervention and planning phases.

4.Intervention

Based on the findings obtained in phase three, an educational program was developed and executed to implement the interventions, and a face-to-face workshop was chosen for training. Training sessions for nurses on the medication administration process cycle were conducted in two phases: "theoretical education" and "practical workshops," as outlined below:

In the first session, the intervention group was divided into two subgroups, and a workshop schedule was provided to the participants. The theoretical content, based on the "Seven Rights of Medication Administration," was covered over two consecutive days. The second session was held one week after the theoretical training in the form of a practical workshop on two consecutive days. This session focused on practical skills, including injection techniques for mannequins, medication preparation, and the steps involved in medication administration. At the end of the workshop, the nurses were asked to perform the learned techniques on the mannequins and demonstrate the practical aspects of medication administration. Additionally, a social media group was created to post educational content from both workshops and respond to participants' questions. Educational materials in PDF format were shared within this group.

5.Re-audit

Three weeks after the completion of the workshops, the medication administration process was re-audited using the original audit form. The checklist for proper medication administration was completed in the same manner as during the first phase, over 240 medication rounds, three weeks after the intervention. To address ethical considerations, informed consent was obtained from head nurses and nurses in the departments before the second phase (observing nurses' performance). The intervention was conducted in coordination with the hospital authorities after obtaining their permission. This study is part of a master's thesis with an ethics code (IR.LUMS.REC.1401.013).

Results

The results indicated no statistically significant differences in sex, education level, marital status, and employment status between the intervention and control groups. The most frequent errors and discrepancies with the standards in both groups were observed in the stages of infusion medications, intramuscular injections, intravenous injections, preparation of intravenous fluids, medication preparation, oral medications, and inhaled medications, respectively.

The results showed that medication errors significantly decreased in the intervention group after the intervention ($p < 0.001$). Table 3 demonstrates that there is no statistically significant difference in the mean medication errors in medication preparation, intramuscular injection, subcutaneous injection, intravenous injection, infusion medications, preparation of intravenous fluids, preparation of oral medications, and inhalation spray in the control group before and after the intervention. The results indicated no statistically significant difference in the mean medication errors between the intervention and comparison groups before the intervention. but, the mean medication errors in medication preparation, intramuscular injection, subcutaneous injection, intravenous injection, infusion medications, preparation of intravenous fluids, and inhalation spray significantly decreased after the intervention in the intervention group ($p < 0.05$).

Table 4 displays a significant improvement in the standards of medication administration in the intervention department

Table 1. Comparing the quantitative sociodemographic characteristics of nurses in the intervention and control groups

Variable	Category	Mean (SD)	P value*
Age	Intervention	31.45 (5.87)	0.321
	Control	29.90 (3.56)	
Work experience (months)	Intervention	87.00 (67.79)	0.415
	Control	72.90 (34.98)	
Length of employment in the ward	Intervention	23.35 (11.96)	0.512
	Control	21.25 (7.59)	

* Independent t-test

Table 2. *Comparing the qualitative sociodemographic characteristics of nurses in the intervention and control groups*

Variable		Group		P Value
		Intervention No. (%)	Contro lNo. (%)	
Sex	Female	16 (80.00)	13 (65.00)	
	Male	4 (20.00)	7 (35.00)	0.540
Educational level	Bachelor's degree	19 (95.00)	19 (95.00)	
	Master's degree	1 (5.00)	1 (5.00)	1.000
Marital status	Single	11 (55.00)	11 (55.00)	
	Married	9 (45.00)	9 (45.00)	1.000

Table 3. *Comparing the average medication errors of nurses during the medication administration for patients with COVID-19 in the intervention group before and after the intervention*

Variable	Time	Intervention group	P value*	comparison group	P value*
Medication preparation	Before	19.40 (1.63)	<0.001	8.85 (3.99)	<0.349
	After	8.40 (2.76)		7.80 (2.19)	
Intramuscular injection	Before	19.45 (1.39)	<0.001	11.20 (3.22)	0.522
	After	11.35 (1.92)		11.70 (1.65)	
Subcutaneous injection	Before	13.00 (1.37)	<0.001	7.50 (2.46)	0.438
	After	7.20 (1.93)		6.95 (2.43)	
Intravenous injection	Before	15.10 (1.37)	<0.001	9.15 (2.58)	0.698
	After	9.35 (1.42)		8.85 (1.78)	
Infusion drugs	Before	20.05 (1.76)	<0.001	13.45 (3.05)	0.873
	After	13.60 (1.53)		13.30 (2.07)	
Preparation of intravenous fluids	Before	12.65 (1.22)	<0.001	8.25 (2.51)	0.790
	After	8.25 (1.29)		8.05 (1.73)	
Preparation of oral medication	Before	11.80 (1.93)	<0.001	3.85 (3.09)	0.825
	After	3.05 (3.26)		3.65 (2.88)	
Inhalation spray	Before	4.65 (1.13)	<0.001	2.45 (1.82)	0.681
	After	1.95 (1.27)		2.25 (1.25)	

* Paired t-test

Table 4. *Comparing the mean medication errors of nurses during the medication administration to COVID-19 patients in the intervention and comparison groups before and after the intervention*

Variable	Group	Before		After	
		Mean (SD)	P value*	Mean (SD)	P value*
Medication preparation	Control	8.40 (2.76)	0.451	19.40 (1.63)	< 0.001
	Intervention	7.80 (2.19)		8.85 (3.99)	
Intramuscular injection	Control	11.35 (1.92)	0.542	19.45 (1.39)	< 0.001
	Intervention	11.70 (1.65)		11.20 (3.22)	
Subcutaneous injection	Control	7.20 (1.93)	0.721	13.00 (1.37)	< 0.001
	Intervention	6.95 (2.43)		7.50 (2.46)	
Intravenous injection	Control	9.35 (1.42)	0.334	15.10 (1.37)	< 0.001
	Intervention	8.85 (1.78)		9.15 (2.58)	
Infusion drugs	Control	13.60 (1.53)	0.607	20.05 (1.76)	< 0.001
	Intervention	13.30 (2.07)		13.45 (3.05)	
Preparation of intravenous fluids	Control	8.25 (1.29)	0.681	12.65 (1.22)	< 0.001
	Intervention	8.05 (1.73)		8.25 (2.51)	
Preparation of oral medication	Control	3.05 (3.26)	0.542	11.80 (1.93)	< 0.001
	Intervention	3.65 (2.88)		19.40 (1.63)	
Inhalation spray	Control	1.95 (1.27)	0.458	8.85 (3.99)	< 0.001
	Intervention	2.25 (1.25)		19.45 (1.39)	

* Independent t-test

Discussion

This study aimed to conduct a clinical audit related to medication errors during the COVID-19 pandemic in teaching hospitals in Khorramabad, and evaluate the impact of implementing the clinical audit cycle on the medication administration process. In accordance with auditing standards, baseline data on medication errors during various stages of medication preparation and administration, including intramuscular, subcutaneous, and intravenous injections, infusion medications, preparation of intravenous fluids, oral medications, and inhalation sprays, were established for both groups prior to the intervention. The findings indicated no significant difference in the mean medication errors between the groups before the intervention, suggesting an equivalent likelihood of errors in both groups. Post-training, the intervention group exhibited a significantly lower total medication error score compared to pre-intervention levels, whereas no significant change was observed in the comparison group. A similar study investigated the impact of a combined learning-based medication education intervention on medication errors among nurses in internal medicine wards, revealing a significant reduction in the mean medication error score [19]. Furthermore, Akbari et al. reported a significant decrease in medication errors following the educational intervention [20], underscoring the efficacy of educational interventions in reducing medication errors. The present study identified the highest rates of errors and non-compliance with standards in both the intervention and control groups during the stages of infusion medications, intramuscular and intravenous injections, preparation of intravenous fluids, medication preparation, oral medications, and inhalation medications. Notably, the highest rate of errors and non-compliance persisted for infusion medications, even post-intervention in both groups. Consistent with these findings, Khalili et al. reported that the most frequent errors among students pertained to infusion medications [21], and Farajzadeh et al. identified the infusion rate of medications as the most common medication error [13]. The present study utilized the audit method to evaluate errors, demonstrating its effectiveness in improving medication errors. Additionally, Mehr et al. found a significant correlation between clinical audit performance and medication error prevention [22], aligning with the results of the present study. Contemporary researchers advocate for clinical auditing as an educational tool to enhance treatment quality and foster innovative thinking in care, recommending regular implementation [23, 24]. Şimsekli et al. assessed 313 nurses in Turkey, discovering a positive and significant relationship between fear of COVID-19 and the propensity to commit medical errors [25], which corroborates the findings of this research. It appears that the incidence of errors escalates in critical situations, such as the COVID-19 pandemic, due to anxiety, stress, and increased workload. Consequently, clinical auditing emerges as an effective model for enhancing nursing performance by measuring the quality of clinical services against established standards, identifying necessary changes to improve structure, processes, and care outcomes, and monitoring the process to ensure correct implementation and improved service quality.

To prevent the Hawthorne effect, the researcher spent one week in the research environment without conducting any sampling, allowing the staff to become accustomed to the presence of the researchers. On the other hand, since the study was conducted only in the COVID-19 emergency departments of teaching hospitals, and considering the purpose of clinical auditing, various considerations should be taken into account when using the results in other hospital departments and other hospitals.

Conclusion

Hospital administrators are advised to use this intervention to improve the quality of services in their centers by holding workshops and training classes for managers and staff regularly and periodically reviewing them. This process is simple, cost-effective, efficient, and practical,

which easily identifies strengths and weaknesses and offers actionable solutions based on the findings.

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Conflict of interests

The authors have no financial interest related to this article

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