

Investigating the Effect of Active Learning from Medication Errors on their Reporting in Nursing

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ARTICLE INFO	ABSTRACT
<p>Article type: Original Article</p> <hr/> <p>Article History: Received: 17 Jan 2023 Accepted: 13 Jun 2023</p> <hr/> <p>Key words: Active learning, Intervention, Medication error, Nurses</p>	<p>Introduction: Medical errors are among the major common challenges that can lead to serious injuries. This study aimed to investigate the effect of active learning from medication errors on their incidence/reporting in nursing.</p> <p>Materials and Methods: This interventional and quasi-experimental study was conducted in 2020 in six departments with internal patients. The participants included 93 nurses divided into two control and intervention groups. The nurses' knowledge was assessed through drug safety management tests, and the active learning of errors was performed on the intervention group. The results and statistics of medication errors were analyzed using the SPSS software version 16 through the two-sample Wilcoxon test.</p> <p>Results: Changes in the medication error rate reported show a significant difference in the intervention group, while this difference does not exist in the control group (significance level = 0.589). Also, this trend was observed in the post-test and pre-test results. This rate improved in the intervention group in the post-test by 6.86%. Also, the ratio of reported medication errors increased to 60.8%.</p> <p>Conclusion: Nurses are one of the most important elements of health services. Therefore, nurses' continuous education and active participation in learning from errors can be critical in knowledge and awareness, medication error reports, and error rate reduction. Also, focusing on teaching the concepts of medical error, drug classification, and how to manage them can significantly impact this regard.</p>
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Introduction

Patient safety is one of the main quality factors of health services. Sometimes, healthcare receivers are harmed while receiving services (1,2). In this respect, medical errors are among the most important challenges with a significantly high incidence rate. Tens of millions die or are seriously injured each year due to medical errors (3,4) and suffer the consequences of medical errors, including physical injuries, stress, and huge costs (5). The cause of most errors is a defect in the process. Thus, the correct assessment of errors and learning from them is required to prevent the recurrence of errors (6,7). The health system authorities have significantly considered detecting and preventing medication errors. In this regard, approximately 7-14% of annual deaths in the United States are due to medical errors. The annual cost of medication deaths and illnesses in the United States is about 1.5 to 5.5 million dollars (8,9). The most important issue is the errors in implementing medication instructions in hospitals (10). Medical errors are major challenges in many countries, especially in the Middle East, such as Iran. However, despite establishing an error reporting system in hospitals, there are no codified statistics of medication errors. Their incidence rate is higher than the reported rate, and approximately 55,000 medication errors occur annually, resulting in 10,500 deaths and 23,000 physical disabilities (11). In a study conducted in Iran, from the perspective of process owners, "drug information" is the most important threat for making errors (12), and 64.5% of medication errors occur by nurses (13). The reason for these high rates is that medication is among the main duties of nurses and is an important part of the care and treatment process (14,15).

More than 40% of nurses' hours are spent on medication (16). As a result, the nurse's performance is questioned more than others when there is a medication error. Medication errors in Iran have become particularly important in their role in increased mortality rates and costs (17). Factors such as the growing trend of drug diversity have also increased the likelihood of making

errors (18). In Iran, 8% of hospital treatments lead to complications, including medication (19), and 20% of all errors due to medication errors are medication errors (20). Although errors are inevitable, more than half of medication errors are preventable, suggesting the vital role of nurses in this regard (21,22). In hospitals, reporting and learning systems for medication errors are disrupted. In addition, nurses do not have the required knowledge about medication errors and their reports to prevent error recurrence (23,24). In addition, despite many advances in patient safety, continuous transfer of its concepts in daily activities seems essential. According to employees, errors are expressed in a favorable learning environment without fear of punishment, used to learn and prevent reoccurrences, and considered unique educational tools (25). Due to the high rate of medication errors, using them as valuable information in nursing education and focusing on training methods is necessary (26,27) regarding their effectiveness in developing and implementing appropriate interventions (28). Hence, the present study aimed to investigate the role of active learning in reducing medication errors made by nurses in inpatient wards.

Materials and Methods

The present study is an interventional and semi-experimental study investigating the effect of active learning from errors and sharing medication errors through their description and analysis, knowledge, and the rate of error reporting among nurses over six months. Nurses working in infectious wards (internal one), including rheumatology and neurology (medical one), infectious (internal one), diabetes (internal two), internal cardiac, endocrine, and gastrointestinal (medical second) and pulmonary wards, were divided into control and intervention groups.

This hospital is an educational, medical, and public hospital in Tehran with 600 beds. Initial training was provided by training classes in the control and intervention departments and classes on cyberspace under the management of a supervisor/instructor for three months. The nursing

staff completed forms for recording and reporting medical errors electronically or manually. Eventually, the safety department summarized them and provided feedback. This methodology follows the procedure proposed by the Tehran University of Medical Sciences. The four-choice drug safety management test was designed based on the instructions of the safety and medication standards of the Ministry of Health and was performed in two stages: post-test and pre-test.

Each correct answer receives a score of 1 (without a negative score), and the total test score is 17. The supervisor described the medication errors as a short story in the interval between the two tests.

Thus, the story included the content of the error in detail and the related standards so that the nurses would not forget it. Then, the

nurses of each ward discussed and shared their strengths and weaknesses in their groups. Finally, the supervisor summarized and commented on "What We Learned from This Mistake". In the end, the frequency of medication errors reported in the quarter before the intervention and the quarter of the intervention were extracted separately for nurses in each ward.

The two-sample Wilcoxon test in the SPSS software version 16 was used to evaluate the effect of the course on drug safety management knowledge and the rate of reported drug errors.

Results

In this study, six internal disease wards of a hospital were selected and divided into intervention and control groups.

Table 1: Relative frequency of demographic characteristics of participants in the study

Variables	Items	Intervention group		Control group		Total
		Quantity	Percentage	Quantity	Percentage	Percentage
Demographic Age	< 25 years	6	12.7	5	10.08	11.57
	25 to 35 years	26	55.3	28	60.8	58.05
	35 to 45 years	11	23.4	7	15.2	19.3
	> 45 years	4	09/0	6	13	6.55
Gender	Male	7	14.8	7	15.2	15
	Female	40	85.1	39	84.7	84.9
Education level	Bachelor	45	95.7	45	97.8	96.75
	Masters	2	0.04	1	0.02	0.03
	Ph.d	0	0	0	0	0
Variables	Single	16	34	23	50	42
	Married	31	65.9	23	50	57.95

The number of nurses in these wards who participated in the study was 93. Of these subjects, 3 (67.74%) participated in the test, and 47 (50.53%) participated in the learning course from errors as an intervention group. The highest percentage of participation was for the pulmonary ward, with 78.94%, and the lowest was for the infectious ward (internal one), with 58.33% of the participants. The participation rate of the intervention group (66.59%) was slightly higher than the participation rate of the control group (68.68%).

According to Table 2, the highest mean correct response of the wards of the intervention group was to know the "importance of medical errors," with 91.1%

correct response. After this component, the highest rate of correct response in this group was for causes of medication errors (85.57%), the definition of drug combination (84.13%), management of high-risk drugs (82.7%), and safe injection tips (81.57%), in the order of their appearance.

On the other hand, the lowest rate of the correct answer to the questions was for the component of "types of drug categories", in which only 3.33% of nurses answered the questions correctly. Preventive management of similar drugs (15.78%) and prevention of medication errors (19.53%) ranked next. The overall mean of the correct answer to the pre-test questions in the intervention group was 54.53%.

Table 2: Pre-test results based on the percentage of positive responses of nurses to the components of the test in the control and intervention groups

Study components	Pre-test		Post-test	
	Intervention	Control	Intervention	Control
Definition of medical error	45.7	37.9	70.47	38.67
Types of medical errors	62.07	69.43	61.27	64.30
The importance of medical error	91.1	71.6	80.13	84.10
Definition of medication error	76.03	75.77	47.30	81.53
The importance of medication error	73.8	88.33	68.43	29.50
Causes of medication error	85.57	85	95.23	85.83
The importance of patients group in the occurrence of medication error	44.3	53.73	52.7	61.40
Safe injection tips	81.57	100	89.67	100
Definition of drug similarities	23.22	22.83	36.80	27
Preventive management of similar drugs	15.87	0.00	3.33	9.30
The concept of transparent communication in the drug management process	73.47	89.17	79.67	77.37
Management of high-risk drugs	82.7	97.43	79.67	100
Types of drug categories	3.33	11.67	39.03	7.5
Reusable vial management	22.53	27	44.60	30.40
Medication Errors Prevention Tips	19.53	16.17	25.57	32
Definition of drug combination	84.13	97.43	57/88	10/94
Method of identifying the patient before medication	42.07	29.57	90/81	17/42
Average	54.53	55.49	39/61	48/60

In the control group pre-test, the highest mean response (100%) was for “safe injection”. After that, the components of “definition of drug combination” and “management of high-risk drugs” had the highest correct response (97.43%). On the other hand, the lowest rate of correct response (0%) was for the component of “preventive management of similar drugs”, followed by the components of “types of drug categories” (11.67%) and “prevention of medication errors” (16.17%).

The overall mean of the correct answer to pre-test questions in the control group was 55.49%, close to the intervention group’s rate (54.53%). In the post-test phase of the intervention group, the highest mean score was for the causes of drug error (95.23%). The other components include “safe injection tips” (89.67%), “drug combination” (88.57%), “identification of the patient before medication (81.90%), and “significance of medical error” (80.13%). Finally, the mean of correct answers to post-test questions in the

intervention group was 61.39%, and the highest mean of general answers to questions was for the pulmonary disease ward (65.88%). The control group in the post-test phase in the components of “types of drug categories” (7.5%) and “preventive management of similar drugs” (9.30%) had the lowest correct answer rate. In comparison, the components of “management of high-risk drugs” and “safe injection tips” (100%), “drug combination” (94.10%), and “the importance of medication error” (92.5%) had the highest correct response rate.

The mean of correct answers to post-test questions by the control group was 60.48%, among which the nurses of the internal medicine department had the best performance with 63.97% correct answers. According to the data, the difference between the mean of correct answers to the questions in the pre-test and post-test stages improved by 6.86% and 3.24% in the intervention and control groups, respectively.

Table 3: Mean test scores and medication error rate in control and intervention groups

Study group	Ward	Pre-test		Po-sttest	
		Average test scores	Quantity of medication errors	Average test scores	Quantity of medication errors
Intervention	pulmonary	55.68	0	65.88	13
	Gastrointestinal and endocrine (medicine two)	54.12	3	61.18	14
	Infectious (internal one)	53.78	4	57.13	29
Control	Rheumatology and Neurology (Medical one)	62.01	0	63.35	3
	Diabetes (internal two)	55.29	0	54.12	1
	Internal cardiac	54.41	4	63.97	4

According to Table 3, seven medication errors were reported in the intervention group before active learning, and the pulmonary ward did not have any

medication errors. In comparison, after active learning, this rate increased to 56 medication errors, so the pulmonary ward had the highest rate of increase.

Table 4: Results of the Kolmogorov-Smirnov (K-S) test on research variables

Test Variable	(Kolmogorov-Smirnov (K-S	
	Quantity	Significance level
Pre-test results (intervention group)	1.357	0.05
Post-test results (intervention group)	1.157	0.137
Pre-test medication error rate (intervention group)	2.552	0.000
Post-test drug error rate (intervention group)	1.558	0.016
Pre-test results (control group)	1.553	0.016
Post-test results (control group)	1.159	0.136
Pre-test medication error rate (control group)	2.841	0.000
Post-test medication error rate (control group)	2.670	0.000

According to Table 4, if the significance level of the K-S test is higher than 0.05, then the data is considered normal. The significance level of the mentioned test in the variables of pre-test and post-test results (in the intervention group) and post-test results (in the control group) is more than 0.05. Therefore, it can be concluded that the distribution of these three variables is normal, and the distribution of other variables is abnormal. As a result, non-parametric tests were performed to test all variables.

According to Table 5, in the intervention group, there is a significant relationship between the level of knowledge of drug safety management and the rate of reporting medication errors in the pre-test and post-test. However, the control group has no statistically significant difference (p-value = 0.192).

This result also applies to the medication error rate with a p-value = 0.589, which is higher than the acceptable 0.05 value.

Table 5: The results of the Wilcoxon test with two samples to investigate the effect of active learning on test results and the frequency of medication error

Group	Studied wards	Test results			Medication error rate		
		Error rate	Significance level	Result	Error rate	Significance level	Result
Intervention	pulmonary	0.05	0.046	Significant difference	0.05	0.026	Significant difference
	Gastrointestinal and endocrine (medicine two)	0.05	0.201	Insignificant difference	0.05	0.04	Significant difference
	Infectious (internal one)	0.05	0.498	Insignificant difference	0.05	0.08	Insignificant difference
Control	Rheumatology and Neurology (Medical one)	0.05	0.317	Insignificant difference	0.05	0.18	Insignificant difference
	Diabetes (internal two)	0.05	0.272	Insignificant difference	0.05	0.317	Insignificant difference
	Internal cardiac	0.05	0.026	Significant difference	0.05	0.414	Insignificant difference

Discussion

This interventional and semi-experimental study aimed to investigate the effect of active learning from errors and sharing medication errors through their description and analysis of their knowledge and the rate of error reporting by nurses. Based on the findings, there is a significant relationship between the level of knowledge of drug safety management in the pre-test and post-test in the intervention group. There is also a significant relationship in the rate of reporting medication errors in this group before and after the intervention.

According to studies, since the nurses cannot deliver medications safely, the patients would be at risk of side effects. According to various studies, the lack of proper training and knowledge about drugs are important reasons for medication errors. Since these subjects are considered insignificant from the nurses’ point of view, it is necessary to train nurses to improve their knowledge about drugs and the correct medication method. In addition, retraining courses on the basic medication techniques for nurses working in hospitals are required. In this respect, reported similar results (29.30.31.32.33).

The highest difference between the pre-test (55.68%) and the post-test (65.88%) was for the pulmonary ward. Also, the rate of reporting medication errors before and after the intervention was 0% and 68.4%, respectively. One of the important reasons for better pulmonary ward functioning is

the follow-up of the head nurse for cohesion and teamwork, and as a result, the participation of nurses in active learning and reporting medication errors. According to Pazkian et al., comprehensive training programs, role models, providing experience, and providing constructive feedback in a favorable learning environment in the educational process and work environment are important factors to consider (34). According to Hashemi and Nasrabadi, team accountability reduces the burden of responsibility and psychological stress of reporting on an individual and motivates nurses to report (35). After active learning, the rate of “patient identification method before medication” was 39.83%, while these rates were 35.70% and 24.77% for “drug classification types” and “medical error definition” was 24.77%, respectively. Compared to the pre-test stage, these rates had a significant progress rate.

In the pulmonary ward, “medical error definition”, “types of drug classification”, “causes of medication error”, and “patient identification method before medication” had the highest response improvement rate. It seems that the content of the error description for active learning and discussions within the wards has effectively improved nurses’ knowledge. According to Ramezani, nurses’ probability of medication errors is high. Therefore, interventions, including improving the training process, encouraging nurses to report, and positive responses from nursing managers have

been suggested to deal with this issue (14). Overall, according to the present study results, education can play an important role in reducing the likelihood of medication errors. In this regard, Hashemi and Nasrabadi stated that the error reporting method, its constituent elements, such as the definition of the error, and how to use the information of previous errors, should be explained to promote error reporting by nurses (35).

According to Moradi Dirin et al., due to the hospitalization of patients with pulmonary diseases and the administration of various sprays for them, after examining the files of this ward, it was found that the number of puffs prescribed by each spray was not entered on Kardex correctly by the nurse. As a result, they were used similarly, leading to a high percentage of errors in the pulmonary ward.

Although the problem of medication errors is one of the most important issues in nursing tasks, and it is not possible to prevent these errors, the role of educators and related officials to reduce and prevent errors is very important. Hence, educational content should be provided to lower these errors. Reporting medication errors is an ethical duty to maximize the quality of patient care to improve patients' health.

For this purpose, the officials should respond positively to reporting medication errors by nurses to reduce the errors and consider the analysis of its cause and effect as a useful tool to study this process (36).

There was a significant difference regarding the changes in the nurses' rate of reporting medical errors in the gastrointestinal and endocrine wards (medical two) of the intervention group compared to changes in nurses' level of knowledge.

Active learning from medication errors in this group may not have included enough teamwork to analyze the error and learn its tips. Still, it has made nurses consider the importance of reporting various medication errors to share and learn. In this regard, Saqra argues that medical error feedback to everyone is necessary to improve reporting and performance (1).

In the diabetes ward (internal two) of the intervention group, the results suggest that

changes in the rate of nurses' knowledge have a significant difference; however, changes in the rate of medication error reporting were nonsignificant (p -value = 5%) and are significant only at a significance level of 10%. In fact, after the intervention, this ward had the highest rate of medication error reports compared to other wards. Nevertheless, simultaneously, the total number of errors reported by its nurses has increased significantly from 11 to 60 cases. There were 4 cases of medication errors before the intervention and 29 cases after the intervention. In other words, this method can effectively promote the reporting of medical errors.

To encourage nurses to learn from errors and avoid repeating them in the future, we should promote a culture of accepting errors as a part of the usual process of tasks. Moreover, nurses should communicate with their colleagues to identify the causes of errors (37).

The use of active learning in nursing education can improve the quality of learning by nursing students. In addition to the effect of active learning on learning improvement, it also ensures and improves marriage survival (38).

Therefore, active learning techniques are a good alternative to traditional methods. Overall, this approach can be considered in nursing education as an alternative to traditional methods, and it can improve the quality of services by improving the quality of nurses' education (39).

According to the research findings, medication errors can be used as a valuable source for learning by using modern educational methods and international models and constructive interaction between officials and nurses. In this way, we can improve the knowledge and awareness of drug safety management, increase the rate of reporting drug errors, and reduce medication errors.

The head nurse's interpersonal interactions and managerial skills also play an essential role in reporting and learning from medication errors. Continuously training nurses by focusing on the process of sharing errors and learning from errors and active participation of nurses in the learning process can be very effective in promoting

knowledge and awareness of drug safety management, increasing the rate of reporting drug errors, thereby reducing the errors. In addition, focusing on teaching the concepts of medical error, drug classification, and how to manage them has been effective in this regard.

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