

The effect of theoretical and simulation training on medical errors of nurse students in Karadeniz Technical University, Turkey

Ilknur Kahrıman,¹ Havva Öztürk,² Nefise Bahcecik,³ Serap Sökmen,⁴ Sibel Küçük,⁵ Nazan Calbayram,⁶ Sebahat Altundag⁷

Abstract

Objective: To assess the efficacy of theoretical training related to medical errors and patient safety and practical simulation training on students' knowledge and skill levels.

Methods: This experimental study was conducted from March 28 to May 18, 2016, at nursing department of a university and comprised of students attending the third grade of the nursing school. The subjects were divided into two equal experimental and control groups. The experimental group, among other things, received simulation training that involved a demonstration and subsequent one-to-one practice. Data was collected on a proforma that included demographic information, pre-test and post-test scores, checklists for pre-assessments and final assessments related to nursing practices.

Results: There were 62 nurses divided into two groups of 31 (50%) each. The difference between post-test scores of the concerning theoretical training about medical errors and patient safety was statistically significant ($p < 0.05$). Pre-assessment of the groups concerning practical training on nursing skills and medical errors revealed no statistically significant difference ($p > 0.05$), while there was a significant difference between their final assessments ($p < 0.05$).

Conclusion: Theoretical education increased students' levels of knowledge regarding medical errors and patient safety, and the practical simulation training reduced malpractices by improving skills.

Keywords: Malpractice, Students, Nurses, Medical errors, Education. (JPMA 68: 1636; 2018)

Introduction

In national and international healthcare institutions, the quality of service and patient safety has recently become subjects of increasing importance. Hence, preventing medical errors and malpractices or minimising them is an important goal for accomplishing patient safety and should be prioritised. In this context, the prevention or minimisation of medical errors is the major responsibility of everyone serving patients, both directly and indirectly, including nursing students and nurses.¹

Prior studies on this subject have usually been conducted with healthcare professionals. However, medical malpractices can be committed not only by healthcare

workers, but also by students who will engage in nursing practice in the future. In this regard, the patient safety programme developed by the World Health Organisation (WHO) for medical students in 2009 was extended to nurses and nursing students as well.²

In Turkey, the provision of the regulations concerning nursing training programmes authorises nursing students to perform certain clinical practices under supervision during their training. In this regard, students who are yet to be nurses are allowed to perform these procedures to a limited extent but strictly under supervision. Hence, to acquire all necessary knowledge and skills at graduation, nursing students perform clinical practices under the supervision of academician nurses or nurses assigned by clinics. As indicated by some domestic studies, however, student quotas have recently been increased for nearly all nursing schools and faculties.^{3,4} Therefore, training institutions are overcrowded with nursing students, and there is also a lack of sufficient

^{1,2}Nursing Department, Faculty of Health Sciences, Karadeniz Technical University, Trabzon, ³Faculty of Health Sciences, Marmara University, Istanbul, ⁴Faculty of Health Sciences, Erzincan University, Erzincan, ⁵Nursing Department, Faculty of Health Sciences, Yildirim Beyazit University, Ankara, ⁶Nursing Department, Faculty of Health Sciences, Ankara University, Ankara, ⁷Nursing Department, Faculty of Health Sciences Pamukkale University, Denizli, Turkey.
Correspondence: Ilknur Kahrıman. e-mail: ilknurkahrıman@hotmail.com

numbers of instructors and adequate space for clinical training. At the same time, nurses working in a clinical setting are low in number and have an excessive workload. Therefore, these nurses cannot support students, and may even expect them to work as qualified nurses.^{3,4} Similar to the current practice in Turkey, a study reported that nurses did not always supervise nursing students during the administration of medications, and in particular, they allow final-year students to practise freely.⁵ However, a study about medication administration described these independent practices of nursing students as unnecessary and unsafe, believing that allowing students to practise free of supervision would increase the medical malpractice rate and compromise patient safety, because nursing students may commit medical malpractice or medical errors.⁶ Students who cannot learn basic nursing skills at the desired level and are inadequate in terms of experience increase the risk of harm to patients when they do not learn and practise these skills directly on the patient.^{7,8} It is therefore evident that nursing students may cause conditions such as death, injury, disability or delayed treatment due to medical errors.⁹ This situation creates fear, anxiety, feelings of guilt and sadness among the nursing students and adversely affects their well-being. It can also lower their training motivation and success, lead to their alienation or withdrawal from the profession, or even result in them leaving school or the profession in the first year.¹⁰

Training is one of the most important ways to avoid medical errors and malpractices, prevent their recurrence, and manage their potential risks. In other words, training has a major role for preventing care- and treatment-related errors and unexpected events.¹ Some studies have stressed the importance of providing training for future nurses to boost their knowledge of and skills for patient care,¹¹ because, as pointed out in a study, one of the reasons for medical errors is the lack of knowledge and skill among healthcare professionals.¹² Therefore, it is recommended that educational lectures related to patient safety and medical errors should be included in the curriculum of all healthcare personnel.¹³ Hence, training for patient safety and addressing medical errors is as necessary for nursing students as it is for working healthcare professionals.¹⁴ Although it has been stated that training for patient safety is provided by various schools in Turkey,¹¹ this training began to be included

in the curriculum of nursing students in only a few schools and only in the last few years.

In addition to theoretical training to increase knowledge and skills before starting clinical practice, students may also be provided with the opportunities for simulation practices and tools as well as in-laboratory training, which are regarded as one of the reliable training methods to prevent medical malpractice and medical errors. That is because the place where psychomotor skills are learned and enhanced in nursing education is vocational skills laboratories.^{15,16} Vocational skills laboratories, which are similar to clinical practice, help students to prepare for the clinic, to provide patient safety in clinical practice, to improve communication skills and team understanding, and to transfer the theoretical knowledge they have acquired to practice.^{8,17-19} It also provides students with the opportunity to repeat their practice until they reach the desired level and it is of great importance to train more equipped nurses by giving them the chance to learn the applications they may meet in clinical practice.¹⁹ Therefore, the skills laboratory, which enables students to actively participate in the learning process and experience patient care, must be fully equipped, supported by simulator models, and compatible with real life.²⁰ A study reported that the use of simulations for training activities aimed at preventing human errors is beneficial because the use of these simulations in nursing training allows students to experience clinical scenarios in a realistic learning setting,²¹ which leads to increased clinical proficiency and skills in the virtual or laboratory setting before entering a hospital or patient care setting.²² Furthermore, simulation trainings may help to reduce students' fear and anxiety caused by lack of experience and to increase their professional skills and self-confidence by regular repetition before beginning clinical practice.^{22,23} Hence, in addition to improving students' professional knowledge and skills, theoretical and practical simulation training may raise their awareness of medical errors and patient safety.

The current study was planned to assess the efficacy of theoretical and simulation training on students' knowledge and skill levels related to medical errors and patient safety.

Subjects and Methods

This experimental study was conducted from March 28 to May 18, 2016, at Nursing Department of Health Science Faculty of Karadeniz Technical University and comprised of nursing students attending the third grade of the nursing school and who took paediatric nursing (PN) class in two separate batches called Branch A and Branch B. The sample size was calculated to reach a statistical power of 82%. Students from Branch A formed the experimental group while those from Branch B were taken as the control group. Third-grade students were preferred because they perform their last clinical practices at the PN class. Besides, they are more self-confident, have more advanced practical skills, take more clinical responsibility, and are granted more freedom by senior nurses for clinical practice. Hence, these students are considered to be more prone to committing errors and were thus suitable for inclusion.

Approval was obtained from the institutional ethics committee. Study participation was on a voluntary basis. The information was collected on a proforma that was composed of 6 questions related to students' age, marital status, gender, school of graduation, status of participation in a training course, or meeting on patient safety/medical errors, and their thoughts about the utility of these trainings.

The pretest and posttest assessment forms had 25 questions related to patient care, including medications, prevention of falling, patient identity validation, communication, infection, blood transfusion, medical error notification, professional and legal responsibilities, and penal conditions. The questions of pretest-posttest comparison were prepared by expert lecturers in nursing, medicine and law presenting in the training, and the tests were performed by the researchers.

Scenarios were prepared in infection, fall, communication, care, and medication administration titles by the researchers and subsequently assessed by a group of 15 experts who specialised in nursing.

The care practice scenario was prepared for the measurement and evaluation of care practices and vital signs of a 30-week, 1000gr baby connected to a mechanical ventilator due to severe respiratory distress and that was fed with total parenteral nutrition through the umbilical cannula. The fall scenario was for a 5-year-old child who had antiepileptic medication, agitation

and frequent convulsions. The drug application scenario was related to the preparation and administration of intramuscular (IM), intravenous (IV) and oral medication (OM) of a 37-week old, 2800gr baby with the physician's request to be monitored, and had hypotension and arrhythmia. The communication scenario was about the communication among the child's mother, a student nurse, a clinical nurse and a doctor about oral ordering of the treatment of a child with a temperature of 39.5 degrees. The infection scenario was prepared for the sterile technique of applying drugs and dressings to two children who were diagnosed with acute lymphoblastic lymphoma. These scenarios were carried out in a laboratory similar to the actual clinical setting, either on models supported by a high- and low-tech simulation, or by role-play with each other.

Checklist was related to 5 scenarios, titled infection, fall, communication, care, and medication administration. They were prepared with the help of the Paediatric Diseases Education Guide.²⁴ The care practice scenario checklist had 105 procedural steps, including newborn respiration, apical pulse, axillary body temperature and blood pressure measurement, aspiration in an intubated child, oropharyngeal/nasopharyngeal aspiration, mouth care, eye care, umbilicus care and diaper rash care. The medication administration scenario checklist had 21 procedural steps for the IV, IM, oral and ocular administration. The communication scenario had 20 procedural steps. The infection scenario checklist contained 17 steps, and the fall scenario checklist contained 24 steps.

First, students in both the groups completed 84 hours of theoretical education in PN class. Then, a pretest was administered to both the groups to rate their knowledge of medical malpractice and patient safety. Each student in the two groups were then observed and underwent a pre-assessment, without being notified for expected behaviours, using procedures of care related to medical malpractice/medical errors, medications, fall, infection and communication scenarios, and the checklist containing these procedural steps. Next, 8 educators administered simulation training only to the experimental group using the same scenarios in the same setting, first by giving a demonstration and then by one-to-one practice, showing the correct techniques for the procedures and interventions with the help of feedbacks provided for medical errors. A 12-hour

theoretical class was held about patient safety and medical errors only for the experimental group. Posttest-1 was administered to the students to evaluate the theoretical training. Students in both groups started the clinical practice of the PN class. The students in both groups who completed the clinical practice of the 28-day PN class were subjected to a final assessment to evaluate the success and proficiency in procedural steps using the same scenarios, procedural steps and in the same laboratory where pre-assessment had been done. Posttest-2 was then administered to students in both the groups to evaluate the difference between the level of knowledge at the beginning and end of the simulation training.

Demographic variables were expressed as frequency

and percentage. The temporal changes in the comparisons of the pretest and posttest and pre-assessment and final assessment scores were compared using t-test and Mann-Whitney U test for independent variables, and t-test and Wilcoxon signed-rank test for dependent variables. Mann-Whitney U test and correlation tests were used for comparing the demographic variables, pretest and posttest scores, and pre-assessment and final assessment scores.

Results

The study was initiated with 72 students but 10(14%) dropped out. Finally, 62 nurses completed the study, with 31(50%) in each of the two groups. Overall mean age of the subjects was 21.16 ± 1.29 years; all (100%) of them

Table-1: Group-based comparison of the pre- and post-test scores of the student nurses participating in the theoretical class (n=62).

Tests		n	Median	Mean rank	U*	p
Pretest score	Study Group	31	60	32.4	452.5	0.69
	Control Group	31	60	30.6		
Posttest-2 score	Study Group	31	60	36.89	313.5	0.017
	Control Group	31	60	26.11		

*U= Mann Whitney U

Table-2 : Comparison of the pre and final assesment scores regarding the practical simulation training in the study and control groups.

Study Group	Pre assesment		Final assesment		t value	p value			
	Mean	SD	Mean	SD					
Infection	45.73	18.40	75.25	20.05	t=-5.127	0,000			
Medication	47.59	12.75	66.69	12,08	t=-7.026	0,000			
Total	41.38	7.81	66.09	8.19	t=-7.257	0,000			
	Final assesment			Pre assesment			ties	z value	p value
	Negative rank			Positive rank					
	n	Mean Rank	Sum of rank	n	Mean Rank	Sum of rank	n		
Fall	1	7	7.0	30	16.30	489.0	-	-4.735	0.000
Care	2	2.5	5.0	29	16.93	491.0	-	-4.762	0.000
Communication	3	10.3	31.0	27	16.07	434.0	1	-4.151	0.000
Control Group	Pre assesment		Final assesment		t value	p value			
	Mean	SD	Mean	SD					
Care	24.25	10.90	25.55	10.38	t=-0.471	0.641			
Infection	50.47	16.27	53.22	17.37	t=-1.015	0.318			
Total	41.80	6.50	47.15	6.31	t=-4.323	0.000			
	Final assesmen			Pre assesment			ties	z value	p value
	Negative Rank			Positive Rank					
	N	Mean Rank	Sum of rank	n	Mean Rank	Sum of rank	n		
Fall	19	15.66	297.5	11	15.23	167.5	1	-1.339	0.180
Medication	13	14.08	183.0	18	17.39	313.0	-	-1.274	0.203
Communication	3	2.5	7.5	27	16.94	457.5	1	-4.640	0.000

SD: Standard deviation

were unmarried; 57(91.9%) were female; and 35(56.5%) were high school graduates. Only 8(12.9%) subjects had earlier participated in a training course, or meeting on patient safety and medical errors, and all of them (100%) said the trainings were useful.

Posttest-1 scores of the experimental group were significantly higher than their pretest scores ($p=0.003$). Posttest-2 scores were not significantly different from the pretest scores in both the groups ($p>0.05$).

There was no significant difference between the pretest scores of the two groups ($p=0.69$), but posttest-2 scores of the experimental group were significantly higher than those of the control group ($p=0.017$) (Table-1).

Final assessment scores in the experimental group were significantly higher than the pre-assessment scores for total ($p=0.001$), medication ($p=0.00$), infection ($p=0.001$), care ($p=0.001$), fall ($p=0.00$) and communication ($p=0.001$) practices. In the control group, the final assessment scores were significantly higher than the pre-assessment scores for total ($p=0.001$) and communication ($p=0.001$) practices. No significant differences were found between the final and pre-assessment scores with respect to other dimensions ($p>0.05$) (Table-2).

In terms of practical simulation training, the experimental group had significantly higher final assessment scores for total ($p=0.00$), communication ($p=0.008$), care ($p=0.00$), medication ($p=0.00$), fall ($p=0.00$) and infection ($p=0.00$) practices compared to the control group. However, no

significant differences were found between the experimental group's pre-assessment scores for total ($p=0.820$), communication ($p=0.334$), care ($p=0.394$), medication ($p=0.172$), fall ($p=0.842$) and infection ($p=0.286$) practices compared those of the control group (Table-3).

Discussion

Future nurses should necessarily have the knowledge and skills for ensuring patient safety and preventing medical errors as well as safely performing nursing practices without committing medical errors.²⁵ Hence, it is important for nursing students to take classes on patient safety and medical errors during school years. Nevertheless, in a Turkish study, nursing students reported that practical training provided at schools was inadequate for ensuring patient safety (75%).¹⁴ A review of prior studies concluded that training programmes aimed at patient safety were inadequate. The role of education is important and indisputable to gain high-quality nursing skills.²⁶ In this context, it was deemed important to provide students with theoretical and laboratory simulation training aimed at preventing medical errors and ensuring patient safety. In the present study theoretical and practical simulation training was given to nursing students, most of whom were students around 21 years old in this regard, the objectives, scope, and main theme of the scenarios used in the simulation trainings were prepared in the areas of care and medication administration, infection, fall, and

Table-3: Comparison of the pre and final assessment scores in the study and control groups.

Pre-assessment	Study group			Control group			MWU/ t value	p value
	Mean/ Mean Rank	SD/ Sum of Ranks	Med.	Mean/ Mean Rank	SD/ Sum of Rank	Med.		
Communication	33.69	1044.5	27.8	29.31	908.5	22.2	U=412.5	0.334
Care	29.55	916.0	20.3	33.45	1037.0	25.1	U=420.0	0.394
Medication	28.37	879.5	48.5	34.63	1073.5	52.5	U=383.5	0.172
Fall	31.95	990.5	59.0	31.05	962.5	59.0	U=466.5	0.842
Infection	45.73	18.40	-	50.47	16.27	47.1	t=-1.075	0.286
Total	41.38	7.81	-	41.80	6.50	42.9	t=-0.228	0.820
Final assesment								
Communication	37.58	1165.0	61.1	25.42	788.0	50.0	U=292.0	0.008
Care	49.23	-	-	25.55	-	-	t= 7.376	0.000
Medication	66.69	-	-	55.26	-	-	t= 4.142	0.000
Fall	46.87	1453.0	81.8	16.13	500.0	54.5	U=4.000	0.000
Infection	70.25	20.05	-	53.22	17.37	-	t=-3.572	0.000
Total	66.09	8.19	-	47.15	6.31	-	t=10.195	0.000

MWU: Mann Withney U SD: Standard deviation

communication, where most medical errors are committed by nurses and nursing students.²⁷ The comparison of the pretest and posttest scores of the nursing students in the theoretical training revealed that the students in the experimental group had higher posttest-1 scores than pretest scores. In other words, theoretical training enhanced the level of knowledge of the students in the experimental group. However, we believe that the practical simulation training provided before the completion of posttest-1 also had a favourable effect on the students' level of knowledge. Nevertheless, the final posttest-2 scores of the experimental group were also increased relative to the control group after the completion of the clinical practice of the PN class. It may be suggested that the students' level of knowledge was boosted by theoretical training and the added effect of simulation training. After observing that the posttest-2 scores decreased over time in the experimental group, however, repeating the training was considered essential. A study on medical students reported that more than 75% opined that patient-safety training should be incorporated into all stages of training including the final years of undergraduate education; they also stated that special training meetings should be held to increase awareness.²⁸ These points clearly show the importance of the repetition of the training. The same study also stressed that training aimed at ensuring patient safety should be provided in an interdisciplinary manner and include nurses and pharmacists.²⁸ However, some studies have reported that despite multidisciplinary training activities aimed at raising the nursing and medical students' awareness of patient safety, the training did not have the desired effect on the interventions aimed at patient safety.^{29,30} In this regard, a need became apparent for repeating theoretical training to prevent students from forgetting the information and to raise their awareness. When interventions are explained at laboratories in each class, students are actually provided with knowledge, skills and attitudes related to patient safety and medical errors.

In our study, which was based on the idea of the importance of education for ensuring patient safety and preventing medical errors, theoretical training appeared to enhance students' level of knowledge about patient safety and medical errors. However, a study considered the role limited because it suggested that the complex conditions in the work setting could not be simulated by theoretical training, and that students would experience

hardship in dealing with these conditions in real life.²⁶ Another study also stated that clinical proficiencies of nursing students should be enhanced in the virtual or laboratory setting before starting clinical practice where real patients are encountered.³¹ A study similarly reported that simulation laboratories that would eliminate lack of self-confidence among nursing students should be established and a realistic setting combined with realistic nursing practices should be prepared for nursing-students' training.³² This is because training activities using simulations offer students a realistic learning platform where they experience real-life events; in this way, the students are provided with knowledge and skills not only at the cognitive level, but also at behavioural and psychomotor levels.³¹ One study emphasised that simulation training is an important part of nursing training because it improves patient care and ensures patient safety.³³ In this regard, students in the experimental and control groups of our study were evaluated using checklist designed for procedures for each scenario and by observation, and the students in the experimental group were given a training by the use of simulation before the PN class's clinical training. When the pre-assessment and final assessment scores obtained through checklist and observation were compared, students in the experimental group had higher final assessment scores compared to the control group both in total and in the infection, medication practices, fall, communication, and care practice areas. Moreover, the experimental group had higher final assessment scores than pre-assessment scores. According to these results, we suggest that practical simulation training improves students' professional knowledge and skills, increases their sensitivity and attention to applications directed at preventing medical errors and improving patient safety and reduces the rate of medical errors in their practices. Similarly, in a systematic examination, in 9 out of 15 studies, a statistically significant increase was found in self-confidence level, knowledge and skills development after the simulation-based learning method.³⁴ One study with student nurses found that students were very satisfied with the experience of the paediatric course in the clinical simulation laboratory, and these experiences increased their skills and confidence in the hospital environment.³⁵ Another study reported that 61% of students could not demonstrate the desired level of proficiency and success in practices related to patient safety, such as patient definition and hand

hygiene.³² Although in the same study, the students' failure rate decreased to 38% after training with the use of a simulator aimed at patient safety, the students were unable to fulfill orders related to these subjects.³² A simulation training on medication administration for nurses and nursing students found that nursing students had a lower awareness and performed less risk assessment than nurses who had received simulation training for medication administration.²¹ A study found higher posttest results than pretest results; in other words, simulation training was effective for improving students' blood transfusion practices and knowledge.³⁶ It was also found that scripted/computerised simulation training markedly improved nursing students' level of self-sufficiency and increased skills of communication, confidence, and clinical decision-making.³⁷ Hence, it was suggested that by offering all students an active learning opportunity, they may be able to experience consistent and comparable experiences and helped to integrate their knowledge and skills. In addition, students would need an opportunity to frequently repeat the training in order to reduce the number of future real-life errors and ensure safe patient care.³³

However, the students in the control group in the current study also had higher final assessment scores than the pre-assessment scores, both as total score and as communication scenarios. Higher final assessment scores may have resulted from the clinical practice of the paediatric nursing class. This is because the clinical training allows the transmission of knowledge, skills and attitudes acquired at classes to be put into practice, and assists in remembering and reinforcing acquired information.³¹ As has been seen, in nursing training, the importance of a clinical training that allows students to learn by practising in a real-life setting is beyond doubt. This is because clinical training completes nursing education and forms one of the most important parts of that education. However, the lack of trust in students in the clinical setting, not permitting them to practise freely, and differences between theoretical teaching and clinical practice may adversely affect training.³¹ In addition, different and complex social environments in the clinical setting, reduced control over environmental conditions, the need for ensuring patient safety versus the students' needs to enhance their skills, and the stress that this creates may also adversely affect training in this setting and prevent students from reaching goals in all dimensions.³⁸

Although the control group students showed success in total and in communication scenarios, they were not as successful as the students in the experimental group in any scenario. This clearly reveals the effect of practical simulation training performed in laboratories at the preclinical stage in establishing patient safety and preventing medical errors.

The limitations of the current study was the fact that it was conducted with volunteers who took the PN class in the university's nursing school. In addition, the simulation training given practically in the laboratory was limited to the application procedures only in caring, falling, infection, medicine, communication and the improvement of nursing students' practical skills in order to reduce their medical errors.

Conclusion

Theoretical and practical simulation training increased the knowledge levels about medical errors of the students in the experimental group compared to those in the control group.

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