Original Article

Effects of Scenario-Based High Fidelity and Repeated Simulation Methods on the Medical Error Tendency, Self-efficacy and State Anxiety Levels of Nursing Students

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Abstract

Introduction: This study aims to define effects of scenario-based high fidelity and repeated simulation methods on the medical error tendency, self-efficacy and state anxiety levels of nursing students.
Method: This experimental study with the pre- and post-test design and control group comprised 80 2nd- grade nursing students.The students were given training on Simulation Scenario of a Patient diagnosed with Chronic Lymphocytic Leukemia.
Results: While the self-efficacy and anxiety levels of the two groups were close to each other in our study, there was a statistically remarkable increase in self-efficacy levels and a decrease in anxiety levels of the repeated simulation group after the training. At the first application, skill and medical error tendency levels of the two groups were close to each other, but after the second application, there was a statistically remarkable decrease in the medical error tendency levels of the Repeated Simulation group and the students in this group correctly fulfilled the nursing interventions as they were supposed to do.
Conclusion: İt could be said that the repeated simulation method can improve nursing students' self-efficacy levels, and reduce their anxiety and medical error tendency levels.

Key words: Scenario-Based High Fidelity Simulation, Repeated Simulation, Medical Error, Self-efficacy, State Anxiety, Nursing Students.

Introduction

Medical errors usually occur due to such causes as neglect, carelessness, being inexperienced /incompetent in the profession, lack of knowledge and skills, failure to comply with orders and regulations, and lack of communication and time (Monteiro et al., 2015).

Despite significant advances in reducing malpractices, medical errors remain a major health problem (Avsar et al., 2016). According to a study conducted by Makary and Daniel (2016) at Johns Hopkins University, medical errors are regarded as the third leading cause of deaths in the United States. Of all the deaths in the United States, 9.5% occur due to medical errors, and the number of deaths due to medical errors is more than 250,000 a year. According to the Statistical and Analysis Report in health services in Turkey (2016), the number of medical errors reported was 74,383 (Ministry of Health Safety Reporting System, Access date: February 08, 2017).

Medical errors are important for all health workers; however, their importance for nurses is even greater. Nurses are directly involved in medical practices and their malpractices endanger the patient's life (Mohsenpour, 2017). Nursing is an applied discipline, and one-to-one practice is required to achieve competence in nursing practice. Due to the inadequacy of health systems and increasingly complex clinical situations faced by nursing students, their being able to make the right decision is of great importance not to cause any harm to patients (Yuan et al., 2012). As the learning environments

of students who are trained in the field of health are not adequate and safe enough, medical errors often become unavoidable (Yuan et al. 2012; Gunberg, 2012).

Due to limitations in students' educational and clinical settings, students cannot improve their current knowledge (Atasoy, Sütütemiz, 2014) and skills (Gaba, 2004; Terzioğlu et al., 2012) or cannot adequately display their behaviors of self-efficacy (Dikmen et al., 2016), and thus may experience high levels of anxiety (Houghton et al., 2012). These negative conditions urge educators to find alternative solutions to support students so that they can better acquire knowledge, skills and self-efficacy (Laschinger et al., 2008). Within this context, in the literature, it is recommended to give students a scenario-based simulation training, an innovative educational strategy to teach them how to perform patient care and clinical applications safely (Laschinger et al., 2008; Terzioglu et al., 2012; Gunberg, 2012; Jeppesen et al., 2017). The use of simulation provides the opportunity for students to prevent them from making errors in the clinical environment and to perform interventions without endangering patient safety (Henneman et al., 2010). Students' anxiety is reduced and their self-efficacy increases with the simulation-based learning which provides a risk-free environment (Dearmon et al., 2012). A qualified clinical simulation plays an important role in improving students' self-efficacy in patient care (Bambını et al., 2009). Educational methods aimed at improving self-efficacy also contribute to the development of self-confidence in students (McConville & Lane, 2005). Within this context, a study conducted on students' normal birth skills and self-efficacy levels by Durmaz et al. in 2017 demonstrated that their simulation experiences contributed to the development of their self-efficacy skills significantly.

In the literature, a short-term and non-repeated simulation method implemented within the scope of a single scenario was reported to be insufficient to prevent students from making errors (Lapkin et al., 2010; Mok et al., 2016). In the literature, the number of international studies on High Fidelity Simulation has started to increase. These studies demonstrated that the Non-Repeated High Fidelity Simulation method reduced students' anxiety (Dearmon et al., 2012; Beischel, 2013; Sivertsen & McNeill, 2016) and tendency to medical errors (Henneman et al., 2010; Daupin et al., 2016; Kahriman et al., 2018) and increased their self-efficacy (McConville & Lane, 2005; Bambını et al., 2009; Akhu et al., 2013; Hsu et al., 2015; Roha et al., 2016; Jonson et al., 2017). However, our search for studies investigating the effectiveness of Repeated Simulation demonstrated a gap in the literature.

Methods

Design: This experimental study with the pre- and post-test design and control group comprised 2nd- grade nursing students attending Sivas Cumhuriyet University during the spring semester of the 2017-2018 academic year. The students were given training on Simulation Scenario of a Patient diagnosed with CLL (Chronic Lymphocytic Leukemia).

Data Collection: Self-Description Form, The State Anxiety Inventory, The Self-Efficacy Scale and The Chronic Lymphocytic Leukaemia Patient Scenario Skill Assessment and The Medical Error Situation Evaluation Checklist have been used as data collecting tools.

Self-Description Form: The form includes 12 items questioning the participating nursing students' demographic characteristics and their opinions about Medical Errors and Repeated Simulation.

The Self-Efficacy Scale: The scale developed by Sherer and Maddux in 1982 was adapted to Turkish by Gozum and Aksayan in 1999. The scale has 23 items rated on a 5-point Likert-type scale. The minimum and maximum possible scores to be obtained from the scale were 23 and 115 respectively. The higher the score obtained from the scale is the higher the participant's perceived general self-efficacy is.

The State Anxiety Inventory: In the present study, the 20-item State Anxiety Inventory of the State-Trait Anxiety Inventory developed by Spielberger et al. was used. The lowest and highest possible scores to be obtained from the scale were 20 and 80 respectively. While high scores indicate a high level of anxiety, low scores indicate a low level of anxiety (Oner and Le Compte, 1998).

The Chronic Lymphocytic Leukaemia Patient Scenario Skill Assessment and The Medical Error Situation Evaluation Checklist: This checklist developed by the researchers was based on the pertinent literature and the items of the Medical Error Tendency Scale in Nursing (Ozata, Altunkan, 2010; Aşti, Acaroglu, 2010; Cevik, Demirci, Guven, 2015; Avsar, 2016). The scores to be obtained from the 50-item Checklist

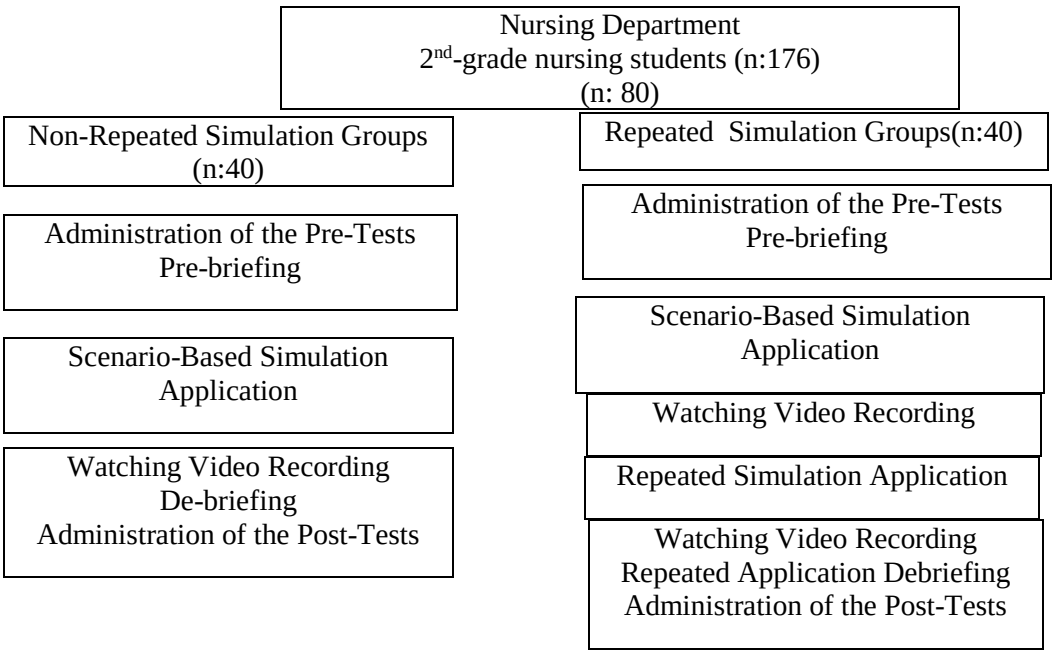
range between 0 and 100. While the high score obtained from the checklist indicated that the participant's medical error tendency was low and that he/she performed the nursing interventions to prevent medical errors correctly, the low score indicated that his/her medical error tendency was high and that he/she performed the nursing interventions incorrectly.

Ethical Considerations: Before the study was conducted, Ethics Committee Approval (dated November 11, .2017, numbered 11/34) was obtained from the Non-Interventional Clinical Research Ethics Committee of Sivas Cumhuriyet University. Before the study was conducted, a written permission to perform the study in the simulation center was obtained from the Faculty of Health Sciences and the Faculty of Medicine where the study was to be conducted. After the students who accepted to participate in the study were informed about the purpose and process of the study, their written and verbal informed consent was obtained. The students to participate in the study were told not to share their knowledge of the process of the practice and practice experiences with the other students in the study sample after they completed the practice.

Participants: The study sample included 80 (repeated simulation group n=40, non-repeated simulation group n=40) 2nd-grade nursing students.Including the non-repeated simulation group(20) and the repeated simulation group(20), a total of 40 subgroups were formed in two-student-groups. These subgroups were participated in the education of the 'The Simulation Scenario of a Patient with Chronic Lymphocytic Leukaemia' which consists of 4 steps.

Procedure: Scenario software created for a Chronic Lymphocytic Leukemia patient considering the interventions the participating students were to perform was uploaded to the Gaumard HAL S3201 model Intensive Care and Advanced Life Support Simulator.Before the start of the study, a four-hour theoretical course about the Chronic Lymphocytic Leukemia (CLL) disease and the nursing care associated with the scenario used in the practice was given to the students who participated in the study by the researchers. This course was video-recorded, and this video recording and training content was shared with the students to re-study the subject matter before the practice. The eight-hour practice was performed for 4 hours a day for 2 days in one week.

Box 1. Flowchart of the Study



The Scenario and the Flowchart Depicting Interventions Students Are Expected to Perform within the Scenario Process: Mr. Yilmaz is a 59-year-old retired teacher. He, who had had CLL for 10 years (Stage 4), received his last cure 3 months ago. He stated that he had been frequently using antibiotics for the last 4 months. The patient who presented to the hospital with the complaints of fever more than 39°C, dysphagia, fatigue, loss of appetite, weight loss and pain in the legs was diagnosed with neutropenic fever and hospitalized in the hematology clinic. Mr. Yilmaz had been receiving symptomatic treatment and care for neutropenic fever for a month. The patient underwent lymph node biopsy 6 months ago. He had DM (Diabetes Mellitus) for 8 years, HT (Hypertension) for 6 years, CAD (Coronary Artery Disease) for 5 years and CRF (Chronic Renal Failure) for 5 years. His family history demonstrated that his father had HT and his mother had DM. He was 68 kg in weight and 1.78 m in height (BMI = 21.46). He had smoked a pack of cigarettes a day for 10 years except for the last year. His blood group was A Rh (+).

Implementation of the Scenario

Interventions Expected to be Performed in the First Phase: - Patient handover, evaluation of the vital signs of the patient being monitored, measurement of the blood glucose level,

- Determining the patient's O_2 requirements: Assessment of saturation levels, observation of cyanotic symptoms, assessment of respiration, positioning of the patient, comfort of the patient.
- Patient safety and prevention of falls: Ensuring patient privacy and safe environment.
- Evaluation of pain; Administration of the Visual Analogue Scale (VAS), implementation of nonpharmacological and pharmacological methods.
- Determining bleeding tendency: Early detection of signs and symptoms of bleeding, prevention of bleeding due to trauma and other factors.

Interventions Expected to be Performed in the Second Phase: - Infection prevention: Evaluation of signs and symptoms of infection, culture collection, compliance with aseptic techniques in the applied procedures, prevention of pressure ulcer formation, taking necessary isolation measures, providing education to the patient and relatives.

Interventions Expected to be Performed in the Third Phase: -Administration of medication: Treatment of the patient with the medication ordered for the patient, checking the history and usability of the vascular route, administration of medication in line with the 8 Rights of Medication Administration, giving fluids to the patient in appropriate doses, performing oral care, monitoring the fluid intake and output of the patient, recording the applications on the observation form.

Interventions Expected to be Performed in the fourth Phase: - Transfusion applications: Initiating the transfusion after performing the necessary controls of the blood product to be administered together with a second nurse, and signing and initialing of the blood transfusion form by the two nurses, monitoring the patient's vital signs at appropriate intervals before and after the transfusion, monitoring the patient for allergic and anaphylactic reactions, monitoring the patient's urine for hematuria and oliguria, and appropriate termination of transfusion.

Data Analysis: The study data were analyzed using the Student t-Test, Mann Whitney U Test, Wilcoxon Marked Rank Test, Paired Sample t-Test, Chi-Square Test, Kruskal Wallis H Test and Cronbach Alfa analysis.

Results

There was no statistically significant difference between the two groups Both the Non-Repeated Simulation and Repeated Simulation groups included in the study had similar characteristics.

Of the students, 27.5% in the Non-Repeated Simulation Group and 32.5% in the Repeated Simulation Group stated that they had witnessed a medical error before. Of the students, 52.9% in the Non-Repeated Simulation group and 40% in the Repeated Simulation group said that the medical errors they witnessed were made by nurses. One of the most common medical errors that the students witnessed during their internship experience was the implementation of the aseptic technique. The percentage of the students who witnessed this medical error was 39.3% in the Non-Repeated Simulation Group and as 64% in the Repeated Simulation Group. Of the students, 97.5% in the Non-Repeated Simulation Group and 100% in the Repeated Simulation Group stated that the practice should be repeated at least twice for the students to ensure the effectiveness of the simulation training (Table 1.).

Table 1. Comparison of Nursing Students in Non-Repeated Simulation and Repeated Simulation Groups in terms of Their Opinions of Medical Errors and Repeated Simulation

	Non-Repeated Simulation		Repeated Simulation		χ^2
	Number (n:40)	**%**	**Number (n:40)**	**%**	**p**
Witnessing medical errors					
Yes	11	27.5	13	32.5	.238
No	29	72.5	27	67.5	.626
***** Who made the medical error?					
Nurse	9	52.9	12	40.0	
Physician	2	11.8	6	20.0	
Staff	0	0.0	3	10.0	3.954
Nursing Student	2	11.8	5	16.7	.556
Medical Student	2	11.8	3	10.0	
Health profession student	2	11.8	1	3.3	
Encounter with medical error during internship					
Yes	19	47.5	21	52.5	.200
No	21	52.5	19	47.5	.655
Medical errors made during internship					
Surgical error	3	4.9	0	0.0	
Administration of wrong medication	10	16.3	7	10.0	
Non-compliance with aseptic technique	24	39.3	32	64.0	13.778
Administration of medication at the wrong time	6	9.8	2	4.0	.130
Patient falls	4	6.6	0	0.0	
Not keeping records	5	8.2	5	10.0	
Interventions likely to create risk for embolism	9	14.8	4	8.0	
How many times should simulation training be repeated?					
One	1	1.25	0	0.0	
Two	26	65.0	23	57.5	
Two-Three	9	22.5	12	30.0	
Three	4	10.0	4	10.0	
Four	0	0.0	1	2.5	

*** Multiple selection question**

Table 2. Comparison of the Non-repeated Simulation and Repeated Simulation Groups in Terms of Their Intergroup and Intragroup Pre-Test and Post-Test Mean Scores Obtained from the State Anxiety Scale, and Pre- and Post-Training Scores Obtained from the Self-Efficacy Scale

Scales	Non-Repeated Simulation Mean ± SD	Repeated Simulation Groups Mean ± SD	**Test and Significance**
State Anxiety Scale			
Pre-Test	39.00±6.820	38.13±7.198	t=.558 p=.578
Post-Test	41.60±5.528	42.93±5.106	t=-1.114 p=.269
Test and Significance	t=-1.909 p=.064	**t=-3.924 p=.000**	
Self-Efficacy Scale			
Pre-Test	86.78±11.421	90.33±10.545	t=-1.444 p=.153
Post-Test	91.20±11.154	96.83±8.177	**t=-2.572 p=.012**
Test and Significance	t=-3.187 **p=.003**	**t=-4.806 p=.000**	

The comparison of the mean scores the students in the Non-Repeated Simulation and Repeated Simulation groups obtained from the Self-Efficacy Scale and the State Anxiety Inventory at the pretest revealed that there was no statistically significant difference between the groups (p>0.05). The comparison of the mean scores the students in the Non-Repeated Simulation and Repeated Simulation groups obtained from the State Anxiety Inventory at the posttest demonstrated no statistically significant difference between the groups (p>0.05). However, the mean scores for the posttest self-efficacy scale were significantly higher in the Repeated Simulation group (**t =-2.572 p=0.012**). Intragroup comparisons showed that the Self-Efficacy Scale posttest scores were higher than were the pretest scores both in the Non-Repeated Simulation group (t =-3,187 **p=, 003**) and in the Repeated Simulation group (**t =-4.806 p=0.000**). Intragroup comparisons also showed that the State Anxiety Inventory posttest scores were not statistically significantly different from the pretest scores in the Non-Repeated Simulation Group (p>0.05) but significantly higher in the Repeated Simulation group (Table 2.).

Table 3. Comparison of the Non-repeated Simulation and Repeated Simulation Groups in Terms of Their Mean Scores for the The Chronic Lymphocytic Leukaemia Patient Scenario Skill Assessment and The Medical Error Situation Evaluation Checklist

Skill Assessment and The Medical Error Situation Evaluation Checklist	Non-Repeated Simulation Mean ± SD	Repeated Simulation Groups Mean ± SD	**Test and Significance**
First application	61.95±12.297	55.55±13.843	U=152.500 p=.201
Second application	-	80.70±11.881	-
Test and Significance		**z=-3.924 p=.000**	

While there was no statistically significant difference between the two groups in terms of the mean scores they obtained at the first application for the Chronic Lymphocytic Leukemia Patient Scenario Skill Assessment and the Medical Error Situation Evaluation Checklist (p >0.05), the mean scores they obtained at the second application were statistically significantly higher in the Repeated Simulation group (**z=-3.924 p=.000)** (p<0.05) (Table 3.).

Discussion

Self-efficacy: When the self-efficacy pretest and posttest scores of the two groups were compared in the simulation application, no statistically significant difference was observed between their pretest scores, but the posttest scores were higher in the Repeated Simulation group. If the applications are to be implemented successfully and effectively, then students' having a high level of self-efficacy is of great importance (Hsu et al., 2015).

Intragroup comparisons of the Non-Repeated Simulation and Repeated Simulation groups revealed that both the non-repeated simulation training (t =-3.187 p= .003) and the repeated simulation training (t =-4.806 p=.000) significantly increased the nursing students' self-efficacy (Table 3.). Several studies in the literature indicate that non-repeated simulation education increases students' self-efficacy levels, which supports our findings. On the other hand, contrary to the results of the present study, the results of some studies in which the relationship between high fidelity simulation and self-efficacy levels were examined indicated that there were no statistically significant differences between the participants' self-efficacy levels (Hoadley, 2009; Roh et al., 2013). However, our search for studies investigating the relationship between repeated simulation training and students' self-efficacy levels demonstrated a gap in the literature. Within this context, based on the results obtained from our study, it can be said that repeated simulation training increases students' self-efficacy more than does the non-repeated simulation training. In the present study, the repeated simulation application carried out after the analysis phase of the simulation enabled

the students to repeat the application and provided them with the learning opportunity. The participating students stated that they realized what they did wrong or incomplete in the first application, and that the repeated simulation training application gave them the opportunity to learn from their mistakes and to correct their incomplete / wrong applications and gained them confidence and competence. In the light of all these results, it can be concluded that repeated simulation application increases students' self-efficacy levels and improves the efficiency of education through target-specific and learner-centered education.

State Anxiety: In the comparison of the mean scores the students in the Non-Repeated Simulation and Repeated Simulation groups obtained from the State Anxiety Inventory at the pretest and posttest, no statistically significant difference was observed between the groups ($p>0.05$). In the intra-group comparisons, there was no statistically significant difference between the mean scores the participants in the Non-Repeated Simulation group obtained from the State Anxiety Inventory at the pretest and posttest; however, in the Repeated Simulation Group, the posttest scores were significantly lower. ($p<0.05$) (Table 3.). In the literature, contrary to our study, there are many studies indicating that non-repeated simulation training reduces students' anxiety (Dearmon et al., 2012; Beischel ,2013; Sivertsen, McNeill, 2016), On the other hand, in the literature, there is only one study indicating that repeated simulation training reduces students' anxiety, which supports our findings (Sivertsen, McNeill, 2016).

The aim of the simulation training is to reduce students' anxiety in new situations by offering them the opportunity to practice their newly acquired skills comfortably and safely in a supportive environment that creates lifelike experiences (Dearmon et al., 2012).Thus, simulation trainings can improve students' self-confidence and reduce their anxiety in real patient care environments. In the present study, the students stated that they were anxious in the first application and therefore they could not fully adapt to the application process and could not achieve their applications at the desired level. Beischel (2013) states that students' anxiety increases due to the lack of preliminary preparation for simulation training, which supports the statements of the students participating in the present study.

The complexity of the scenarios in simulation training and one-to-one observation and evaluation of the participants by the trainers in simulation applications and video recording of the application can be extremely worrying for the participants (Bong et al., 2010). If high-level anxiety experienced by students in the non-repeated simulation training poses an obstacle to learning, educators' developing different methods to reduce anxiety is of great importance (Beischel, 2013). Therefore, students' anxiety can be minimized through repeated simulation applications. For instance, in the present study, the students stated that their being given the opportunity to repeat the simulation enabled them to complete the applications more comfortably. Within this context, it can be said that the students involved in our study adapted to the simulation environment in the second application after the first application and spent the education process more easily and effectively. In their study, Sivertsen and McNeill (2016) stated that repeated simulation application reduced negative effects such as anxiety and stress in students.

Medical Error Tendency: In the first simulation training conducted within the scope of our study, medical error tendency was generally below average both in the Non-repeated Simulation group and in the Repeated Simulation groups, and the difference between the groups was not statistically significant ($U=152.500$ $p=.201$). There was a statistically significant difference between the first and second applications of the students in the repeated simulation group in terms of medical error tendency (**$z=-3.924$ $p=.000$)**, and their medical error tendency decreased significantly in the second application, which suggests that the repeated simulation method was an effective approach in reducing medical error tendency (Table 4.).

Our search in the literature indicated that although there were a limited number of studies indicating that non-repeated simulation training decreases medical error tendency in students (Henneman et al., 2010; Daupin et al., 2016; Kahriman et al., 2018), there were no studies indicating that repeated simulation training would reduce medical error tendency in students.

In the literature, it is emphasized that the non-repeated simulation application cannot reduce students' error making potential sufficiently, and

that other effective strategies to reduce the medical errors should be developed (Henneman et al., 2010; Lapkin et al., 2010; Mok et al., 2016). Within this context, the use of the repeated simulation method can be considered as the most effective strategy.

Kahriman et al. (2018) stated that simulation training improved students' sensitivity to practices performed to prevent medical errors and to improve patient safety and decreased the rate of medical errors made by students in their applications, but that in order to prevent students from forgetting their theoretical knowledge and to raise their awareness, theoretical education should be repeated too. Within this context, it is assumed that students can perform applications without any or with a few errors by receiving repeated simulation training together with the theoretical education, and that their knowledge will remain permanent.

Our search in the literature demonstrated that there was only one study which investigated the effects of non-repeated simulation method on medical errors made by nursing students in such domains as infection, falls, communication, care and drug management by creating a checklist (Kahriman et al., 2018). In the present study, nursing students' medical error tendencies and their attempts to prevent medical errors were assessed with the Chronic Lymphocytic Leukemia Patient Scenario Skill Assessment and The Medical Error Situation Evaluation Checklist consisting of four sub-dimensions related to medical errors in such areas as patient safety, hospital acquired infections; drug and transfusion applications and communication.

Because many people suffer from harm due to medical errors, patient safety should be ensured and medical errors should be prevented, which can only be achieved by providing nursing students with the essential and up-to-date training. Therefore, it is essential to use current education methods aimed at preventing / reducing medical errors in nursing education. It is thought that the use of repeated simulation method, which is an innovative educational strategy, in nursing education to teach students patient care and clinical practices safely has gained importance.

Conclusions and Suggestions: While the self-efficacy and anxiety levels of the two groups were close to each other in our study, there was a statistically remarkable increase in self-efficacy levels and a decrease in anxiety levels of the repeated simulation group after the training. At the first application, skill and medical error tendency levels of the two groups were close to each other, but after the second application, there was a statistically remarkable decrease in the medical error tendency levels of the Repeated Simulation group and the students in this group correctly fulfilled the nursing interventions as they were supposed to do.The majority of the students in our study emphasized that the simulation should be repeated for the effectiveness of education. In conclusion, it could be said that the repeated simulation method can improve nursing students' self-efficacy levels, and reduce their anxiety and medical error tendency levels. Thus, nursing schools should include the repeated simulation method in their curriculums.

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