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Using High-Fidelity Simulation and Standardized Patient to Improve the Intravenous Therapy of Nursing Students: A Quasi-Experimental Study

Hemşirelik Öğrencilerinin İntravenöz Tedavi Yönetimini Geliştirmek İçin Yüksek Gerçeklikli Simülasyon ve Standartlaştırılmış Hasta Kullanımı: Yarı-Deneysel Çalışma

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ABSTRACT Objective: To compare the effects of high-fidelity simulations and standardised patients on students' knowledge and skill levels regarding intravenous (IV) therapy administration. **Material and Methods:** This quasi experimental study was carried out among first-year nursing students in Türkiye. The study sample included 59 students. The participants were divided into two groups. Group 1 (high-fidelity simulation) comprised 30 students, and Group 2 (standardised patient) comprised 29 students. Pre and post-test IV drug therapy administration knowledge form and IV drug therapy administration performance checklist forms were used for data collection. Mann-Whitney U and Wilcoxon signed-rank tests were used for analyses. **Results:** In the standardised patient group, participants' post-test knowledge scores were significantly higher than their pre-test knowledge scores. The skill scores of the standardised patient group were significantly higher than those of the high-fidelity simulation group. Students in standardized patient group scored higher on some items of the "opening the lid of the IV catheter, three-way tap control, closing the three-way faucet, attaching the IV drug injector to the catheter, injecting the drug, removing the injector, using washing solution and closing the lid of the catheter" in drug administration procedure. **Conclusion:** The results of this study showed that the use of standardised patients was more effective in increasing students' knowledge and skills in IV drug therapy administration than high-fidelity simulation situations. In the IV drug therapy administration training, nursing instructors can use standardised patients to enable students to gain knowledge and competence.

Keywords: High-fidelity simulator; nursing education; safe medication administration; simulation; standardised patient

ÖZET Amaç: Yüksek gerçeklikli simülasyonların ve standardize edilmiş hastaların, öğrencilerin intravenöz (İV) tedavi uygulamasına ilişkin bilgi ve beceri düzeyleri üzerindeki etkilerini karşılaştırmak. **Gereç ve Yöntemler:** Bu yarı-deneysel çalışma Türkiye'deki hemşirelik birinci sınıf öğrencileri arasında gerçekleştirildi. Araştırmanın örneklemini 59 öğrenci oluşturmuştur. Katılımcılar 2 gruba ayrılmıştır. Grup 1 (yüksek gerçeklikli simülasyon) 30 öğrenciden ve Grup 2 (standardize hasta) 29 öğrenciden oluşuyordu. Verilerin toplanmasında ön-son test İV ilaç tedavisi uygulama bilgi formu ve İV ilaç tedavisi uygulama performans kontrol listesi formları kullanılmıştır. Analizlerde Mann-Whitney U ve Wilcoxon işaretli sıra testleri kullanılmıştır. **Bulgular:** Standardize edilmiş hasta grubunda katılımcıların son test bilgi puanları, ön test bilgi puanlarına göre anlamlı düzeyde yüksekti. Standardize edilmiş hasta grubunun beceri puanları, yüksek gerçeklikli simülasyon grubundan anlamlı derecede daha yüksekti. Standardize edilmiş hasta grubundaki öğrenciler İV kateterin kapağını açma, üç yönlü musluk kontrolü, üç yollu musluğu kapatma, İV ilaç enjektörünü katetere takma, ilacı enjekte etme, enjektörü çıkarma, ilaç uygulama işleminde yıkama solüsyonu kullanma ve kateterin kapağını kapatma" maddelerinden daha yüksek puanlar aldılar. **Sonuç:** Bu çalışmanın sonuçları, standardize edilmiş hasta kullanımının, öğrencilerin İV ilaç tedavisi uygulamasındaki bilgi ve becerilerini arttırmada yüksek gerçeklikli simülasyon grubuna göre daha etkili olduğunu gösterdi. İntravenöz ilaç tedavisi yönetimi eğitiminde hemşirelik eğitmenleri, öğrencilerin bilgi ve yeterlilik kazanmasını sağlamak için standardize edilmiş hastaları kullanabilir.

Anahtar Kelimeler: Yüksek gerçeklikli stimülasyon; hemşirelik eğitimi; güvenli ilaç yönetimi; stimülasyon; standardize edilmiş hasta

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Intravenous (IV) drug therapy administration is a basic nursing skill and a key component of nursing education, quality of care, and patient safety in addition to being an important role implemented by the nurse.[1,2] The basis of this is the responsibility of nurses to have knowledge about the drug they administer, to prepare, control, administer and monitor the effect of the treatment.[3] This task starts from undergraduate education and becomes complex and difficult for nurse students.[4] Nurses need to use a framework known as the "ten right principles" to ensure IV therapy administration in the delivery of healthcare to patients. These are to use the right drug for the right patient, at the right time, in the right dose, on the right path, with the right to refuse, with the right information, with the right questions or difficulties, with the right advice and the right answer.[5] Factors that contribute to the correct administration of drugs are directly linked to the "ten right principles". In fact, failure to comply with the "ten right principles" causes the IV therapy administration to not be managed safely. This causes medication errors, which are a serious cause of morbidity and mortality in patients, and can be prevented with education.[6] According to Drug Administration Error Statistics, 7,000-9,000 people die each year due to incorrect drug therapy administration in the United States.[7] Medication errors in Türkiye have been identified as the third most common type of medical error according to the Safety Reporting System. It was determined that 5,092 people reported drug administration errors.[8] The most frequent medication errors that nurses encounter regarding drug administration are related to faulty physician requests, failure to administer the medication properly, the correct dose, and the right time.[9] Therefore, IV therapy administration of nursing students is the area that needs the most urgent attention and it is important to develop these skills before they graduate.[1]

Many problems encountered in nursing education may adversely affect students' knowledge and skills regarding IV drug therapy administration, posing important problems for patients.[9] Lack of clinical practice, concern about being unfamiliar with the equipment used in the hospital environment, anxiety about doing the application wrong, the number of students per academician, the excessive workload of the nurse in the hospital environment, time constraints and students' unwillingness to take responsibility cause clinical education to be inefficient and students may feel stress and anxiety during clinical practice.[10,11] Therefore, effective teaching methods are needed to use in which students are active in the educational process, and their learning experiences and opinions will determine learning behaviors in the next process, positively affects students' learning outcomes.

Simulation-based education is one of the active learning strategies, has increased in nursing education in recent years. It is a teaching method in which students experience the true dimensions of their future professional roles by following a specific scenario, helping them to integrate into the health sector workforce more quickly.[12] Simulation is a method that enables the development of cognitive, affective, and psychomotor skills by imitating the situations that can be encountered in real life in a realistic and reliable environment.[13,14] High Fidelity Simulations improve students' psychomotor skills as well as develop their decision-making skills. There are some reports in the literature showing that high-fidelity simulators are an effective teaching method for improving knowledge, skills, and attitudes of students.[2,10,15] Another effective simulation technique is standardized patient. International Nursing Association for Clinical Simulation and Learning defined the standardized patient that "*a person trained to consistently portray a patient or other individual in a scripted scenario for the purposes of instruction, practice, or evaluation*" which are actors or real patients standardized patient especially trained to interact with students.[13,16] Using of the standardized patient enables the development of high-level knowledge and skills.[10] It allows instructors to create a learning environment that repeats the same real clinical scenarios and increases the efficiency of the learning process in a controlled and secure medium.[2] Previous studies have reported that standardized patient use has positive contributions to the development of students' cognitive, affective and psychomotor skills.[17,18] Tuzer et al., in their study, they found that the use of standardized patients was

more effective in increasing their knowledge scores on the chest, lung and cardiac examination.[10]

In this study, they experienced a one-to-one simulation practice at all stages of drug administration, which represented the real role of the nurse more precisely. It is thought that this research will contribute to the development of students' IV drug therapy administration knowledge and skills by adding high-fidelity simulation and standardized patient methods, which are current teaching approaches, to the Nursing Fundamentals course. In addition, it is thought that it will contribute to the students' ability to maintain, apply and synthesize information through analysis sessions and feedback from the educator so that they can analyze their own mistakes and increase their skills. In this study, it is aimed to compare the effects of high-fidelity simulations and standardized patients on students' knowledge and skill levels regarding IV therapy administration.

MATERIAL AND METHODS

STUDY DESIGN

A quasi experimental study was conducted.

STUDY SAMPLE

The universe of the research contained 121 first-year nursing students registered in the Faculty of Health Sciences of a university. This study was conducted between March 2022 and June 2022. The following inclusion criteria were met by 110 students: being able to speak and understand Turkish, taking the lesson for the first time, and having no previous experience of simulation methods. A power analysis was performed to specify the sample size. To determine whether the difference between the mean values of the three groups was different from 0, the required sample size for each group was calculated to be 24 with an effect size of 0.80, power of 0.90 and a margin of error of 0.05.[19] A total of 110 nursing students were numbered from 1 to 110 according to the class list by a co-researcher. Considering the possibility of dropouts, the study sample comprised 59 students (Figure 1). Random selection was performed using "https://www.random.org" to eliminate the possibility of bias. Students were randomly allocated to the high-fidelity simulation (Group 1; n=30) or standardised patient (Group 2; n=29) groups (Figure 1).

DATA COLLECTION TOOLS

Pre And Post-Test IV Drug Therapy Administration Knowledge Form

The knowledge form contained ten multiple-choice questions. The questions were prepared by the researcher using the relevant literature.[20-22] In this form, the incorrect and correct answers were evaluated as "0" and "1", respectively. The total scores ranged between 0 and 10.

IV Drug Therapy Administration Performance Checklist Form

The checklist form contained 33 items under five domains: 7 items in the "beginning procedure", 4 items in the "medical asepsis", 3 in the "communication with the patient", 13 in the "application procedure" and 6 in the "ending procedure" domains. If the step was "not observed" or "incorrect", the student received a score of "0". If the step was "missing", the student received "1" point. If the step was observed as "correct/complete", the student received "2" points. The total scores ranged between 0 and 66. The obtained scores were converted into a full score of 100.

The checklist was prepared by the researchers depending upon the existing literature (File S2).[23] A pilot study was conducted on five randomly selected students who ensured the inclusion criteria. Based on the result of the pilot study, no change was required in the checklist form.

PROCEDURE

This study was performed in the following phases (Figure 1).

Theoretical education: The content of drug administration through the IV catheter was provided by the researcher through the narrative and demonstration method conducted over four hours.

Preliminary Theoretical Assessment: A pre-test knowledge form was administered to the two groups participating in the study to measure their knowledge levels.

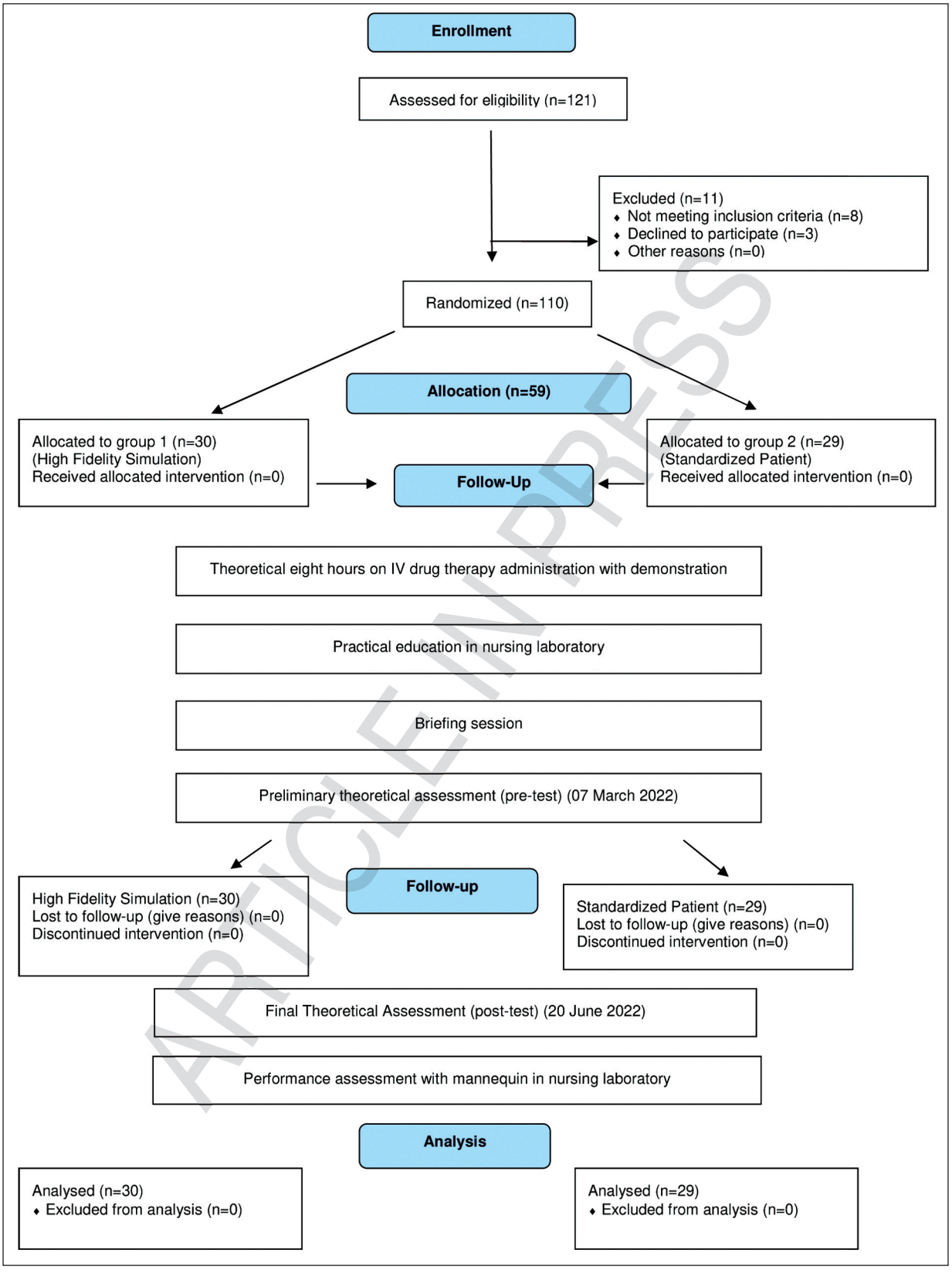

FIGURE 1: The flow diagrams of the study.

Practical Education: All students were separated into two laboratory groups consisting of 15 students who participated in training on low-fidelity mannequins in a nursing skills laboratory.

Simulation setting: Learning objectives and IV Drug Therapy Administration Scenario were prepared (Table 1). The light and sound system of the device was set for the high-fidelity simulation. The drugs to be used, material tray, and infusion pump were also prepared. The vital parameters of the manikin were adjusted. The standardised patients were informed of the scenario, roles, and responsibilities.

Briefing Session: An information session was provided to the two groups before the practical applications. Additionally, the students were informed about the introduction of the simulator, environment, location of the materials and procedure to perform the application.

Simulation Practice and Assessment: The application was performed in the Simulation Laboratory for 2 days with high-fidelity simulation for Group 1 (n=30) and standardised patient for Group 2 (n=29). In both groups, "IV Drug Therapy Administration Scenario" was used. Each simulation required approximately 20 min to complete. After this, a debriefing session was carried out with a group of six students that lasted an average of 30 min. During the analysis session, the students discussed the simulation scenario and clarified the parts that they could not perform during the implementation.

Final Theoretical Assessment: The post-test knowledge form was administered to the two groups participating in the study to measure their knowledge levels.

Skill Assessment: All students, who were divided into two groups, were given an opportunity to practice their skills with a low-fidelity mannequin in the nursing laboratory under the observance of the researcher. Two teaching staff members, who were unaware of the students' groups, evaluated the students' skills using the checklist form and Cohen's kappa statistic was used to evaluate the agreement. The result showed a high and significant agreement ($p<0.05$). The compliance percentage was over 78 for all items, and Cohen's kappa statistic was 0.853.

DATA ANALYSIS

Data were analysed using the SPSS 22 package programme. Since the data were not normally distributed, the Mann-Whitney U test was used for between-group comparisons. Wilcoxon sign test was used for within-group comparisons. Consistency among observers was examined using Cohen's kappa statistics. Results were considered significant at $p\leq0.05$. There was a significant difference or correlation when $p<0.05$, whereas there was no significant difference or correlation when $p>0.05$.

ETHICAL CONSIDERATION

Ethical confirming for the study was achieved from the Çankırı Karatekin University's Ethics Committee on 2 March 2022 (no: 900c9c2592094597). Students who voluntarily participated in the study were provided with an informed consent document containing the aim and process of the study, and their written consent was acquired. All processes of the research were carried out in accordance with the principles of the Declaration of Helsinki.

RESULTS

KNOWLEDGE ACQUISITION

There were no significant differences between the groups in the sense of knowledge scores on the pretest assessment. In the standardised group, post-test knowledge scores were significantly higher than pretest knowledge scores. Post-test knowledge scores were significantly higher in the standardised group than in the simulation group ($z=-3.32$; $p=0.001$) (Table 2).

SKILLS ACQUISITION

Table 2 shows the comparison of the students' skill scores between the simulation and standardised groups. The total skill score was 78.25±12.98 in the standardised patient group and 72.25±19.63 in the simulation group, indicating a statistically significant difference ($U=352$; $p=0.02$). When the sub-dimensions of the skill scores were compared, there was a statistically significant difference between the groups for communication with the patient and application procedure domains (Table 3).

TABLE 1: IV drug therapy administration scenario.

Time	Mannequin actions	Environmental factors	Expected initiatives	Tips
1-3 min	HR: 90/min. RR: 14/min. SpO_2: 97% BP: 150/80 mm/Hg The patient is lying on the bed	-Creation of lights and sound system of the device. -Preparation of the drug to be used. -Preparation of necessary materials.	-Checking the physician's request. -HR measurement. Evaluation of factors affecting IV Digoxin drug administration. -Checking the information on the medication card and the nurse observation form. Evaluation of 8 right principles. -Preparation of necessary materials. -Initiating communication with the patient (verifying the patient's identity, providing information about the procedure and ensuring patient privacy)	Physician (facilitator): factors affecting drug administration are not controlled. Calls and asks "Is there any factor affecting IV Digoxin drug administration?" he asks. Patient: If he is not informed, "Will we be started on medication today? No one gave us information," he asks.
3-12 min	HR: 120/min. RR: 24/min. SpO_2: 97% BP: 200/120 mm/Hg The patient states that he has palpitations. The patient is lying on the bed.	There is a material tray and an infusion pump ready in the patient's room.	- Taking protective measures for IV drug administration (control of bed level and bed brakes, hand hygiene and wearing gloves, placing a tarp under the application area) - Calculate the appropriate dose - Carrying out the steps of administering drugs from the IV catheter systematically by following the principles of patient safety. - Evaluation of drug responses (observation of the patient for reactions such as swelling, infiltration, hematoma that may develop against the drug). -Recording of practice and observations	Physician (facilitator): Instructs the dose calculation to be done again. Patient: if drug response is not assessed. "Is my medicine going?" he asks.
12-15 min	The patient's condition continues. The patient is lying in his bed.	There is a material tray and an infusion pump ready in the patient's room.	-Output 1: If every app does it right: HR: 95 min. BP: 130/70 mm/Hg -Output 2: Incorrect dose administration HR: 60 min. BP: 140/70 mm/Hg -Output 3: If completely wrong implementation: HR: 140 min. BP: 220/120 mm/Hg	

IV: Intravenous.

TABLE 2: Students' pre-test and post-test knowledge scores according to education method (n=59).

	Simulation group (n=30)	Standardized patient group (n=29)	Statistical analysis	
	X̄±SD	X̄±SD	Z[a]	p value
Pre-test	6.90±1.42	7.52±1.74	323	0.084
Post-test	7.50±1.30	8.90±1.10	173.5	0.0001
p value	0.103	0.001		
Z[b]	-1.63	-3.32		
d[c]		0.065		

[a]Mann-Whitney U test; [b]Wilcoxon sign test; [c]Effect size; SD: Standard deviation.

TABLE 3: Comparisons of the students' intravenous drug therapy administration skill scores in the simulation and standardized groups (n=59).

	Simulation Group (n=30)	Standardized patient group (n=29)	Statistical analysisa	
	X̄±SD	X̄±SD	Z	p value
Beginning procedure	8.45±2.21	8.56±1.14	243	0.71
Apply medical asepsis	9.51±7.13	9.42±3.75	254	0.54
Communication with patient	7.36±1.27	8.53±3.71	274	**0.01**
Application procedure	34.56±5.31	40.28±5.67	489	**0.01**
Ending procedure	12.37±3.14	12.54±1.75	240	0.78
Total score	72.25±19.63	78.25±12.98	352	**0.02**

[a]Mann-Whitney U test; SD: Standard deviation.

COMPARISON OF SKILL SITUATIONS

IV drug administration was compared on 33 items according to the education method of the students. The results showed that students in standardized patient group scored higher on some items of the drug administration procedure than in other practices. These items are as follows: "opening the lid of the IV catheter (p=0.002), three-way tap control (χ^2=6.271, p=0.043), closing the three-way faucet (p=0.001), attaching the IV drug injector to the catheter (χ^2=10.22, p=0.06), injecting the drug (p=0.002), removing the injector (p=0.013), using washing solution (χ^2=13.22, p=0.01) and closing the lid of the catheter" (χ^2=17.43, p=0.0001) (Table 4).

DISCUSSION

The findings of this study highlighted the effectiveness of using a standardised patient in increasing the knowledge scores on IV drug therapy administration of undergraduate nursing students (Table 2). Studies focusing on high-fidelity simulationsor standardised patient use have shown an increase in IV drug therapy administration knowledge scores among students.[11,15,18,24-26] However, few studies have compared the effects of high-fidelity simulations and standardised patients on students' knowledge scores.[10,27] In this study, the high knowledge scores obtained by students practicing with the standardised patient were due to the high realism perceived by the students in the use of standardised patients, their ability to communicate visually, verbally or nonverbally, and their experiences of receiving feedback from them. Another reason could be that the scenarios used in this study included information on medication administration. Tuzer et al. used a high-fidelity simulator and a standard patient.[10] They observed that the post-test knowledge mean scores of the students in both groups regarding chest and heart examination skills were significantly higher than their pre-test scores (p<0.001). Between the groups, the knowledge scores of the students using standard patients were considerably high.[10] In a study examining the effects of simulation-based learning on first-year nursing students' knowledge of IV therapy, the use of hybrid simulation was more effective than the use of low-fidelity simulation in improving students' IV therapy practice knowledge level.[1] In another study, researchers

TABLE 4: Comparison of IV drug therapy administration skill status according to the education.

IV catheter drug administration		Simulation group (30) n	Simulation group (30) %	Standard patient group (29) n	Standard patient group (29) %	Statisticaly analysis χ2	Statisticaly analysis p*
1. Physician request-medication card control	Not observed	3	10.0	5	17.2	*	0.301
	Observed	27	90.0	24	82.8		
2. Factors affecting drug administration	Not observed	10	33.3	9	31.0	0.117	0.943
	Observed	20	66.6	20	69.0		
3. Hand washing	Not observed	8	26.6	5	17.2	*	0.604
	Observed	22	73.3	24	82.8		
4. Material preparation	Not observed	14	46.6	10	34.5	2.568	0.277
	Observed	16	53.3	19	65.5		
5. Drug interaction control	Not observed	18	60.0	17	58.6	0.54	0.763
	Observed	12	40.0	12	41.4		
6. 8 rights	Not observed	15	50.0	14	48.3	0	1
	Observed	15	50.0	15	51.7		
7. Patient ID check	Not observed	1	3.3	4	13.8	*	0.216
	Observed	29	96.6	25	86.2		
8. Giving information	Not observed	4	13.3	9	31.0	*	0.063
	Observed	26	86.6	20	69.0		
9. Privacy	Not observed	10	33.3	9	31.0	1.719	0.423
	Observed	20	66.6	20	69.0		
10. Bed level	Not observed	10	33.3	9	31.0	0.117	0.943
	Observed	20	66.6	20	69.0		
11. Bed borders	Not observed	5	16.6	7	24.1	*	0.724
	Observed	25	83.3	22	75.9		
12. Wearing gloves	Not observed	6	20.0	4	13.8	*	0.5
	Observed	24	80.0	25	86.2		
13. Using treatment tarp	Not observed	6	20.0	3	10.3	*	0.349
	Observed	24	80.0	26	89.7		
14. Opening the IV catheter cap	Not observed	7	23.3	4	13.8	*	**0.002**
	Observed	23	76.6	25	86.2		
15. Three-way tap control	Not observed	6	20.0	6	20.7	6.271	**0.043**
	Observed	24	80.0	23	79.3		
16. Attaching the cap to the syringe needle	Not observed	12	40.0	9	31.0	5.204	0.074
	Observed	18	60.0	20	69.0		
17. Three-way faucet connection direction	Not observed	9	30.0	10	34.5	3.976	0.137
	Observed	21	70.0	19	65.5		
18. IV catheter aspiration	Not observed	6	20.0	7	24.1	*	0.842
	Observed	24	80.0	22	75.9		
19. Applying wash solution	Not observed	11	36.6	11	37.9	3.444	0.179
	Observed	19	63.3	18	62.1		
20. Closing the three-way faucet	Not observed	7	23.3	7	24.1	*	**0.001**
	Observed	23	76.6	22	75.9		
21. Attaching the IV drug injector to the catheter	Not observed	8	15.0	8	27.6	10.221	**0.006**
	Observed	22	85.0	21	72.4		
22. Injecting the drug	Not observed	9	25.0	5	17.2	*	**0.002**
	Observed	21	75.0	24	82.8		
23. Drug reaction monitoring	Not observed	14	40.0	10	34.5	5.438	0.066
	Observed	16	60.0	19	65.5		
24. Removing the injector	Not observed	5	10.0	5	17.2	*	**0.013**
	Observed	25	90.0	24	82.8		
25. Using washing solution	Not observed	10	20.0	7	24.1	13.222	**0.001**
	Observed	20	80.0	22	75.9		
26. Closing the catheter cap	Not observed	9	15.0	6	20.7	17.435	**0.0001**
	Observed	21	85.0	23	79.3		
27. Cutting-drilling tool separation	Not observed	11	25.0	12	41.4	5.439	0.066
	Observed	19	75.0	17	58.6		
28. Removing the glove	Not observed	8	26.6	12	41.4	2.64	0.267
	Observed	22	73.3	17	58.6		
29. Patient position	Not observed	13	43.3	13	44.8	0.002	0.999
	Observed	17	56.6	16	55.2		
30. Removing bed borders	Not observed	7	23.3	9	31.0	0.572	0.751
	Observed	23	76.6	20	69.0		
31. Gathering materials	Not observed	8	26.6	8	27.6	10.221	**0.006**
	Observed	22	73.3	21	72.4		
32. Providing hand hygiene	Not observed	16	53.3	14	48.3	1.021	0.6
	Observed	14	46.6	15	51.7		
33. Registration in the nurse observation form	Not observed	6	20.0	7	24.1	*	0.38
	Observed	24	80.0	22	75.9		
Total		30	100.0	29	100.0		

IV: Intravenous.

evaluated nursing students' knowledge about elder abuse, and standardised patient simulation significantly increased their knowledge scores.[28] In a comparative study that examined the effect of high-reality and virtual simulation experiences on nurses' knowledge of coronavirus disease-2019 patients, it was found that nurses who applied virtual simulation gained more information.[29] Contrary to our findings, in a randomised controlled intervention study by Jørgensen et al. in which simulation was used as an educational tool in acute nursing care, nursing students took traditional classroom courses combined with simulation-based courses in the hospital.[30] According to the results of this study, no significant differences were found between groups in terms of basic knowledge.

The findings of this study showed that standard patient use was effective in increasing IV drug treatment application skills among undergraduate nursing students and in increasing their scores on communication with the patient and application procedure items, which were sub-dimensions (Table 3). Various factors contributed to this effect. The first is the realistic characteristics of a standardised patient. Second, the fact that the students performed one-to-one simulations at all stages of drug administration may have affected the significance of the findings. Another significant contribution of this study is the favourable impression of the information session. The debriefing session is an integral part of the simulations and provides feedback on students' skills to enable them to correct their mistakes before proceeding with a real patient.[10] In this way, the participant could be more successful in the clinical setting by learning each step of the simulation practice.[2] In their study evaluating the effectiveness of simulation training with nurses, Van den Bos-Boon et al. stated that the effect size on both resuscitation and teamwork skills was high after the intervention.[25] In a study examining the effects of simulation-based learning on first-year nursing students' performance and clinical assessment skills of IV therapy, the use of hybrid simulation was more effective than the use of low-fidelity simulation in improving students' IV therapy practice performance and clinical evaluation level.[1] Kim et al. used standardised patients in infection control education for nursing students. Infection control skills in the simulation using the standard patient group were significantly higher than those in the peer role-playing group.[31] In a systematic review using standardised patients in nursing education, it was determined that standardised patients were a learning method that contributed to the acquisition of motor skills.[32] In the study of Ross et al., investigators assessed nursing students' communication skills and they found statistically significant high scores for assessment skills after standardised patient simulation.[28] Basak et al. used standardised patient application to enhance the hygiene care skills of first-year nursing students and found that it was an effective teaching method in enhancing the skill scores of nursing students.[18] Contrary to our study findings, in the study by Tuzer et al., the use of standardised patients and high-fidelity simulators in the education of thorax, lung and cardiac inspection skills was not significantly different considering the skill scores between the groups.[10] In a study evaluating the efficiency of simulation in IV catheter skills training for nursing students, no difference was found between the performance scores of the scenario-based hybrid simulation and traditional groups.[22]

When the sub-dimensions of the skill scores were compared, there was a statistically significant difference between the groups for the domains of communication with the patient and application procedure (Table 3). In the nursing curriculum, psychomotor skills and communication skills are taught as separate subjects. However, these skills are inseparable from those used in the clinical practice. Therefore, simulations should be conducted to integrate these skills. The primary aim of nursing education is to prepare students for real-world clinical environments. Simulations using a standardised patient offer a realistic learning opportunity.[18] Based on the literature review, experiences in communicating with standardised patients and following the standardised patient's condition further improved students' adjustment to the clinical setting and patient intervention more than high-fidelity simulation practice alone.[33] The effect of simulation on six Rs of drug administration was investigated by conducting pre-test and post-test studies on the experimental and control

groups with 85 nursing students. Simulation practices were found to be a useful strategy for preparing nurses for safe drug administration.[15]

In this study, significant differences were found in the steps including the stages of IV drug therapy administration in the evaluation of student's skill status of IV drug therapy administration according to the education method (Table 4). These findings show that both high fidelity simulation and standardized patient applications improve drug administration steps. However, in this study, no significant difference was found in the items such as "factors affecting drug administration, drug interaction control, 8 correct principles, patient identity control, information, drug reaction observation and registration in the nurse observation form", which are the items that will enable the evaluation of a drug administration and whether it is the right drug for the patient. Methods for the preparation and administration of medicines are based on certain principles. The nurse performs the drug therapy administration according to the "eight correct principles". These principles are the right drug, the right patient, the right dose, the right route of administration, the right time, the right drug form, the right record, and the right effect.[6] Contrary to our study findings, It was investigated the effect of simulation on six Rs of drug administration and they conducted pre-test and post-test studies on the experimental and control groups among 85 nursing students. It was reported that simulation practice was a useful strategy in preparing nurses for safe drug administration.[15]

The aim of nursing education is to prepare students for the real clinical environment. Simulations using both high-fidelity simulations and standardised patients provide a realistic learning environment. The realistic characteristic of the simulation practice allows students to experience the clinical environment positively.[18] In this study, the use of standardised patients was an effective teaching method for nursing students to learn the management of IV drug therapy administration and transfer this skill to clinical settings; however, its disadvantages should also be considered. For example, nurse educators face another challenge regarding student engagement while trying to provide a satisfactory educational experience.[11] However, the biggest difficulties with simulation are related to the arrangement, implementation of standardised patients, training, availability, recruitment of professional standardised patients and costs of using one-to-one simulation techniques.[11,16] Since students gain knowledge and skills through concepts, questioning and receiving feedback, it is essential to have content experts' specific to that area available during simulation briefings.[11] This study is noteworthy in that our results support the limited literature on the IV drug therapy administration capabilities using high-fidelity simulations and standardised patients. However, owing to several limitations, the results of the current study should be interpreted with attention.

LIMITATIONS

The results are limited to a single institution, and it is difficult to generalise our results to the general population. The small quantity of students in the lesson restricted the number of students in each group. Another limitation was that the skills learned through both simulations were not evaluated in clinical practice.

CONCLUSION

The results of this study showed that the use of standardised patients was more effective in increasing students' knowledge and skills in IV drug therapy administration than high-fidelity simulation situations. In the IV drug therapy administration training, nursing instructors can use standardised patients to enable students to gain knowledge and competence. Professional training with standardised patients is recommended to further increase their realism and usefulness in education. More studies with larger sample sizes are needed to evaluate the impact of simulation strategies on students' performance in clinical settings.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or mem-

bers of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Gözde Özaras Öz;* ***Design:*** *Gözde Özaras Öz;* ***Control/Supervision:*** *Gözde Özaras Öz, Müjgan Onarıcı;* ***Data Collection and/or Processing:*** *Gözde Özaras Öz, Müjgan Onarıcı;* ***Analysis and/or Interpretation:*** *Gözde Özaras Öz, Müjgan Onarıcı;* ***Literature Review:*** *Gözde Özaras Öz;* ***Writing the Article:*** *Gözde Özaras Öz;* ***Critical Review:*** *Gözde Özaras Öz, Müjgan Onarıcı;* ***References and Fundings:*** *Gözde Özaras Öz, Müjgan Onarıcı;* ***Materials:*** *Gözde Özaras Öz, Müjgan Onarıcı.*

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