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MedicaMAP: A Simulation Design to Examine Nursing Students' Skills for Identifying Medication Errors

MedicaMAP: Hemşirelik Öğrencilerinin İlaç Hatalarını Bulma Becerilerini İnceleyen Bir Simülasyon Tasarımı

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ABSTRACT

The aim of this study is to examine nursing students' skills in correctly identifying medication errors using a Level-0 simulation design as a pilot study for another study.

The cross-sectional observational study was conducted by 47 senior nursing students studying at a university. Considering the 10 rights of medication safety, a medication quiz consisting of five MedicaMAPs was designed. Students identified a medication error on MedicaMAP by comparing the consistency of information on essential elements.

None of the students correctly identified the five medication errors. Six students could not correctly identify any medication errors (12.8%). The students correctly identified three medication error types at the highest rates in the medication quiz: wrong medication 15 out of 19 (78.9%), wrong patient 23 out of 38 (60.5%), and wrong dose 23 out of 48 (47.9%). The students' mean satisfaction level was found to be 8.51 ± 1.28.

MedicaMAP can help nurse educators increase nursing students' safe medication administration skills, particularly with the 10 rights.

Keywords: Medication Errors, Patient Safety, Simulation Training, Baccalaureate Nursing Education

ÖZ

Bu çalışmanın amacı, başka bir çalışmanın pilot çalışması olarak, Düzey-0 simülasyon tasarımı kullanarak hemşirelik öğrencilerinin ilaç hatalarını doğru bir şekilde belirleme becerilerini incelemektir.

Kesitsel gözlemsel olan bu çalışma, bir üniversitede öğrenim gören 47 hemşirelik son sınıf öğrencisi ile gerçekleştirildi. İlaç güvenliğinin 10 doğrusu göz önüna alınarak beş MedicaMAP'den oluşan bir ilaç bilgi sınavı tasarlandı. Öğrenciler, temel unsurlarla ilgili olan bilgilerin tutarlılığını karşılaştırarak MedicaMAP'te yer alan bir ilaç hatası tespit etti.

Öğrencilerin hiçbiri beş ilaç hatasını doğru bir şekilde belirlemedi. Altı öğrenci herhangi bir ilaç hatasını doğru bir şekilde tespit edemedi (%12,8). Öğrencilerin ilaç bilgi sınavında üç ilaç hatasını en yüksek oranda belirledi: 19 öğrenciden 15'i (%78,9) yanlış ilaç, 38 öğrenciden 23'ü (%60,5) yanlış hasta, 48 öğrenciden 23'ü (%47,9) yanlış doz. Öğrencilerin ortalama memnuniyet düzeyi 8,51 ± 1,28 olarak bulundu.

MedicaMAP, hemşirelik öğrencilerinin özellikle 10 doğru kuralı ile güvenli ilaç uygulama becerilerini artırmada hemşire eğitimcilere yardımcı olabilir.

Anahtar Kelimeler: İlaç Hataları, Hasta Güvenliği, Simülasyon Eğitimi, Hemşirelik Lisans Eğitimi

The study protocol was approved by the Istanbul Medipol University Non-Invasive Research Ethics Committee, (Date: 16.04.2020, Decision Number: 290)

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INTRODUCTION

In the early 2000s, the United States of America (USA) Institute of Medicine (IOM) reported the necessity of a competent healthcare workforce for the quality and safety of healthcare services.[1] In 2005, nursing leaders formed the Quality and Safety Education for Nurses project to integrate quality and safety content into nursing education by responding to this national call.[2] The World Health Organization (WHO) published the Patient Safety Curriculum Guide in 2011 as an international recommendation to incorporate patient safety education in the curriculum of healthcare science students.[3] Therefore, nursing educators primarily educate professionals with quality and safety competencies.

Medication errors are a significant global problem with severe consequences.[4] A medication error is defined as ‘’any preventable error in the prescribing, documenting, dispensing, administering, and monitoring of a medicine, irrespective of whether such errors lead to adverse consequences or not’’.[5] Medication administration is a high-risk and changing process that involves physicians, pharmacists, and nurses. However, critical nursing consumes 40% of a nurse’s daily time.[6] Previous studies showed that nurses were predominantly responsible for medication errors; medication errors occurred most frequently in the administration phase, and dose-related errors are the most common. Lack of knowledge and skills in nurses is one of the leading causes of medication errors.[7-10] Therefore, nurses should have more knowledge and skills in medication safety than in nursing education.[11]

Nursing students theoretically learn safe medication administration in classrooms and skills laboratories, a fundamental part of nursing education.[6] Theoretical content generally includes basic knowledge of pharmacology, calculation, preparation, and administration of medications, as well as skills and attitudes towards medication safety.[3,12] Also, nursing students need to practice in a clinical setting that provides the opportunity to test medication administration skills with actual patients.[6] Studies showed that medication errors by nursing students occurred at low or moderate levels in clinical settings and were generally unreported.[13,14,15,16] A current systematic review reported that simulations at different levels of fidelity were an innovative strategy for developing knowledge, skills, and attitudes about safe medication administration among nursing students.[17]

A limited number of studies focused on the skills of nursing students to identify medication errors. A study by Sears, Goldsworthy, and Goodman highlighted that the number of medication errors among nursing students decreased when simulation was used as an alternative classroom lecture method.[18] Another study using simulated prescriptions reported that nursing students had low error identification rates, demonstrating the necessity of alternative methods to teach students how to identify medication errors.[19] Hewitt, Tower, and Latimer (2015)[20] found that a series of short digital recordings about the factors influencing medication errors was an effective teaching methodology in helping students identify the factors influencing safe medication administration. Edwards, Williams, and Lee (2019)[21] reported that nursing students gained a better insight into safe medication administration by experiencing a series of simulations that integrated ten rights of medication administration. The current study explained the details of a simulation design called "Escape Room" which aimed to develop nursing students' skills in identifying and reporting medication errors.[22]

In Türkiye, simulation-based learning has started to be used in nursing education. However, traditional teaching methods are more common in nursing education due to the high number of students per teaching staff and the limited opportunities for simulation laboratories in Türkiye.[23]

Therefore, practical and innovative simulation designs are needed in large classrooms, mainly described as Level-0. Level-0 simulations are written simulations that include pen-and-paper simulations or "Patient Management Issues" and latent images. Simulations at this level are usually student-led in the classroom and target the passive cognitive domain. The main advantages of Level-0 simulations are low cost and the need for only a few teaching staff.[24] Considering the importance of safe medication administration in nursing, there is a need for Level-0 simulation designs that focus on nursing students' skills to identify medication errors in Türkiye. The aim of this study is to examine nursing students' skills to correctly identify medication errors using a Level-0 simulation design as a pilot study of another study. The secondary aim was to assess the level of satisfaction and to determine views and recommendations towards Level-0 simulation design among nursing students.

MATERIALS AND METHODS

Design

This study was conducted in a cross-sectional observational design using the medication quiz of a Level-0 simulation design called MedicaMAP.

Setting and Sample

The study setting was a four-year baccalaureate nursing program at a university. Students complete classroom, laboratory, and clinical experiences in each of the eight semesters of the program. Furthermore, ten private hospitals are affiliated with this university. For two semesters, senior nursing students generally have internships three days a week in these private hospitals and attend three elective courses one day a week. Participants for this study consisted of senior nursing students who enrolled in the Health Quality Management elective course (n=47).

The Healthcare Quality Management course focused on processes and practices related to patient and employee safety in healthcare systems. The course was offered only to senior-level nursing students. The topical outline for this course included (a) introduction to basic concepts related to health quality management, (b) characteristics and measurement of quality management in healthcare services, (c) quality improvement, (d) medical errors causes, reporting, and management, (e) patient safety, (f) hospital infections, medication and transfusion errors, patient falls, surgery errors, (g) employee safety. This course was delivered to students through face-to-face meetings every week for 2 hours. The primary teaching methods were lecture, brainstorming, question-answer, discussion, and simulation.

Only 47 students enrolled in the Health Quality Management elective course were eligible to participate in the medication errors quiz conducted as a classroom exercise. Students had received all the content of this course before the study.

Instrument

In this study, the medication errors quiz contained five MedicaMAPs developed by the researchers. Researchers defined the aim of MedicaMAP as developing nursing students' skills to identify medication errors. Therefore, MedicaMAP was created using 10 rights of medication administration. These include the right patient, right medication, right dose, right time, right route, right documentation, right patient education, right to refuse, right assessment, and right evaluation (5). However, the right evaluation and the right to refuse could not be included in MedicaMAP due to the need for patient-nurse interaction. Seventeen scenarios were prepared, including only one of these eight rights of medication administration as an error type. Table 1 outlines some example scenarios by error types generated on MedicaMAP.

Table 1: Examples of Scenarios by Error Types for MedicaMAP

Examples of Scenarios	Error Type
The scenario takes place in the Pulmonology Service at 11.00. Patients have been prescribed Methylprednisolone 20 mg per IV twice a day at a dosing schedule of 08.00 h and 20.00 h. The identification information of the second patient written on the medication chart and medical wristband is inconsistent.	Wrong patient Three scenarios
The scenario takes place in the Medical-Surgical Service at 23.00. Cefamezin 500 mg has been prescribed to one of the two patients, and Ceftazidime 500 mg to the other. However, there are two medicine boxes on MedicaMAP that are equivalent to each other and contain the active ingredient Ceftazidime.	Wrong medication A scenario
The scenario takes place in the Oncology Service at 12.00. Patients have been prescribed Furosemide 20 mg per IV three times a day at a dosing schedule of 08.00 h, 16.00 h, and 24.00 h. On the medicine box, it wrote that each 20 mg of Furosemide is 2 ml. The first patient's injector contains about 6 ml of liquid.	Wrong dose Four scenarios
The scenario takes place in the Cardiology Service at 16.00. Patients have been prescribed Coraspin 500 mg per oral twice a day for thrombosis prophylaxis at a dosing schedule of 08.00 h and 20.00 h. The second dose was administered before 20.00 on the medication chart of first patient.	Wrong time A scenario
The scenario takes place in the Orthopaedics Service at 20.00. Patients have been prescribed IV antibiotics on the medication charts. On the medicine box of the second patient, it wrote that the medicine could administer as intramuscular.	Wrong route Three scenarios
The scenario takes place in the Rheumatology Service at 18.00. Patients have been prescribed IV antibiotics per three times a day at a dosing schedule of 08.00 h, 16.00 h, and 24.00 h. On the first patient's medication chart, the time of administration was circled, but the nurse's name and surname were not written.	Wrong documentation Two scenarios
The scenario takes place in the Medical-Surgical Service at 17.00. Patients have been prescribed İbuprofen 200 mg per oral three times a day at a dosing schedule of 08.00 h, 16.00 h, and 24.00 h. In the information note, the second patient was prescribed this medication to protect the stomach.	Wrong patient education A scenario
The scenario takes place in the Endocrinology Service at 19.30. Patients have been prescribed Novorapid pen 10 unit per two times a day at a dosing schedule of 07.00 h, and 19.00 h. Although the fasting blood glucose of the first patient was measured as 60 mg/dl and stated in the information note, the evening insulin dose was administered as subcutaneous.	Wrong assessment Two scenarios

MedicaMAP consisted of six essential elements: location and date information, a simulated medication chart, an information note related to medications, a medical wristband, a medicine box, materials showing the dose and amount of the medication such as an injector, an insulin pen, or a plastic vial. The location and date information of the scenario are specified on MedicaMAP. Medication charts and wristbands were simulated and used in hospitals affiliated with universities. Also, medication boxes with the same active ingredients produced by different companies were used. For intravenous and intramuscular medications, injectors were attached to MedicaMAP. The liquid in the number of milligrams and millilitres written on the medication chart was filled into the injectors. Plastic vials were attached to MedicaMAP for oral medications. The small white gums in the number of milligrams written on the medication chart were filled into the plastic vials. In addition, insulin pens that turned the dial to the correct dose were attached to MedicaMAP. Doses written on the medication chart were not considered when creating a wrong medication dose on MedicaMAP. The information note included medication-related indications, side effects, and points to be considered besides patients' vital signs and laboratory results. Figure 1

portrays an example of MedicaMAP that contains the wrong time.

Baseline demographic information was collected using the medication quiz, including age, gender, and whether students witnessed and made a medication error. In the medication quiz, students wrote down the types of medication errors identified on five MedicaMAP. A questionnaire form consisting of two questions was distributed to the students after the medication quiz. A question was related to satisfaction level with MedicaMAP, rating from 0=strongly disagree to 10=strongly agree on a scale. The other open-ended question was related to views and recommendations about MedicaMAP.

Data Collection

Before participating in the study, students were informed verbally related to the aim of the study and the medication quiz. The classroom had five tables in a row, with five different MedicaMAPs on each. In the medication quiz, students had 10 minutes for identifying medication errors on five MedicaMAPs, two minutes for each. Students waited for two minutes to pass from one table to the next, even if identifying medication error on MedicaMAP. Firstly, students filled in basic demographic information. After the first student completed the two minutes at the first table, the second student moved on to the first table. This process continued until all students completed the medication quiz. The 47 students determined a total of 235 medication errors. These errors were 20.4% wrong dose (n=48), 16.2% wrong patient and wrong route (n=38), 11.9% wrong documentation (n=28), 11.5% wrong assessment (n=27), 8.1% wrong medication and wrong patient education (n=19) and 7.6% wrong time (n=18).

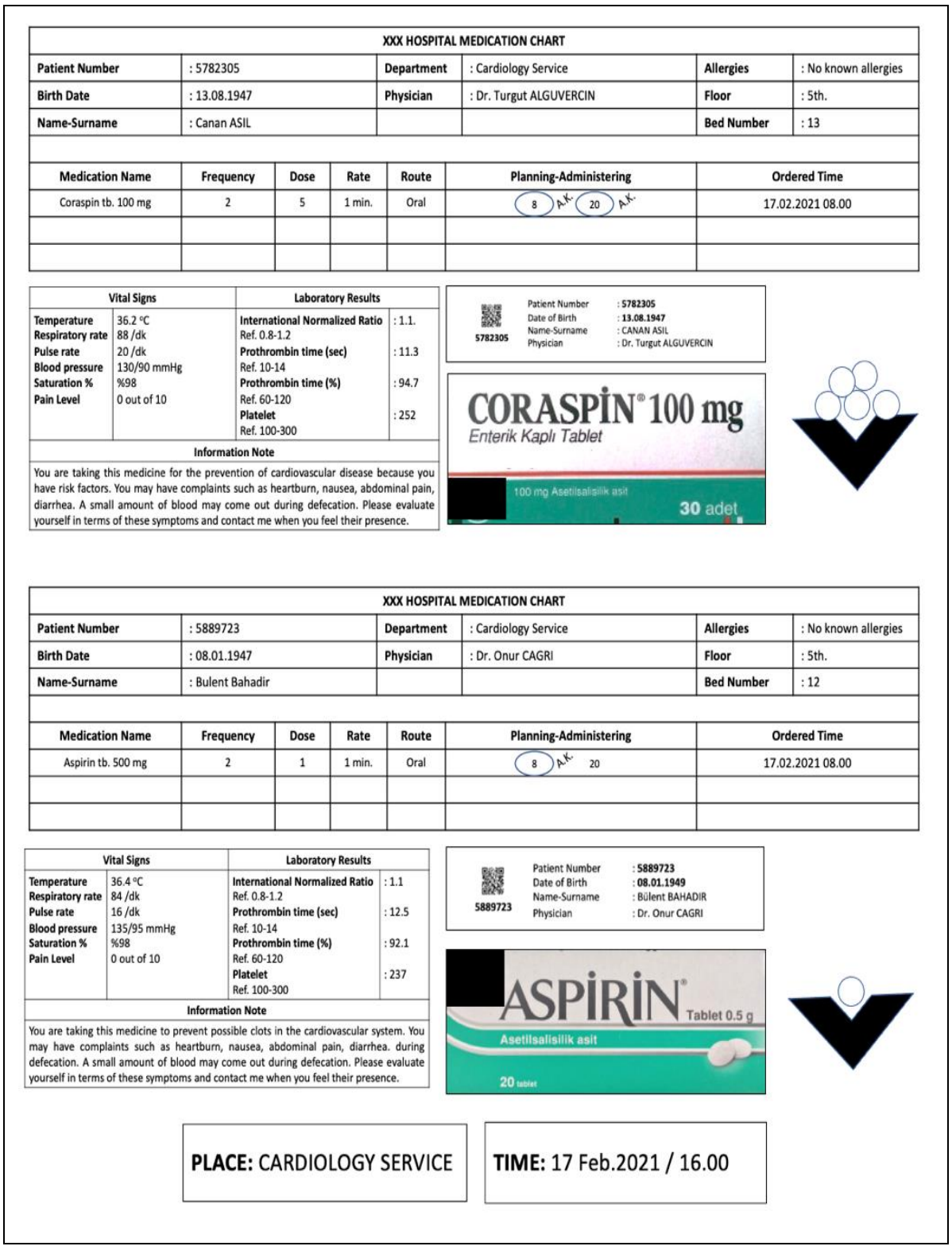
After each of the five students completed the medication quiz, a session with the correct answers was held. After this session, students evaluated the medication quiz using a questionnaire.

Data Analysis

Data analysis was performed using the Statistical Package for Social Sciences (IBM SPSS, version 22.0) at a significance level. Statistical analysis of the student's demographic information, the overall number of correctly identified errors and types of medication errors, and the views and recommendations related to MedicaMAP were performed using descriptive statistics.

Ethical Considerations

The Istanbul Medipol University Non-Invasive Research Ethics Committee approved the study protocol (Date: 16.04.2020, Decision Number: 290), and the nursing school gave written approval to collect data. Students also gave informed consent before participating in the study.



XXX HOSPITAL MEDICATION CHART

Patient Number	: 5782305	**Department**	: Cardiology Service	**Allergies**	: No known allergies
Birth Date	: 13.08.1947	**Physician**	: Dr. Turgut ALGUVERCIN	**Floor**	: 5th.
Name-Surname	: Canan ASIL			**Bed Number**	: 13

Medication Name	Frequency	Dose	Rate	Route	Planning-Administering	Ordered Time
Coraspin tb. 100 mg	2	5	1 min.	Oral	8 A.K. 20 A.K.	17.02.2021 08.00

Vital Signs		Laboratory Results	
Temperature	36.2 °C	**International Normalized Ratio**	: 1.1.
Respiratory rate	88 /dk	Ref. 0.8-1.2	
Pulse rate	20 /dk	**Prothrombin time (sec)**	: 11.3
Blood pressure	130/90 mmHg	Ref. 10-14	
Saturation %	%98	**Prothrombin time (%)**	: 94.7
Pain Level	0 out of 10	Ref. 60-120	
		Platelet	: 252
		Ref. 100-300	

Information Note

You are taking this medicine for the prevention of cardiovascular disease because you have risk factors. You may have complaints such as heartburn, nausea, abdominal pain, diarrhea. A small amount of blood may come out during defecation. Please evaluate yourself in terms of these symptoms and contact me when you feel their presence.

5782305
Patient Number : 5782305
Date of Birth : 13.08.1947
Name-Surname : CANAN ASIL
Physician : Dr. Turgut ALGUVERCIN

CORASPİN® 100 mg
Enterik Kaplı Tablet
100 mg Asetilsalisilik asit
30 adet

XXX HOSPITAL MEDICATION CHART

Patient Number	: 5889723	**Department**	: Cardiology Service	**Allergies**	: No known allergies
Birth Date	: 08.01.1947	**Physician**	: Dr. Onur CAGRI	**Floor**	: 5th.
Name-Surname	: Bulent Bahadir			**Bed Number**	: 12

Medication Name	Frequency	Dose	Rate	Route	Planning-Administering	Ordered Time
Aspirin tb. 500 mg	2	1	1 min.	Oral	8 A.K. 20	17.02.2021 08.00

Vital Signs		Laboratory Results	
Temperature	36.4 °C	**International Normalized Ratio**	: 1.1
Respiratory rate	84 /dk	Ref. 0.8-1.2	
Pulse rate	16 /dk	**Prothrombin time (sec)**	: 12.5
Blood pressure	135/95 mmHg	Ref. 10-14	
Saturation %	%98	**Prothrombin time (%)**	: 92.1
Pain Level	0 out of 10	Ref. 60-120	
		Platelet	: 237
		Ref. 100-300	

Information Note

You are taking this medicine to prevent possible clots in the cardiovascular system. You may have complaints such as heartburn, nausea, abdominal pain, diarrhea. during defecation. A small amount of blood may come out during defecation. Please evaluate yourself in terms of these symptoms and contact me when you feel their presence.

5889723
Patient Number : 5889723
Date of Birth : 08.01.1949
Name-Surname : Bülent BAHADIR
Physician : Dr. Onur CAGRI

ASPİRİN® Tablet 0.5 g
Asetilsalisilik asit
20 tablet

PLACE: CARDIOLOGY SERVICE

TIME: 17 Feb.2021 / 16.00

Figure 1. Example of a MedicaMAP

RESULTS

Demographic Characteristics

The mean age of nursing students was 21.4 years (range 20-24; SD: 1.1), whereas more than half were 21 years or younger (59.6%). Many nursing students were female (80.9%). More than half of nursing students had witnessed medication errors during clinical education (53.2%). Of these, 40.4% made a medication error during nursing education.

Medication Errors Identification Rates

Table 2 presents the number and percentage of students who correctly identified medication errors. In the study, the medication errors the students correctly identified in the medication quiz ranged from 0 to 5. None of the students identified the five medication errors correctly. Six students could not correctly identify any medication errors (12.8%). Nearly half of the students identified two medication errors correctly in the medication quiz (48.8%).

Table 2. Number and Percentage of Correctly Identified Medication Errors by Students

Number of Medication Errors	n	%
Five	0	0
Four	3	6.4
Three	7	14.9
Two	23	48.8
One	8	17.1
Zero	6	12.8

Table 3 outlines the number of responses and percentage of correctly identified medication error types by students. There were 235 medication errors on 17 different MedicaMAPs for all students in the medication quiz. The students correctly identified 37% of medication errors in the quiz (n=87). The students identified three medication error types correctly in the medication quiz as follows: wrong medication 15 out of 19 (78.9%), wrong patient 23 out of 38 (60.5%), wrong dose 23 out of 48 (47.9%). Wrong assessment (18.5%) and patient education (10.5%) were the least correctly identified medication errors. None of the students correctly identified the wrong documentation.

Table 3. Number and Percentage of Correctly Identified Medication Error Types by Students

Types of Medication Error	n/N	%
Right medication	15/19	78.9
Right patient	23/38	60.5
Right dose	23/48	47.9
Right route	14/38	36.8
Right time	5/18	27.7
Right approach	5/27	18.5
Right information	2/19	10.5
Right documentation	0/28	0
TOTAL	87/235	37

Satisfaction Level

The mean students' satisfaction level from MedicaMAP was 8.51±1.28 (range from 5 to 10). Three-quarters of the students stated that MedicaMAP, a level 0 simulation, was a useful teaching method to increase their skills and awareness to identify medication errors. Most students reported that the best aspect of MedicaMAP was to improve problem-solving skills. Some have stated that MedicaMAP is an entertaining teaching method that should be used from the first year of nursing education. A few students stated that the worst aspect of MedicaMAP was not to give feedback immediately.

DISCUSSION

Raising nursing students' awareness of medication errors is vital in providing the quality and safety of healthcare in the future. Therefore, nursing education should focus on raising awareness and attitudes about medication safety. This study used a Level-0 simulation design called MedicaMAP to

examine nursing students' ability to identify medication errors.

Demographic Characteristics

In the study, two of every five students made a medication error. Studies in Türkiye reported that 38.3% of nursing students had made medication errors, 59% of medical errors made by midwives and final-year nursing students were medication errors, and nursing students reported 72 medication errors during their 28-week clinical practice.[13,16,25] Studies in the Philippines, Iran, and Jordan emphasized that 18%, 30%, and 65% of nursing students made at least one medication error during nursing education.[14,15,26] In this study, nursing students made medication errors at a lower rate than in previous studies. However, it is thought that the medication error rates of nursing students are higher than the reported rates. The rate of making medication errors among nursing students (40.2%) was lower than the rate of witnessing (53.2%) in the study supports this view. Previous studies showed that the fear of low grades, being demeaned, and being labelled incompetent were the main reasons for not reporting medication errors among nursing students.[13,26] For such reasons, the students in the study may have hesitated to state experiences related to medication errors.

Medication Errors Identification Rates

Nursing students correctly identified 37% of 235 medication errors presented through the MedicaMAPs. In a study conducted by Tarhan, Dogan, Yaman, and Disci (2019)[27], new graduate nurses correctly identified 8.4% of medical errors in different types with a simulation design called pint-size errors of room. Nursing students may have higher error identification rates in the study because MedicaMAP only focuses on medication errors. A study reported that nurses identified 67.1% of medication errors with a simulation design called a medication error room.[28] Another study showed that nursing students correctly identified 44.2% to 59.2% of medication error types using simulated prescriptions.[18] The rate of identifying medication errors by nursing students and nurses in Türkiye is lower than in international studies. In addition, none of the students correctly identified five medication errors, and 12.8% of them could not identify any medication errors in the study. Whitehair et al. (2014)[19] reported that 7.3% of nursing students identified all medication errors, but 10.9% could not identify any medication errors correctly. Simulation-based learning is widely used as a pedagogy strategy in nursing education internationally. Therefore, students with no or limited simulation experience had a lower rate of identifying medication errors in this study compared to international studies, which is an expected result.

The medication errors identified by nursing students with rates below 25% were wrong assessment, wrong patient education, and wrong documentation. On the MedicaMAP, the information note, including vital signs, laboratory results, and basic knowledge about the medication, should be examined to identify wrong assessment and patient education. Therefore, students should know basic pharmacology and physiology to identify such errors on MedicaMAP. In the study, the low rates of identifying wrong assessment and wrong patient education may be due to nursing students' need for knowledge about pharmacology and physiology. Also, no students in the study identified wrong documentation. To identify wrong documentation, medication charts on MedicaMAP should be examined in terms of a missing or wrong date, time, and signature, as well as misuse of symbols or abbreviations. The failure to identify wrong documentation in the study may have resulted from the nursing students' need for knowledge and awareness of the components of high-quality documentation.

The medication errors identified by nursing students with rates between 25% and 50% were wrong dose, route, and time. The wrong dose is identified by comparing the injector, insulin pen, or plastic vial with the medication chart or box in terms of dose and amount. At this point, medication boxes

showing different amounts of the same active ingredients are used as a challenging factor to identify medication errors. The wrong route is identified by comparing the medication chart and medication box information. The wrong time is identified because of the inconsistency between the information on the medication chart and the date information of the scenario. The wrong route, wrong time, and wrong dose are known and checked more frequently during preparation for drug administration. In addition, identifying these types of errors on MedicaMAP requires attention rather than theoretical knowledge about safe medication administration. Therefore, students may have identified such errors more easily in MedicaMAP.

The medication errors identified by MedicaMAP with a rate above %50 were wrong medication (78.9%) and wrong patient (60.5%). Wrong medication is identified by comparing information on the medication chart with the medication box. Similarly, the wrong patient is created by inconsistent information between the medical wristband and medication chart. The wrong patient and medication, which are more familiar than other medication errors, can be easily identified at first sight by students in the study.

Limitations

The study's limitations included the fact that it was completed with senior nursing students from a single school and did not include two of the ten 'right' medication principles.

CONCLUSIONS AND RECOMMENDATIONS

The study results showed that nursing students' awareness and skills in correctly identifying medication errors were low, especially in wrong assessment, patient education, and documentation. According to student feedback, MedicaMAP, Level-0 simulation, was a teaching method that was useful, entertaining, and didactic but not to give feedback immediately.

These results support the need for nursing educators to increase awareness and knowledge of nursing students about safe medication administration, especially 10 rights, with innovative and creative Level-0 simulation designs. MedicaMAP can help nurse educators increase nursing students' skills in safe medication administration, particularly with the 10 rights. Future studies should further analyse MedicaMAP's effectiveness, validity and reliability. In addition, MedicaMAP should be designed in a digital environment to be more standardised and give feedback immediately. MedicaMAP can be designed either from simple to complex or as a starting point between various levels of simulation in a digital environment.

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