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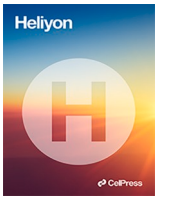

Research article

# How simulation training for nursing students in emergency internships affects triage decision-making and anxiety: A quasi-experimental study

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ABSTRACT

*Purpose:* This study aimed to determine the effects of simulation-based training on triage decision-making skills and anxiety in fourth-year nursing students.
*Methods:* This study employed an experimental pretest-posttest design and randomly assigned 90 nursing students from adult and pediatric emergency internships to control (n = 48) and intervention groups (n = 42). Although both groups underwent triage decision-making training, only the intervention group received simulation-based triage training.
*Results:* A significant difference in posttest triage decision-making knowledge and anxiety scores was observed between the control and intervention groups ($p < 0.05$). The posttest triage decision-making knowledge score of the intervention group was significantly higher than the pretest score, whereas the posttest anxiety score was significantly lower.
*Conclusion:* Theoretical triage decision-making training was effective, whereas simulation-based triage training improved the nursing students' knowledge and performance. Therefore, simulation-based training should be integrated into traditional learning methods to improve the triage decision-making skills of nursing students.

## 1. Introduction

Triage is an assessment and classification method used to prioritize patients who present to emergency departments (EDs) based on the severity of their health problems, ranging from high (i.e., life-threatening) to low severity, to determine appropriate care and treatment. The term *triage* derives from the French verb *trier*, meaning "to separate, sort, or select." Triage, predominantly performed by emergency nurses, aims to efficiently place patients in the appropriate area of the emergency department and allocate appropriate personnel and resources for their proper treatment and care. Emergency nurses facilitate efficient assessment and appropriate diagnostic categorization to provide effective care to emergency patients across various health care institutions, thereby ensuring accurate decision-making. To achieve this, they require sufficient triage-related knowledge and skills [1], which are influenced by various factors including knowledge of triage, education, experience in triage settings, and professional tenure [2].

Nurses play a critical role in the triage decision-making process for both adult and pediatric patients, especially in emergency situations where patient outcomes are directly impacted. As essential and active members of healthcare teams, nurses are increasingly

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needed during emergencies and disasters. Consequently, they are expected to have knowledge of decision-making and triage principles, particularly in emergency and disaster scenarios [3]. A study assessing the levels of knowledge, skills, and practices related to triage among emergency nurses in Jordan indicated that the development of policies supporting triage-focused education for nurses directly influenced patient care outcomes [4]. Another study highlighted the complexity of accurately assessing and swiftly managing patients with acute coronary syndrome among emergency nurses, emphasizing that these processes and actions significantly affect the clinical outcomes of patients. It has been suggested that triage-focused education provided to these nurses could be critical for making accurate triage decisions [5].

Triage is a complex process requiring critical thinking regarding patient treatment and care. Triage decision-making can affect patient safety. In a study aimed at exploring the effectiveness of educational support programs to develop clinical decision-making skills for triage among newly graduated nurses, it was discovered that nurses often undertook complex triage tasks without developing critical thinking skills and frequently did not receive educational support. Significant gaps were also identified in a literature review on this topic [6]. Moreover, the importance of triage-focused education for nursing students and graduates is evident. To achieve competence in triage decision-making, undergraduate nursing students and recent graduates must receive sufficient and effective education. To this end, the literature suggests the development and implementation of training programs that foster confidence in triage decision-making [7]. Therefore, in our study, we considered it necessary to address this gap in the literature and emphasized the importance of providing pregraduate triage-focused education within significant emergency services and supporting public health using various teaching methods. A previous study demonstrated a significant positive relationship between triage skills, practice, and experience with triage. This finding supports the notion that such experiences enhance skills and practices, thereby enhancing the quality of patient care in the EDs [4]. Kerie et al. (2017) showed a strong relationship between emergency nurses' experience and triage skills, indicating that learning care guidelines and protocols for trauma patients also demonstrate better skills and care practices [8].

Nursing is a profession that requires cognitive, psychomotor, and behavioral competencies. More recently, the indispensability of simulation applications in healthcare education has been recognized. Simulation-based education particularly benefits the development of adult and pediatric emergency nursing and triage decision-making skills. Therefore, providing education and support for triage decision-making to newly assigned or graduated nurses in EDs is crucial. Simulation training has positive effects on responses to emergency situations, contributing to the development of participants' skills and confidence [9]. Simulation education supports critical thinking and practical skills and increases professional responsibility among nursing students. Simulations provide an opportunity for students to experience preclinical scenarios by creating environments similar to real-life clinical situations. This method promotes critical thinking and decision-making in clinical problem-solving. Simulation-based nursing education creates a safe learning environment that enables learning through educator and peer collaboration without fear of harming patients. It also contributes to the development of knowledge and acquisition of skills, while reducing fear and anxiety related to a lack of experience in clinical practice [10,11].

Triage is pivotal for the successful management of many patients with limited resources. In their study on the effectiveness of hybrid simulations in triage-focused education for nursing students, Uslu et al. (2019) found that students demonstrated the best performance in the yellow triage category. Moreover, their study revealed that students' satisfaction levels, awareness, clinical decision-making, team communication, safety as staff, and skills were enhanced by simulation-based triage-focused education [12]. In a study on the factors influencing triage, the knowledge of nursing students and nurses regarding pediatric triage was addressed, and it was suggested that nursing education programs should include courses that impart proficiency in pediatric triage [13]. Simulation-based education can contribute to the training of more competent graduates, enhance the quality of care, and ensure patient safety. Similar to many other countries, Turkey provides simulation-based nursing education to nursing students. Leading universities and exemplary practices in simulation applications for undergraduate nursing education exist throughout the country. In Turkey, a country that experiences numerous disasters annually, the curriculum covering healthcare services in disaster and emergency aid situations is supported by simulation practices. Under extraordinarily simulated conditions, performance in nursing drills and simulation applications is enhanced, particularly in triage decision-making and patient management [10,14,15].

Triage nurses are expected to make decisions in stressful environments based on limited information and time pressure. Because misguided triage decisions can have adverse effects on patient health, understanding the processes and strategies that triage nurses use to make decisions is an important component of enhancing patient safety [16]. In this context, cognitive continuum theory provides scientific explanations for identifying the modes of reasoning used in triage decision-making. The theory frames and synthesizes triage evidence, scrutinizes decision-making in the literature on emergency nursing, and elucidates its rationale. Decision-making exists along a continuum, with intuitive judgment on one end and scientific thinking (i.e., analysis) on the other. While there is considerable debate surrounding the theory, triage decision-making is predominantly explained by it [7]. Therefore, the design of our study was based on this theory.

The simulation method may enhance the ability of nursing students and newly graduated nurses to greet patients in EDs, assess their conditions, and make appropriate triage decisions. Using simulation methods, nursing students can integrate all the nursing competencies related to the care of critical patients in a safe and realistic environment using simulation methods [17,18]. Improving and integrating education, policies, and protocols for the proper implementation of triage can enhance the quality of emergency care, reduce undesirable outcomes and complications that worsen patient outcomes, and decrease the economic burden on hospitals. Therefore, providing theoretical and practical training to nursing students to ensure their competence in triage after graduation has been recognized. Our study was designed based on the understanding that simulation training facilitates experiential learning and enhances memorability. We aimed to determine the impact of simulation-based education on senior nursing students' knowledge and anxiety levels regarding triage decision-making, as well as the satisfaction level of the group subjected to simulation.

## 2. Methods

### 2.1. Study design

The clinical reasoning model provided a theoretical foundation for our simulation intervention. The model proposes eight steps:

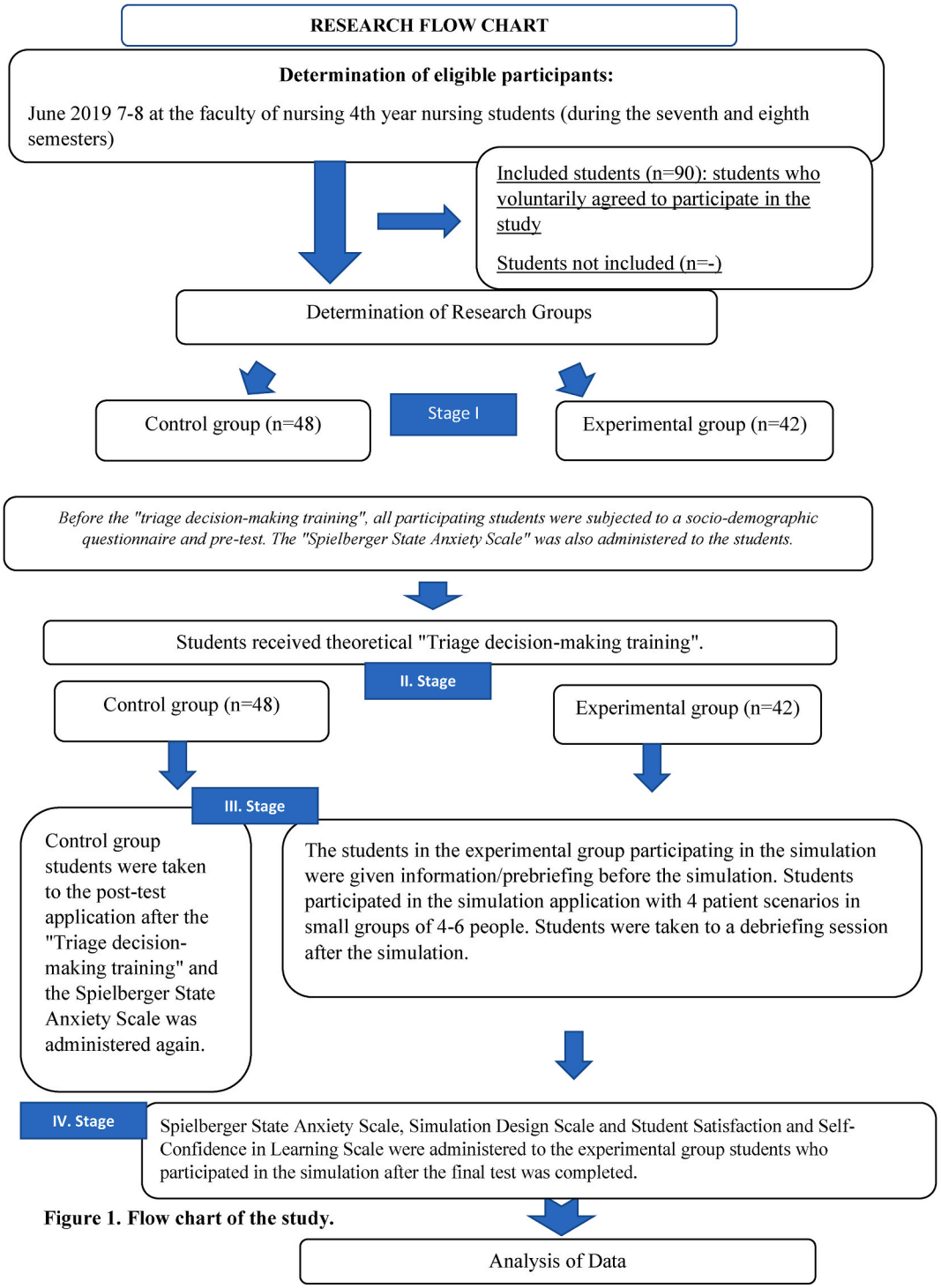


**Figure 1. Flow chart of the study.**

**Fig. 1.** Flow chart of the study.

noticing, collecting, processing, decision-making, planning, acting, evaluating, and reflecting [19]. We performed a quasi-experimental study following a two-group pre- and posttest design in which a pretest and posttest were administered to students in the control and simulation groups before and after triage decision-making training. The Simulation Research Rubric and guidelines for reporting simulation-based research were followed to conduct and report our study [20,21], and a computer lottery was used to assign fourth-year undergraduate students to experimental or control group. The research flowchart is presented in Fig. 1.

### 2.2. Participants and setting

The study population comprised fourth-year students from the Gulhane Faculty of Nursing at the University of Health Sciences in Ankara, Turkey, between September 2018 and June 2019. In general, the nursing students completed eight semesters of education. During the second year, they took a theoretical course on triage within the scope of the First Aid and Emergency Nursing course. During their final year, they participated in training in the adult and pediatric ED.

Fourth-year volunteer nursing students who received training in adult and pediatric ED during the seventh and eighth semesters were included in our study. Power analysis was performed using the G*Power software package, and the effect size was found to be 2.04. Accordingly, with 90 participants (48 in the control group and 42 in the simulation group), the power of the study was calculated to be 100 % at a significance level of 0.05 with an effect size of 2.04. Simple randomization was applied to determine the number of students to be included in the control and intervention groups, who were selected by drawing lots.

### 2.3. Intervention

The students included in the study received emergency triage training as part of their First Aid and Emergency Nursing courses during their second year of study. During their fourth-year internship, they participated in emergency clinical rotations (adult and pediatric emergency) as part of their clinical practice. The participants in both the simulation and control groups underwent triage decision-making training. We prepared the content of the training in line with the literature, and expert feedback was received from two academic nurses working in the triage field and an emergency medical specialist. Prior to training, the participants were informed about the aim and content of the study, and their consent was obtained. Face-to-face training was conducted in two sessions in a faculty classroom. During the first session, participants attended a 45-min PowerPoint presentation titled 'Correct Triage in ED' on the definition and history of triage, aims of triage in EDs, roles of nurses in triage, and the Emergency Severity Index (ESI) algorithm. The second 45-min session included a presentation of triage case studies, a discussion, and a question-and-answer session for brainstorming and learning how to accurately assign ESI scores. Feedback was provided at the end of the second session (see Table 1–A).

After training, the simulation application phase was initiated. The number of students in each simulation session ranged from four to six and nine teams were formed. They evaluated scenarios in a realistically arranged ED patient room and assigned triage codes. Initially, the first student team (i.e., 4–6 individuals) began with Scenario 1, followed by the sequential execution of the other three scenarios. The remaining eight teams performed the same procedure in a similar manner. In a realistically arranged emergency patient room, the students simulated Scenarios 1 and 2 using a high-reality patient simulator and Scenarios 3 and 4 using a standard patient, and provided the appropriate triage code to the patient. This allowed students to evaluate patients, make judgments, and experience triage decision-making in a realistic emergency room environment. Students developed clinical reasoning skills to make decisions during the simulation and had the opportunity to integrate prior knowledge and triage principles.

Participants in the intervention group received simulation-based triage training in the certified Clinical Simulation Training Laboratory in the Gulhane Faculty of Nursing (see Table 1–A). The laboratory hosts high- and low-fidelity patient simulators along with a virtual patient simulator as well as realistic hospital equipment and supplies. In rooms where high-fidelity patient simulators are located, there is a control room equipped with computers and tablets that allow parameters to be adjusted according to facilitative scenarios, thereby ensuring that the patient provides realistic verbal responses.

The laboratory provided high-fidelity patient simulators, equipment, and software. The parameters for the scenarios were adjusted in a control room. During the simulation-based training, four triage decision-making simulations were performed in accordance with the ESI. The researchers who provided the training possessed simulation trainer certificates. The content and process of the simulation training were reviewed by an expert panel consisting of a simulation expert, an emergency nurse, two experts in the fields of nursing fundamentals and pediatric nursing, and a professor of emergency medicine. The panel does not suggest any revisions. Using a guideline, participants were informed about the training during the pre-briefing meeting; an example of a pre-briefing guideline is given in Table 1–B [22]. Next, the following four scenarios were simulated using the ESI.

- Scenario 1: A patient is admitted to the ED with chest pain, weakness, and possible diagnosis of acute myocardial infarction
- Scenario 2: A patient is admitted to the ED with nausea, vomiting, and a diagnosis of hypertension.
- Scenario 3: A 14-year-old child is admitted to the ED with earache.
- Scenario 4: A 17-year-old adolescent patient presents with injuries from a non-vehicle traffic accident, particularly a comminuted fracture of the fibula and tibia of the right lower leg.

Groups of 4–6 students evaluated each scenario for 5–10 min and assigned an ESI score to each scenario. At the end of the scenario, participants were asked to share their experiences using the share–explore–notice–support–extend, or SENSE, debriefing model developed by Ko and Choi (2020). In the share phase, learners share the events and emotions of the simulation practice, and the instructor encourages them to fully disclose their feelings and simulation events. In the exploration phase, learners analyze the causes

of difficulty with the situation or emotion in the simulation exercise. In the notice phase, the instructor assesses the learner's level of education and negative emotions, including extreme stress or anxiety, and notes any necessary help or intervention. In the support phase, the instructor encourages students' learning achievements, offers educational direction, and guides them through emotional relaxation therapy, including deep breathing and maintaining a healthy lifestyle to reduce stress and anxiety. Finally, the extended phase aids students in extensively applying their newfound knowledge and experiences to future simulation exercises and clinical practice [23].

### 2.4. Instruments

A personal information form addressing the age and sex of the participants, a triage decision-making knowledge test, the Simulation Design Scale (SDS), the Student Satisfaction and Self-Confidence in Learning Scale (SCLS), and the State–Trait Anxiety Inventory (STAI), specifically the State Subscale (STAI-S), were used for data collection. The triage decision-making knowledge test and STAI-S were administered to both groups as a pretest and posttest, whereas the SDS and SCLS were administered to the simulation group only.

#### 2.4.1. Triage decision-making knowledge test

The test consisted of 15 questions (9 multiple-choice questions and 6 fill-in-the-blank questions) covering the responsibilities of triage nurses, initial actions to be taken in the ED, ESI, and assignment of ESI scores. The pre- and post-triage decision-making tests comprised 10 questions each on the objectives of triage conducted in the ED, the responsibilities of triage nurses, the triage color code for adult and pediatric cases, the first action of the nurse in a triage case arriving at the ED, the assignment of an ESI triage code to each case, questions related to the ESI, a question about the start of the triage system, and life-saving interventions in emergencies. Each correct answer on the test was awarded 1 point, whereas incorrect answers received 0 points. The total score was calculated based on the correct answers, such that individuals who answered all questions correctly received 15 points, whereas those who did not answer any questions correctly received 0 points.

#### 2.4.2. State–Trait Anxiety Inventory-state (STAI-S)

The STAI-S, a subscale of the STAI developed by Spielberg et al. (1964) to measure state of anxiety levels, was adapted into Turkish by Oner and Le Compte (1983). The items of the STAI-S gauge feelings or behaviors according to intensity on a 4-point scale [1]: *not at all* [2], *somewhat* [3], *very much*, and [4] *completely*. The STAI-S has 10 reverse-scored items (items 1, 2, 5, 8, 10, 11, 15, 16, 19, and 20), and the subscale's total score is calculated by adding 50 points to the difference between the total weighted scores of the directly scored and reverse-scored items. The STAI-S scores range from 20 to 80 points, with scores below <36 indicating no anxiety, scores between 37 and 42 indicating mild anxiety, and scores of 42 and above indicating high anxiety. In a reliability study conducted by Oner and Le Compte, Cronbach's α of the STAI-S ranged between 0.94 and 0.96, a high reliability coefficient indicating the STAI-S's reliability [24]. In our study, Cronbach's α of the STAI-S was 0.91.

#### 2.4.3. Simulation Design Scale (SDS)

The SDS, developed by Jeffries and Rizzolo (2006) to assess simulation models, is a 20-item instrument. The design features rated by students are goals and information (five items), student support (four items), problem-solving (five items), guided reflection or feedback (four items), and fidelity (two items). Responses are rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), with higher scores indicating greater recognition of design features in the simulation. A validity and reliability study of the SDS was conducted by Unver et al. (2017), and Cronbach's α of the scale has been reported to be 0.92 [25–27]. In our study, Cronbach's α of the SDS was 0.95.

#### 2.4.4. Student Satisfaction and Self-Confidence in Learning Scale (SCLS)

The SCLS, published by the National League for Nursing, was validated and its reliability assessed by Unver et al. (2017) [27]. The scale consists of two subscales, Satisfaction in Learning and Confidence in Learning, each comprising 5 and 7 items, respectively, for a total of 12 items. The SCLS items are rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's α values of the scale range from 0.77 to 0.85 [26,27]; however, in our study, Cronbach's α was 0.95.

### 2.5. Data analysis

SPSS version 28.0 was used for data analysis. Descriptive data are presented as frequencies, percentages, means, and standard deviations. The skewness and kurtosis coefficients of numerical variables were examined for assumptions of normality across groups, and because the coefficients fell within the range of ±1.5, thereby indicating the normal distribution of the variables, we applied parametric statistical methods. The relationships between two independent categorical variables were interpreted using chi-square analysis. Differences between two independent groups were examined using the independent samples *t*-test, and differences between two dependent numerical variables were analyzed using the dependent samples *T* test. Finally, Pearson's correlation coefficient was used to explore the relationship between two independent numerical variables. Statistical significance was set at $p < 0.05$.

### 2.6. Ethical considerations

This study was approved by the University of Health Sciences Gulhane Scientific Research Ethics Committee (approval number:

2019/08–19/188), and written permission was obtained from the faculty of nursing to conduct the study. This study was conducted in accordance with the principles of the Declaration of Helsinki. All participants were informed of the purpose of the study, and their written informed consent was obtained. Participation was voluntary and uncompensated. Participant anonymity was maintained throughout the study. Data were stored on an encrypted computer.

## 3. Results

The control and simulation groups included 48 students aged 21.77 ± 0.47 years and 42 aged 21.1 ± 0.53 years, 77.1 % and 95.3 % of whom were women, respectively. The control group and 95.3 % of the intervention group were aware of the definition of triage (These are findings not given in the table).

Table 2 presents the intergroup and intragroup comparisons of the pre- and posttest scores obtained by the control and simulation groups on the triage decision-making knowledge test and STAI-S. Independent samples *t* tests revealed no significant differences between the groups in the pretest STAI-S ($t^a = -1.107, p = 0.271$), posttest STAI-S ($t^a = -0.599, p = 0.551$), or pretest triage decision-making knowledge test scores ($t^a = -0.167, p = 0.868$). However, significant differences in posttest triage decision-making knowledge test scores were observed between the groups ($t^a = -2.218, p = 0.029$), thereby indicating that the simulation group had significantly higher posttest scores than the control group. Dependent samples *t* tests revealed no significant differences within the control group between pretest and posttest STAI-S ($t^b = 0.170, p = 0.340$) and triage decision-making knowledge test scores ($t^b = -0.898, p = 0.374$). However, in the simulation group, significant differences were found between pretest and posttest STAI-S scores ($t^b = 2.020$, $p = 0.049$), as well as in triage decision-making knowledge test scores ($t^b = -3.630, p < 0.001$), thereby indicating that individuals in the simulation group experienced a significant decrease in STAI-S and a significant increase in triage decision-making knowledge test scores from pretest to posttest.

Table 3 compares the SCLS and SDS scores in the simulation group, all of which were greater than moderate. Table 4 lists the ESI scores of the nine simulation groups for the four scenarios. Finally, Table 5 presents the distribution of the simulation group's correct and incorrect responses on the ESI in the four scenarios; the percentages of correct answers for Scenarios 1, 2, 3, and 4 were 66.7 %, 88.9 %, 22.2 %, and 55.5 %, respectively.

## 4. Discussion

This study aimed to determine the effects of simulation-based education on triage decision-making and anxiety among senior nursing students participating in emergency internships. A significant difference was found between triage decision-making knowledge and anxiety scores in the control and simulation groups before and after triage decision-making education. The intervention group's triage decision-making knowledge test scores increased and their anxiety levels decreased significantly after receiving simulation-based triage-focused education. Consistent with our findings, Hu et al. (2021) evaluated the effectiveness of simulation-based, triage-focused education on nursing students' clinical judgment and found that students achieved better reasoning skills in simulation-based education than in a lecture-based triage-focused education program [3]. In another study employing an experimental design, both experimental and control groups of nursing students underwent pretest and posttest assessments using the triage decision-making inventory, and students who completed both the Advanced Cardiac Life Support course and simulation education had higher scores in triage decision-making than other groups. Enhancing nursing education by integrating technology has been reported to increase experience and confidence in triage decision-making during emergency care [7].

Mohan et al. (2017) compared the effectiveness of an educational video game with that of traditional educational methods in enhancing triage decision-making for trauma and discovered that exposure to a theoretically grounded video game improved triage decision-making among physicians [28]. Similarly, Dubovsky et al. (2017) tasked 10 ED triage nurses experienced in conducting triage using ESI and found that computerized simulation served as a reasonably accurate proxy for ED triage knowledge level [29]. Farahmand et al. (2017) employed artificial intelligence-based triage to predict ESI levels and demonstrated the usefulness of AI in triage [30]. Simulations used in emergency nursing represent a satisfactory instructional approach that enhances the accuracy of triage-related decisions in emergency scenarios and fosters nurses' self-confidence and skills [9]. While examining the effects of simulation practices on nursing students' emergency case management skills, Topbas et al. (2021) recorded their performance in

**Table 1A**
Content of TDM and simulation-based triage training.

| Training | Content | Duration |
|---|---|---|
| **TDM training** | Introduction | 45 |
| | Definition and history of triage | |
| | Aims of triage in EDs | |
| | ESI algorithm | |
| | Triage case studies | 45 |
| | Discussion and Q&A | |
| **Simulation-based triage training** | **Prebriefing** on scenarios and the steps training | 30 |
| | **Scenario play**: 4 scenarios were simulated using ESI. Groups of 4–6 students evaluated each scenario for 5–10 min and assigned ESI score | 45 |
| | **Debriefing** for sharing experiences using SENSE model | 30 |

**Table 1B**
Pre-briefing guideline example.

| | | |
|---|---|---|
| General information | Name: | Ayse Onal A.O. |
| | Gender: | Female Age: 57 |
| | Height: | 160 cm Weight: 70 kg |
| | Diagnosis: | AMI, Hypertension, CAD, COPD |
| | Reason of admission: | Chest pain, weakness |
| Nursing interventions | A.O., 57 years old, was admitted to ED on 24.04.2019 with complaints of chest pain and weakness. About a week ago, she visited the ED due to same reasons, was diagnosed with AMI and transferred to cardiology clinic. Cardiac arrest occurred during angiography. The patient visited the ED with pain in midline of the chest for the last 2 days. Welcome the patient and carry out the following nursing orders for 15 min:<br>Is the patient dying?<br>Is this a patient that cannot wait?<br>How many resources does this patient need in the ED? The nurse decides upon these resources by taking the following questions into consideration:<br>1. What are the procedures to be performed in the ED?<br>2. How long may this patient occupy the emergency room?<br>What are patient's vital signs? Vital signs are used to evaluate the followings:<br>1. Urgent life-saving intervention is needed<br>2. The patient should be taken to the examination room and the intervention should start within 10 min<br>Within the scope of ESI, the nurse performs the followings:<br>1. Applies therapeutic communication skills<br>2. Establishes trust with the patient<br>3. Assesses patient's levels of pain and anxiety<br>4. Provides psychological support to the patient | |

CAD: coronary artery disease, COPD: Chronic obstructive pulmonary disease, AMI: acute myocardial infarction.

**Table 2**
Intergroup and intragroup comparison of pretest and posttest scores obtained from the TDM knowledge test and STAI-S.

| | Control (n = 48) | | Simulation (n = 42) | | $t^a$ | p |
|---|---|---|---|---|---|---|
| | Mean ± SD | Median (Min-Max) | Mean ± SD | Median (Min-Max) | | |
| STAI-S | | | | | | |
| Pretest | 34.62 ± 11.06 | 32(20–56) | 36.74 ± 6.92 | 35(22–48) | −1.107 | 0.271 |
| Posttest | 32.79 ± 11.35 | 31(20–69) | 34.00 ± 7.53 | 33(20–50) | −0.599 | 0.551 |
| $t^b$; p | 0.170; 0.340 | | 2.020;**0.049*** | | | |
| **TDM Knowledge** | | | | | | |
| Pretest | 10.58 ± 2.31 | 11(5–14) | 10.65 ± 1.53 | 11(6–13) | −0.167 | 0.868 |
| Posttest | 10.92 ± 2.27 | 11(6–15) | 11.86 ± 1.75 | 12(5–15) | −2.218 | **0.029*** |
| $t^b$;p | −0.898; 0.374 | | −3.630;**<0.001*** | | | |

$t^a$: Independent sample *t*-test, $t^b$: dependent sample *t*-test, *: $p < .05$.

**Table 3**
Comparison of SCLS and SDS scores of the simulation group (n = 42).

| | Mean | SD | Median | Min | Max |
|---|---|---|---|---|---|
| SCLS | 4.19 | 0.51 | 4.04 | 3 | 5 |
| Satisfaction with current learning | 4.19 | 0.56 | 4.00 | 3 | 5 |
| Self-confidence in learning | 4.19 | 0.53 | 4.00 | 3 | 5 |
| SDS Total | 4.28 | 0.50 | 4.20 | 3 | 5 |
| Objectives/information | 4.32 | 0.56 | 4.20 | 3 | 5 |
| Support | 4.17 | 0.57 | 4.00 | 2.75 | 5 |
| Problem solving | 4.32 | 0.53 | 4.00 | 3 | 5 |
| Feedback | 4.33 | 0.57 | 4.25 | 3 | 5 |
| Fidelity | 4.27 | 0.72 | 4.25 | 2.5 | 5 |

emergency case scenarios and found that their self-efficacy and knowledge levels increased after they had participated in emergency case scenarios [31]. Altogether, these studies suggest that simulation-based education in triage decision-making has a positive impact on learning outcomes. The practical significance of these results for nursing practice is evident. The observed improvements in simulation-based education particularly benefit patient care in emergency situations because EDs are among the most critical sections of hospitals in which healthcare workers' coping skills and knowledge are paramount. Numerous training and simulation programs have been and are being conducted [32].

In another study, the use of creative teaching strategies such as simulation to teach cardiopulmonary resuscitation gained popularity. The impact of advanced cardiac life support simulation training on nursing students' self-efficacy, attitudes, and anxieties was also evaluated, and the simulation application was found to be an effective educational strategy among nursing students, one that

**Table 4**
Distribution of the ESI scores of the simulation groups obtained from the four scenarios (n = 42).

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| Group 1 (4 students) | **2** | **4** | **4** | **2** |
| Group 2 (4 students) | **2** | **4** | **4** | **2** |
| Group 3 (6 students) | **2** | **4** | **5** | **1** |
| Group 4 (6 students) | **1** | **4** | **3** | **1** |
| Group 5 (6 students) | **2** | **3** | **5** | **2** |
| Group 6 (4 students) | **3** | **4** | **5** | **2** |
| Group 7 (4 students) | **2** | **4** | **5** | **1** |
| Group 8 (4 students) | **2** | **4** | **5** | **1** |
| Group 9 (4 students) | **1** | **4** | **5** | **2** |

**Table 5**
Distribution of the ESI scores of the simulation group according to four scenarios (n = 9).

| | Correct | | Wrong | |
|---|---|---|---|---|
| | n | % | n | % |
| Scenario 1 | 6 | 66.7 % | 3 | 33.3 % |
| Scenario 2 | 8 | 88.9 % | 1 | 11.1 % |
| Scenario 3 | 2 | 22.2 % | 7 | 77.8 % |
| Scenario 4 | 5 | 55.5 % | 4 | 44.5 % |

improved their self-efficacy and attitudes and reduced their anxiety [33]. The results of our study showed a positive effect of simulation-based training, which is consistent with the findings reported in the literature. Because a triage nurse is the first point of contact with patients needing emergency care, having knowledge and experience is crucial. Moreover, triage begins upon entry into the ED, but continues to require re-evaluation as the patient waits for appropriate care at a reliable and safe level or moves elsewhere within the system. Continuously performing care underscores the importance of adequate knowledge, skills, and expertise in triage nurses. In contrast, a lack of triage knowledge and skills can lead to service inconsistencies. Appropriate and timely in-service training is essential to optimize triage performance in EDs, including skills workshops to teach triage assessment and documentation standards, thereby ensuring that new staff are adequately trained and experienced staff refresh their knowledge and skills [34]. In another study examining how nursing experience in the ED affects triage decision-making, nursing experience was found to be a significant factor, even when highly structured tools such as ESI were used. Therefore, in future studies, it would be beneficial to examine not only nurses' experience but also their education (e.g., training, especially triage-specific training) and their impact on triage decision-making [35]. The development of triage decision-making skills can be facilitated via simulations using techniques such as thinking aloud and reflective practice. In practice, nurses can experience the decision-making processes through simulations developed using real triage cases. Simulation training may not only expedite the acquisition of operational knowledge for newly graduated ED nurses but also reduce the time needed to acquire the skills required to perform tasks essential to emergency care [36].

In this context, we found that the intervention group exhibited increased knowledge of triage decision-making and decreased anxiety following the simulation. These findings suggest that simulations using techniques such as thinking aloud foster critical thinking and decision-making skills, thereby enhancing students' triage decision-making abilities. Simulations are also believed to be beneficial for acquiring sufficient knowledge, skills, and expertise in emergency nursing before graduation. Emergency nurses must make rapid triage-related decisions based on their knowledge and experience. Clinical educators and experienced emergency nurse mentors also believe that nurses should be trained in ED patient triage. Triage simulations developed from real triage cases may enable nurses to experience the decision-making process [36]. In our study, students in the simulation group scored above average on the SCLS and the subdimensions of the SDS, and their scores on these instruments showed a significant moderate positive relationship. Similarly, Erdem (2018) analyzed the effects of simulation-based learning on the development of skills in inserting peripheral intravenous catheters, and found that the SCLS scores of the intervention group were more than moderate, whereas scores obtained from the Best Design Elements subscale of the SDS indicated the positive effects of simulation-based learning on those skills [37].

To prepare for working in real-world clinical settings, nursing students can benefit from simulation practices in laboratory environments, especially with regard to triage decision-making skills and anxiety levels. In this context, training future professional nurses who are proficient in the core competencies of the profession and can cope with these complex environments will also be beneficial. In a study examining nursing students' satisfaction and anxiety levels during clinical education, students were highly satisfied with their clinical education in hospital settings and experienced mild anxiety. The need to develop strategies to enhance the effectiveness of clinical education environments was also emphasized, as was the importance of student participation in pre-graduation laboratory training [38]**.** In this context, simulation training conducted in a laboratory environment before clinical practice supports students in overcoming their fears and becoming more aware and courageous in preparation for clinical placement. In a study investigating the experiences of final-year nursing students during their placement in emergency and intensive care units, students experienced intense emotions, enhanced their learning in complex environments, and learned the humane aspects of care while developing new attitudes [39]. Simulation and virtual reality-based training programs in real clinical settings have been reported to enhance nurses' performance in hospital triage as well [32]. Training in emergency nursing and triage is important for acquiring pregraduate emergency

nursing competencies and enhancing postgraduate knowledge and skills.

The triage systems used in EDs typically have three or five levels. The ESI is a five-level triage system developed by a group of physicians and nurses in the mid-1990s in the United States to categorize patients based on clinical needs. It has been successfully adopted by an increasing number of hospitals in the United States and some European countries. In ESI, the triage nurse decides which patients should be examined first and how long each patient can wait safely. As such, this system, which can be applied within a short timeframe, differs from complaint-based classification methods. A patient's treatment priority and ESI level are classified from levels 1 to 5 according to the severity of the patient's status and resource requirements. ESI is a highly accurate and effective triage system for predicting patient outcomes [40]. Therefore, we used ESI as the triage system in our study. Simulation groups consisting of four to six students participated in simulations that were designed with scenarios; on average, 58.3 % of the participants provided correct answers to the scenarios under the guidance of the ESI triage decision-making scale. Consistent with the results of the study, it was also found in a study by Jordi et al. in which 69 triage nurses assigned an ESI score to each of 30 standard ESI teaching case scenarios, that they scored 59.6 % of the case scenarios correctly and 78 % felt confident in their ability to apply the ESI [41].

The results of our study provide fundamental data for researchers seeking to develop new methods to enhance emergency nursing and triage decision-making, knowledge, and skills among nursing students. Different educational methods and simulation practices aimed at increasing pregraduate knowledge, skills, and applications in emergency nursing and triage should be investigated along with their impact on nursing education and associated factors. It is also recommended that new experimental studies be conducted on both adult and child triage with large sample groups. Multicenter research or improvements can be realized using different samples of students to develop simulation-based triage-focused education for nursing students. Simulation-based, triage-focused education involving multiple patient scenarios for emergency nursing students has been found to enhance knowledge and clinical judgment abilities while reducing anxiety levels. In this context, students have the opportunity to recall and integrate their previous knowledge and principles of triage during simulations. To enhance simulation-based triage decision-making education for nursing students, adequate facilities should be provided in nursing simulation laboratories, integration into nursing curricula should be ensured, and more time should be allocated to such training. These changes in educational methods will allow the training of more competent graduates, improve the quality of care, and ensure patient safety.

Future research in this field should expand its scope. Studies should be conducted on topics such as triage time stages and resource optimization within simulation-based triage practices in nursing education. Moreover, simulation training sessions involving emergency case assessment and triage practices can be planned for medical students from different disciplines to enhance their understanding of emergency medical team training. Training environments in which the interdisciplinary spirit of the emergency team is developed and emergency medicine and nursing knowledge are continually updated will be beneficial for ensuring pregraduate competencies.

### *4.1. Strengths and limitations*

In our study, the integration of traditional teaching methods with simulation-based education enhanced nursing students' triage decision-making skills. Students experienced a positive adaptation process in acquiring triage knowledge and skills through clinical simulation-based case studies. During the simulation, students had the opportunity to develop their clinical reasoning skills and integrate preexisting knowledge and principles regarding triage decision-making. While past studies aimed at improving safe triage practices have enabled students to understand what is necessary in triage during emergency situations and to reinforce their knowledge through critical thinking, our study has revealed ways to enhance students' knowledge, skills, and awareness regarding triage decision-making.

In addition to its strengths, our study has some limitations. In our study, it could not be guaranteed that students' enhanced clinical reasoning abilities would be sustained over time immediately after the simulation intervention, because follow-up measurements over time were not taken. Moreover, the study was conducted at a single center, and students' triage decision-making and evaluation performance were assessed in a small sample using an experimental method and the ESI index. Therefore, the results may not be generalizable across fields. In response, more repeated measurements and observations of clinical practice are needed to evaluate improvements in triage-focused education among nursing students. Therefore, in the future, more studies with larger sample sizes should be conducted to evaluate patient triage at all levels and monitor reflections in the clinical environment.

### *4.2. Implications for practice*

Simulation education in triage decision-making and critical thinking should be integrated into undergraduate nursing education programs, especially those focused on triage coding and managing adult and pediatric emergency patients. Simulation applications currently play a significant role in nursing education as an effective way to improve patient outcomes and the quality of care. Such simulation training can be enhanced by presenting cases with different triage codes (e.g., severity of illness) in more realistic simulated environments with larger samples. Simulation-based emergency triage training would also be beneficial for newly hired and newly graduated nurses working in EDs, as they work to gain competence and positively influence patient outcomes.

## 5. Conclusion

The study results showed that students who completed simulation education in triage decision-making had increased levels of triage decision-making knowledge and decreased levels of anxiety. Moreover, the integration of traditional theoretical education with

simulation-based education was effective in teaching emergency triage decision-making skills to nursing students. Students experienced a positive adaptation process in learning about emergency triage through clinical simulation-based case studies and had better opportunities to learn the subject matter through simulation training designed to closely resemble reality.

## Data availability statement

The data given in this work has not been publicly archived owing to privacy concerns. The data that support the findings of this study are available from the corresponding author on reasonable request.

## Ethics statement

This study was reviewed and approved by University of Health Sciences Gulhane Scientific Research Ethics Committee, with the approval number: [No. 2019/08–19/188]. All participants provided informed consent to participate in the study.

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## CRediT authorship contribution statement

**Oznur Kavakli:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Dilek Konukbay:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Formal analysis, Data curation, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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