

High-fidelity simulation for the education of nursing students: a scoping review of the literature

La simulazione ad alta fedeltà per la formazione degli studenti di infermieristica: una scoping review della letteratura

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ABSTRACT

BACKGROUND: High-fidelity simulation can be defined as a technique to refine specific human performance in a protected environment, and thanks to the innovation of technologies it has been possible to obtain increasingly realistic performances. The aim of this study is to map and describe the effects of training through a high-fidelity simulation method on the technical and non-technical skills of nursing students in an emergency setting.

METHODS: A scoping review was chosen as research methodology within some main databases of biomedical interest: MEDLINE, Scopus, CINAHL, PsycINFO, Academic Search Index, Science Citation Index and ERIC.

RESULTS: 530 articles were selected. Of these, 21 met the inclusion criteria and underwent the review process. Participants undergoing the intervention demonstrated better skills than the control group when subjected to a simulation based on realistic scenarios. The selected articles can be divided into two categories: those that focus essentially on non-technical skills and those that study only technical skills.

CONCLUSION: Evidence suggests that HFS should include feedback, briefing and debriefing; it should be applied in every area of nursing education; student self-efficacy, confidence and competence are key principles to consider when measuring the effect of a simulation environment.

KEYWORDS: Nursing students; High-fidelity simulation; Emergency; Technical Skills; Non-technical skills.

RIASSUNTO

BACKGROUND: La simulazione ad alta fedeltà può essere definita come una tecnica per affinare specifiche prestazioni umane in un ambiente protetto e, grazie all'innovazione delle tecnologie simulate è stato possibile ottenere prestazioni sempre più realistiche. Lo scopo di questo studio è quello di mappare e descrivere gli effetti della simulazione ad alta fedeltà nella formazione universitaria infermieristica sulle abilità tecniche e non tecniche degli studenti in un contesto di emergenza/area critica.

METODO: La metodologia di revisione scelta è stata una scoping review all'interno dei più importanti database di interesse biomedico: MEDLINE, Scopus, CINAHL, PsycINFO, Academic Search Index, Science Citation Index and ERIC.

RISULTATI: Sono stati selezionati 530 articoli. Di questi, 21 hanno soddisfatto i criteri di inclusione e sono stati sottoposti al processo di revisione. I partecipanti che hanno ricevuto l'intervento hanno dimostrato abilità migliori rispetto al gruppo di controllo quando sottoposti ad una simulazione basata su scenari realistici. Gli articoli selezionati, inoltre, possono essere suddivisi in due categorie: quelli che si concentrano essenzialmente sulle non-technical skills e quelli che studiano solo le technical skills.

CONCLUSIONI: I risultati suggeriscono che l'HFS (High-Fidelity Simulation) dovrebbe includere feedback, briefing e debriefing degli scenari; dovrebbe essere applicato in ogni area della formazione infermieristica; l'autoefficacia, la fiducia e le conoscenze dello studente sono principi chiave da considerare quando si vuole misurare l'effetto di un ambiente di simulazione.

PAROLE CHIAVE: Nursing students; High-fidelity simulation; Emergency; Technical Skills; Non-technical skills.

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INTRODUCTION

Simulation has always been part of medical training: simple simulation techniques have been used since the earliest times (for example, teaching how to give bad news was accomplished by talking to colleagues and even performing surgery on cadavers), but interest has grown when particular attention was paid to patient safety in relation to the performance of healthcare professionals. The simulation mimics reality and replicates some aspects of the working environment. It can be defined as a technique to refine specific human performance in a protected environment, and thanks to the innovation of technologies it has been possible to obtain increasingly realistic performances.

High fidelity refers to the dummy's high sense of reality reproduction and faithful responses to student actions. The studies on the effectiveness of simulation activities when they are used instead of clinical experiences are varied. A 2018 systematic review revealed a gap in the literature on the efficacy of High-Fidelity Patient Simulation (HFPS). As regards the available tests, HFPS is particularly useful for the training of non-technical skills (Zhang et al., 2018). The review identified two specific themes: a) the use of simulation for clinical performance and b) the use of simulation in assessing self-confidence and perceived competence. Active learning experiences, such as simulation, facilitate the development of cognitive skills and knowledge, which can be assessed using multiple choice tests (Morrell et al., 2019). Tawalbeh and Tubaishat (2014) conducted a randomized controlled study with a pre- and posttest design to determine the differences in knowledge of Advanced Cardiac Life Support (ACLS) between a control group that received a lecture with demonstration, and an experimental group who received a lesson with demonstration and a practical lesson in simulation. The experimental group ($n = 40$) demonstrated significantly higher post-test scores ($p < 0.001$) than the control group ($n = 42$) (Tawalbeh & Tubaishat, 2014).

Using HFS with debriefing has become a critical component in nursing education and training to meet advances in nursing responsibilities, practice and standards of professional performance. The literature argues that debriefing is an integral component of simulation learning experiences as it allows students to reflect on their actions and how they have affected the overall care provided (Al-Ghareeb et al., 2019).

Training in the critical area and emergencies for healthcare professionals focuses on the incremental development of psychomotor and critical thinking skills to allow an effective assessment of the patient and the implementation of any resuscitation maneuvers. However, busy healthcare professionals do not always recognize when a patient's clinical condition begins to deteriorate. It was observed in a study that some healthcare professionals have difficulty initiating treatment and obtaining assistance, which is crucial in situations where early intervention is linked to better patient outcomes (Alhaj Ali et al., 2020). While developing psychomotor skills for life support practices may be simple, critical thinking and responding to such a scenario can be more

challenging. This can be attributed, in part, to the unpredictability and stressful nature of real-life clinical-critical situations. However, both the cognitive and psychomotor domains need to be effectively engaged for skills development. Simulation also has the potential to take a constructivist epistemological approach to learning, particularly when it incorporates past learning and experiences that allow students to develop their knowledge and skills and focuses on prioritizing, teamwork and effective communication (Baker et al., 2015 & Bogossian et al., 2014). Moreover, it offers interactive clinical learning to (a) assess the patient's critical parameters through observation and communication, (b) plan appropriate interventions based on different simulation scenarios, (c) intervene to stabilize the situation and (d) assess the patient's condition (Cook et al., 2012 & Filomeno et al., 2020). Debriefing after each simulation scenario allowed integration of teaching and focused on student-centered concerns, interests and areas for improvement. Systematic reviews have shown that well-integrated simulation with a focus on feedback and debriefing, facilitates the learning of both technical and non-technical skills in medical education (Cooper et al., 2015; Coppens et al., 2018 & Donovan et al., 2018). Non-technical skills are cognitive, social and personal resource skills that complement technical skills and contribute to safe and efficient assistance (Lewis et al., 2012).

Simulation offers opportunities to develop assessment, critical thinking, problem solving, collaboration and decision-making skills while maintaining patient safety. It can be even better than traditional clinical training because learning is acquired through personal experience followed by structured debriefing, reflection and discussion. University teaching programs that embrace innovation as a strategic component of curriculum development are likely to expand student experience and satisfaction. As these methods continue to form, nursing faculties must work strategically to apply a student-centered model that addresses the course objectives while engaging it through active participation. Results from previous studies have indicated that education that focuses too much on theory leads to a lack of self-confidence for recent graduate nurses (Fawaz & Hamdan-Mansour, 2016 & Endacott et al., 2010). Simulation training not only results in more self-efficacy, but also stimulates insights into the technical skills that are needed in complex situations and improves clinical reasoning processes, prioritization and teamwork (Eikeland Husebø et al., 2012). David Kolb's theory of experiential learning requires the student to be actively involved and reflect during and after the experience (Kolb, 2014).

In the context of simulation, experiential learning is "particularly adaptable to adult learners; it gives the opportunity to see the real consequences of one's actions". Kolb's theory provides a framework for simulation where students can apply their knowledge to a simulated patient within a safe environment, which leads to better knowledge acquisition. Students' use of reflective thinking after a live experience, both clinical and simulated, should lead to improved critical thinking, greater satisfaction and, in the long run, better patient care. One study stated that simu-

lation as a teaching strategy incorporates two of the seven principles for good practice in college education: active learning and rapid feedback, both of which can improve learning and ultimately its satisfaction (Reime et al., 2017).

One of the pedagogues who have focused on learning through experience is John Dewey, who accuses the traditional school of turning students into passive listeners. Hence the enhancement of manual work, not as an introduction to the professions, but as an education in the discipline, sociality and planning required by laboratory activities. The student is placed at the center of the teaching-learning process and the importance of laboratory activities is emphasized, which should concern all disciplines, precisely because true learning is made up not only of knowledge, but of skills and competences that must therefore be promoted through various didactic strategies.

This study was conducted with the aim of mapping and describing the effects of training through a high-fidelity simulation method on the technical and non-technical skills of nursing students in a critical area and emergency management setting.

Seven Non-Technical Skills are identified in the literature, which can be outlined and summarized as follows:

- situational awareness: ability to collect information and interpret it correctly; this competence, also characterized by the ability to anticipate possible future scenarios, is an indispensable prerequisite for safety in complex and dynamic environments and, not surprisingly, is indicated as a causal factor in numerous accidents;
- decision-making: ability to adequately define problems, to consider the various options and to select and implement the latter;
- communication: ability that involves sending and exchanging clear and concise information, receiving such information, listening and identifying what may be the "barriers" of the communication process;
- teamwork: characterized by the ability to support collaborators/colleagues, to resolve possible conflicts, to exchange information and to coordinate the various activities;
- leadership: it refers to an optimal use of authority, planning and prioritization, management of workloads and resources;
- stress management: ability to correctly identify any symptoms of stress, to recognize its effects and to implement the most effective coping strategies;
- coping strategies: related to previous competence, it involves the identification of symptoms of fatigue, the recognition of symptoms of the latter and the implementation of coping strategies.

METHODS

A scoping review was chosen as research methodology. This supports what is referred to as a systematic approach to the synthesis of evidence, helping to identify gaps for

Tab. 1 - PCC

POPULATION	Nursing students
CONCEPT	High fidelity simulations
CONTEXT	Technical and Non-Technical Skills

future studies. In this case, the goal is to determine the strength of the evidence using a consistent best practice approach.

The search of the international literature was conducted in accordance with the PRISMA-ScR Statement (PRISMA extension for Scoping Reviews) (Tricco et al., 2018) and was conducted within some main databases of biomedical interest: MEDLINE, Scopus, CINAHL, PsycINFO, Academic Search Index, Science Citation Index and ERIC. Data were collected between May and July 2020. The keywords used were Nursing students; High-fidelity simulation; Critical care; Emergencies and Technical and Non-technical skills.

The latter were useful in formulating the research question according to the PCC (Population, Concept and Context) methodology (Tab. 1).

Research question: "What are the effects of high-fidelity simulation in the critical area on the skills of nursing students?". The search string was created using the Boolean operators "AND" and "OR" and Mesh terms to ensure maximum search sensitivity and specificity:

(Emergencies or intensive care or critical care or Life Support Care) and (Students, Nursing) and (High Fidelity Simulation Training or Simulation Training)

The study population were nursing students who had already completed the critical area and emergencies module. Primary studies concerning the evaluation of the HFS on the efficacy and validity within the Degree Programs were considered eligible. The research included experimental or quasi-experimental studies and observational studies. Those who used computer simulations on web platforms and through gaming software were excluded. Methods that included standardized patients or medium / high fidelity simulations were included. Since gray literature (i.e., unpublished conference proceedings or theses or dissertations) was not considered, other potentially relevant studies were not included in this review.

Eligibility criteria

The selection criteria listed below were met to identify suitable studies for the purpose of this review.

Inclusion criteria:

- publication date from 2010 to include the most recent literature from the last 10 years;
- articles written in Italian and / or English;
- experimental and observational studies: RCT (Randomized Controlled Trial), quasi-experimental research designs, pretest-posttest, cross-sectional;
- Standardized Patients (SP).

Exclusion criteria:

- students of other health professions;
- nursing students who had not attended courses in the critical area (first year);

- Computer, Gaming and Web-based simulations;
- articles written in a language other than Italian and English;
- gray literature;
- qualitative and mixed-methods studies;

Data analysis

Quality assessment was limited to experimental studies. The quality of randomized controlled trials was assessed with the Jadad scale, focusing on methods for random allocation, double blinding, withdrawals and dropouts. Total scores ranged from 0 to 5 points, where studies with 0-2 points were considered poor quality and those with 3-5 points represented high-quality evidence (Jadad et al., 1996).

The following data were collected for each article: title, first author, year of publication, study sample and design, objective, intervention, outcome and summary of results. The approach used to group the articles was thematic: the main objective of the thematic analysis is to identify similar concepts in the collected dataset, exploring their relationships of meaning. These reports can be used to further develop and corroborate the interpretation of theories that seek to investigate the phenomena studied (Allo-dola, 2014).

The main information of the relevant articles was organized in a data extraction table (Table 3).

RESULTS

Initially, 530 articles were selected with duplicates removed. Precisely 263 on Pubmed, 110 on Academic Search Index, 97 on CINAHL Plus with Full Text, 90 on Science Citation Index, 42 on PsycInfo, 16 on Scopus® and 4 on ERIC. Of these, 21 met the inclusion criteria and underwent the review process. Studies conducted in 10 different countries were included (Table 2). Most of the research came from the United States; this demonstrates a notable absence of literature in Italy. The studies included a sample ranging from a minimum of 31 to a maximum of 534 students. The most recent study dates back to October 2019, while the oldest one dates back to July 2010.

Tab. 2 – Geographical reference of the selected articles

Country	Number of studies
Japan	2
South Korea	1
France	1
Spain	1
Turkey	2
USA	5
Australia	2
China	1
Jordan	2
Malta	1

Summary of the results

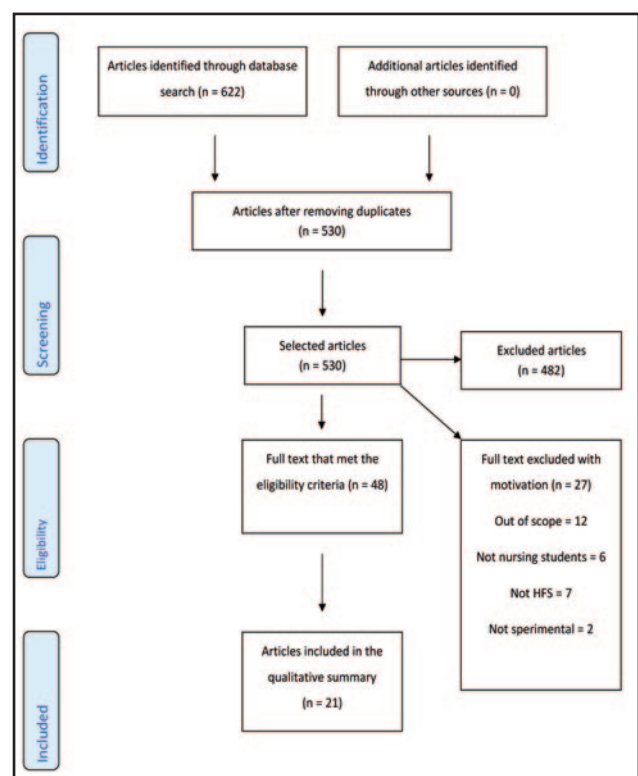
In most of the selected articles, the participants undergoing the intervention demonstrated better skills and abilities than the control group, when subjected to a simulation based on realistic scenarios, using high precision mannequins, such as the Human Patient Simulator (HPS, SimMan, Medical Education Technologies, Inc., Sarasota, FL, USA and Laerdal Sales Office, New York, NY, USA), and the MicroSim (Laerdal Sales Office) or the Emergency Care Simulator (ECS) (Laerdal Sales Office). The simulations included clinical cases with background information, disease status and simulated events, and questions for students during each of the scenarios. The learning process included clarifications on the topics covered, group discussions, exercises, reflections, debriefing and evaluation.

The selected articles can be divided into two categories according to the objectives, i.e., those that focus essentially on non-technical skills (team-working, communication skills, critical thinking, decision-making and clinical reasoning), and those that study technical skills related to clinical practice, subject-specific knowledge and student performance.

Non-technical skills analysis

Sánchez Expósito, J. et al. (2017) analyses students' communication skills when they interacted with high-fidelity manikins during situations of severe clinical deterioration, to study the relationships between communication skills and teamwork. Other studies have also done so, which have described the best types of interventions to be adopted in order to improve communication with both the patient and team members for good teamwork

Fig. 4 – PRISMA Flow Diagram



Tab. 3. Articles included - section 1.

TITLE, AUTHOR, YEAR	SAMPLE AND STUDY DESIGN	OBJECTIVES	INTERVENTION	OUTCOMES
Ensuring relational competency in critical care: Importance of nursing students' communication skills Sánchez Expósito, J. et al. (2017)	n. 52 students Cross-sectional study	Analyse students' communication skills in interacting with simulated critically ill patients, to study the relationships between communication skills, teamwork and clinical skills.	High fidelity clinical simulation scenarios with critically ill patients in a prepared room. The scenarios were recorded and displayed in real time during the simulation sessions.	Students demonstrated lack of communication skills in simulated clinical scenarios with critically ill patients. However, they showed good communication with the team, good teamwork and a good command of advanced clinical skills.
Evaluation of disaster preparedness training and disaster drill for nursing students Alim, S. et al. (2015)	n. 534 students Observational study	Assess the effectiveness of a disaster training program, followed by an exercise designed for nursing students.	One day of disaster preparedness training with exercise.	The program improved the disaster preparedness capacity of nursing students. The extent of the improvement depended on previous training experience.
Effects of communication on the performance of nursing students during the simulation of an emergency situation Chapelain, P. et al. (2015)	n. 52 students Quasi-experimental study	Explore how nursing performance is affected by different forms of group communication.	The experiment comprised three phases: briefing, simulation and debriefing. In each scenario there was an emergency room where the doctor on call was temporarily unavailable.	The contribution of simulation in group communication and clinical performance appears significant.
Hybrid Simulation in Triage Training Uslu, Y. et al (2019)	n. 40 students Descriptive study	Evaluate the effectiveness of simulation in "triage training" for nursing students.	4 clinical cases with different triage categories (at approximately 1-minute intervals) in an environment that simulated emergency room.	Students showed better performance for yellow-coded triage. The drop in performance for the red code is due to their inadequate experience and professional competence. Likewise, it was determined that students did not show the necessary attention when evaluating the green codes (not urgent).
Effect of simulation on the development of critical thinking in associate degree nursing students Goodstone, L. et al (2013)	n. 42 students Quasi-experimental study	Explore the development of critical thinking for students who used high fidelity simulation versus low fidelity simulation (case studies written by the tutor).	One group participated in weekly high-fidelity simulations, another participated in weekly group work on written clinical cases.	The results suggest that both high-fidelity and low-fidelity simulations are both associated with improved critical thinking.
Final-year nursing students' ability to assess, detect and act on clinical cues of deterioration in a simulated environment Endacott, R. et al (2010)	n. 51 students Observational study	Investigate the processes used by final year nursing students to recognize and act on clinical signs of deterioration in a simulated environment.	The students attended a simulation lab for 1.5 hours and completed two scenarios (on manikin) that simulated worsening patients with hypovolaemia and septic shock. Furthermore, the scenarios were stopped in the middle to ascertain the level of situational awareness of the students.	The simulation proved useful for students to become familiar with the recognition of clinical deterioration.
Standardised simulation-based emergency and intensive care nursing curriculum to improve nursing students' performance during simulated resuscitation: A quasi-experimental study Chen, J. et al. (2018)	n. 39 students Quasi-experimental study	Evaluate the impact of a standardized nursing curriculum based on simulations in emergencies, intensive care and on student response times during resuscitation.	The experimental group participated in a standardized nursing curriculum based on high-fidelity, emergency and intensive care simulation. The curriculum consisted of three modules: immediate response, emergency care, and intensive care.	The simulation-based curriculum was associated with increased performance: a) reduction in the time elapsed between requesting assistance and the initiation of chest compressions and b) successful defibrillation in less than 180 seconds.
Effectiveness of a structured curriculum focused on recognition and response to acute patient deterioration in an undergraduate BSN program Hart, PL. Et al. (2013)	n. 48 students Studio quasi-experimentale	Evaluate the effectiveness of a structured simulation curriculum in nursing students to recognize and respond promptly to patients with acute deterioration.	The course consists of 45 hours structured in four modules: 1) didactic lessons, 2) gestural workshops, 3) three high fidelity simulations and 4) debriefing sessions.	Structured curricula with simulation sessions are effective in preparing students to hone their skills to recognize and respond to critical events.
Investigating the Effect of Training with the Method of Simulation on the Knowledge and Performance of Nursing Students in the Pre-Hospital Triage Farhadloo, R. et al. (2018)	n. 70 students Quasi-experimental study	Determine the effect of training through the simulation method on the knowledge and performance of nursing students in performing pre-hospital triage.	Written test with 10 questions of four answer options each and a practical test that includes examining the correct execution of triage according to the START criteria using 10 models of simulation dummies, designed according to the reference scenario.	Training with the simulation method on high fidelity mannequins was found to be effective for preparing for triage in case of accidents and emergencies. There has also been an improvement in knowledge in this regard.
Use of an Emergency Preparedness Disaster Simulation with Undergraduate Nursing Students Kaplan, BG. Et al. (2011)	n. 90 students Observational study	Prepare students to respond to disasters, ensure optimal patient care and safety during such events, develop student skills in teamwork, clinical reasoning, critical thinking, effective communication and familiarization with triage operations during a disaster.	The strategy includes simulating a disaster in a nursing simulation lab, using live mannequins and actors.	The simulation was found to be effective in increasing basic knowledge, in the acquisition of skills and in providing nursing care during a disaster without risk for patients or students.

Tab. 3. Articles included - section 2.

TITLE, AUTHOR, YEAR	SAMPLE AND STUDY DESIGN	OBJECTIVES	INTERVENTION	OUTCOMES
Effects of a System Thinking-Based Simulation Program for Congestive Heart Failure Kim, H. et al. (2017)	n. 67 students RCT	Examine a critical thinking-based simulation program and analyse its effects on problem solving and clinical performance of nursing students.	The experimental group received a 4-hour critical thinking teaching and a 2-hour simulation program, while the control group had a 4-hour clinical case and a 2-hour simulation program.	The program developed for this study proved to be a potentially effective teaching strategy for improving problem-solving and clinical performance.
Effect of simulation-based emergency cardiac arrest education on nursing students' self-efficacy and critical thinking skills: Roleplay versus lecture Kim, H. et al. (2018)	n. 76 students Quasi-experimental study	To examine the effects of simulation-based education, self-efficacy and critical thinking skills of nursing students in a cardiac arrest emergency.	Both groups participated in a simulation lesson based on the same emergency scenario. Group A first completed a role play of cardiac arrest in a clinical setting, while Group B first heard a theoretical lecture on the procedure. After 10 days, group A repeated the simulation exercise after listening to the lesson, while group B completed the exercise after the role play.	Conducting the simulation exercise after the role play was a more effective teaching method than conducting it after class. This led students to a deeper understanding of clinical situations and improved their self-efficacy and critical thinking skills.
An interprofessional communication training using simulation to enhance safe care for a deteriorating patient Liaw, SY. et al. (2014)	n. 92 students Quasi-experimental prospective study	To describe the development, implementation and evaluation of a simulation-based interprofessional education program (Sim-IPE), to enhance the communication skills of nursing students in the care of a critically ill patient.	The program used large-scale simulation and communication strategies adapted to the 3-hour Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) in small groups that included simulation of emergencies scenarios on patients.	The Sim-IPE has improved the communication between students and their perception in recognizing the states that are about to evolve into an emergency.
Evaluation of a critical care simulation series for undergraduate nursing students Mould, J. et al. (2011)	n. 219 students Observational study	To assess self-efficacy and self-reported competence using clinical scenario-based simulations.	27 scenarios including high fidelity mannequins and actors. The scenarios were recorded and used for debriefing.	The simulations of multiple scenarios are effective in improving self-efficacy and skills related to emergency practice and are a pleasant experience for students.
Effects of an integrated simulation-based resuscitation skills training with clinical practicum on mastery learning and self-efficacy in nursing students Roh, YS. Et al. (2016)	n. 255 students Observational study	To evaluate psychomotor skills, self-efficacy and knowledge of resuscitation practices based on simulation integrated with an internship.	A resuscitation skills training course based on a 2-hour simulation and an 80-hour clinical internship in an emergency room.	The intervention improved knowledge, self-efficacy and psychomotor skills of nursing students.
The effectiveness of virtual simulation in improving student nurses' knowledge and performance during patient deterioration: A pre and post-test design Sapiano, AB. et al. (2017)	n. 166 students Observational study	To study the effectiveness of simulation in improving the knowledge and performance of nursing students during rapid patient deterioration.	The simulation included three scenarios (Cardiac-Shock-Respiratory) depicting worsening patients. Prior to their participation, the students had access to an online course and a PowerPoint lesson.	Simulation programs can significantly improve knowledge and appear to improve performance.
Implementing simulation in oncology emergencies education: A quasi-experimental design Sharour, LA. (2018)	n. 70 students Quasi-experimental study	To evaluate the effectiveness of the use of HFS on the satisfaction, self-confidence, self-efficacy and knowledge of nursing students in emergency oncology care.	Scenarios including septic shock and IV infusion reaction were implemented. The training program, including lectures and simulation, was performed in a high-fidelity simulation laboratory.	High-fidelity simulation in nursing has increased students' knowledge, self-confidence, satisfaction, and self-efficacy in managing septic shock and infusion response as common
Use of multiple pedagogies to promote Confidence in triage decision making: A pilot study Smith, A. et al. (2013)	n. 31 students RCT	To determine whether adding simulations to clinical hours promotes confidence in triage decision making among nursing students.	Educational interventions included a 2-day ACLS course, simulations with debriefing, or a combination of both.	Students demonstrated increased confidence in decision making by adding simulations in combination with clinical internship.
Effect of Simulation on Knowledge of Advanced Cardiac Life Support, Knowledge Retention, and Confidence of Nursing Students in Jordan Tawalbeh, LI. et al. (2013)	n. 40 students RCT	To examine the effect of simulation on knowledge and confidence in applying ACLS activities.	The experimental group took part in a simulation scenario related to ACLS, a 4-hour PowerPoint presentation and a demonstration on a manikin, while the control group participated only in the presentation and demonstration on manikin.	The simulation has positively influenced the knowledge and confidence of students in applying the ACLS. Students who have been trained through high-fidelity simulation have obtained better knowledge and greater confidence in the application of the ACLS.
Integrating simulation-based learning into nursing education programs: Hybrid simulation Unver, V. et al. (2017)	n. 39 students Quasi-experimental study	To analyse the effects of a hybrid simulation technique in an emergency scenario.	The students were divided into subgroups. Each subgroup ran the same simulation scenario. Afterwards, the students had a debriefing session where they had the opportunity to discuss the case and clarify any questions about their performance.	The simulation was found to improve self-confidence in patient care.
A Deliberate Practice-Based Training Protocol for Student Nurses Care of the Critically Ill Patient: A Randomized Controlled Trial of a Deliberate Practice-Based Training Protocol Whyte, J. et al. (2014)	n. 40 students RCT	To establish the effectiveness of a simulation intervention designed to improve clinical performance levels in nursing students.	The control group only completed the pre- and post-testing sessions, with the post scheduled 6 weeks after the initial testing. Participants in the intervention group completed two mock sessions, 1 and 3 weeks after their initial test and the post-test 6 weeks after the pretest.	The intervention prompted the participants to reconsider and act according to clinical reasoning, resulting in a substantial improvement in performance.

(Chapelain et al., 2015 & Sánchez Expósito et al., 2018). The contribution of simulation on group communication appears significant.

Secondly, other studies have established their focus on critical thinking and clinical reasoning / decision making (H.-Y. Kim & Yun, 2018; Kaplan et al., 2012; Goodstone et al., 2013 & Liaw et al., 2014). The results suggest that both high-fidelity and low-fidelity simulations are associated with improved critical thinking; this led students to a deeper understanding of clinical situations and improved their critical thinking skills. Simulation programs specifically developed have also proven to be a potentially effective teaching strategy for improving problem solving and therefore clinical reasoning and decision making.

Technical skills analysis

There are also several studies that tested the increase in the technical skills described above. Some studies have recreated the setting of disasters and catastrophes that occurred in the country itself in previous years, in such a way they were able to evaluate the effectiveness of a training program on the subject, followed by an exercise designed with simulations (Smith et al., 2013; Uslu et al., 2019; Alim et al., 2015 & H.-Y. Kim & Yun, 2018). In particular, Alim, S. et al. (2015) developed a curriculum on emergencies during disasters and applied it to nursing students, improving disaster preparedness. The extent of the improvement, however, depended on previous training experience.

The rest of the selected articles, studies technical skills related to clinical practice, subject-specific knowledge and student performance.

Three studies evaluated the effectiveness of simulation in "triage training" (Mould et al., 2011; Endacott et al., 2010 & Farhadloo et al., 2018). Students demonstrated better performance for triaging yellow codes. On the other hand, there was a decline in performance for the red code, due to the inadequate experience and professional competence of the students. Likewise, it was established that the students did not show the necessary attention when evaluating the green codes.

Training with the simulation method on high-fidelity mannequins was found to be effective in preparing for triage in the event of accidents and emergencies. There was also an improvement in knowledge in this regard and an increase in confidence in the decision-making process.

In other studies, simulation has proved useful for students to become familiar with the recognition of clinical deterioration and therefore self-confidence in patient care, to improve self-efficacy and skills, as well as being a pleasant experience for the student (Hart et al., 2014; Borg Sapiano et al., 2018; Unver et al., 2018; Whyte & Cormier, 2014 & Chen et al., 2018).

Two studies have designed true standardized nursing curricula based on simulations in emergencies, intensive care and on student response times during resuscitation (Roha et al., 2016; Hart et al., 2014). Structured curricula through simulation sessions are effective in preparing students to hone their skills to recognize and respond to

critical events. Specifically, it has been associated with increased performance: a) reduction in the time elapsed between requesting assistance and the initiation of chest compressions and b) successful defibrillation in less than 180 seconds.

Finally, two studies evaluated the psychomotor skills and self-efficacy of the students undergoing the intervention, compared with those included in the control group (Sharour, 2019). High-fidelity simulation in nursing, increased student knowledge, self-confidence, satisfaction and self-efficacy. Sharour, LA. (2019) was the only one to focus interventions on the oncology field, demonstrating an improvement of the student in the management of septic shock and infusion reaction as common oncological emergencies.

Interventions

Each study included in the analysis, contained high-fidelity simulation as an intervention, but at the same time, many of them differed from each other in the way the latter was integrated into the student's academic career.

Several studies divided the intervention into three phases: briefing, simulation and debriefing; others recorded audio and video of the simulations and then discussed them with the students. Still, others attended a simulation lab for a few hours and / or weeks and completed a number of manikin scenarios.

Furthermore, entire academic curricula including modules on the critical area were designed and used, pretest-posttest questionnaires and other validated assessment tools were administered.

Usually, the control group, either supported the same type of intervention but for less time or supported the intervention in a different order from the other group or participated only in the theoretical presentation / lesson and/or demonstration, exclusively visual.

DISCUSSION

A student is educated in order to learn the knowledge and skills necessary to provide quality care. Clinical experience provides the environment for applying knowledge to patient care. However, not all clinical experiences are the same and considerable variation in the student's experience is inevitable.

Therefore, well-designed simulations support the achievement of knowledge, skills and communication before or in combination with the clinic, to improve the self-efficacy of a nursing student (Ramey et al., 2018). This statement is in line with the findings of this scoping review, in particular, the studies of Smith, A. et al. (2013), Sánchez Expósito, J. et al. (2017) and Sapiano, AB. et al. (2017) consider simulation an essential tool for measuring student achievement that focuses on self-efficacy, self-confidence and decision-making skills.

Many of the studies considered used a model based on "Standardized Patients" (SP) (Ramey et al., 2018; Xia et al., 2020; Sharour, 2019; Roha et al., 2016; Hart et al.,

2014; Borg Sapiano et al., 2018; Mould et al., 2011 & Smith et al., 2013). In support of what has been reported, other recent studies have shown that SPs encourage interaction with "real" patients, help in communication and interpersonal skills and provide a realistic experience (Curl et al., 2016). SPs not only participate in the simulation as patients or caregivers but can portray other members of the team as doctors and healthcare professionals. In the nursing literature, a great deal of research has emulated the effectiveness of SPs in simulation. Chapelain, P. et al. (2015) and Uslu, Y. et al (2019) include the manikin's ability to provide immediate feedback, improve clinical skills, competence, confidence and anxiety reduction. These outcomes are also reported by several RCTs which confirm that simulation and feedback devices are resources that favour learning and awareness of performance in the execution of manoeuvres (Tobase et al., 2017; Curl et al., 2016).

Research is still evolving into what is best for students and learning outcomes. Kim, H. et al. (2018) determined that more research is needed to determine whether high-fidelity simulation improves clinical psychomotor performance. A 2017 supplementary review indicated that high fidelity simulations benefited nursing students in acquiring knowledge, critical thinking and confidence in performing clinical practices (Cant & Cooper, 2017).

From the analysis of the studies taken into consideration, some of them made use of validated assessment tools and scales to evaluate the progress achieved by the student in the most objective way possible. However, Doolen, J. et al. (2016) concluded that nursing simulations used too wide a variety of measurement results and lacked valid and reliable assessment tools (Doolen et al., 2016). The results of a meta-analysis found that simulation improved problem solving, critical thinking, clinical judgment and clinical competence of nursing students, and found that simulation with standardized patients improved knowledge, communication, self-efficacy and motivation (Lee & Oh, 2015). Another meta-analysis compared the education through simulation with controlled groups who have not participated in the simulation (Shin et al., 2015). The authors found that high-fidelity simulations have had a great effect on the achievement of psychomotor skills.

Limitations

This study has some limitations that should be mentioned. In the analysis, only research articles published in English and Italian were included, which may have produced a linguistic bias regarding the conclusions, since some scientific articles published in other languages were automatically excluded. Additionally, only primary studies were included in the research, and it is possible that relevant articles were missed that may have documented other interventions that did not emerge here. A limitation of this approach is that the review does not include an assessment of the effectiveness of the interventions.

However, evaluative research in this area is limited and we are confident that this scoping review provides a comprehensive summary of the current evidence. It should be noted that the search strategy was conducted according to the guidelines established for the scoping reviews and

extensive bio-medical databases were used.

CONCLUSION

The purpose of this scoping review was to map and describe the effects of high-fidelity simulation on the technical and non-technical skills of nursing students in a critical area and emergency management setting. Evidence suggests that:

- Simulation environments should include feedback, briefing and debriefing of activities;
- High fidelity should be considered and applied in every area of university nursing education to meet the complexity of the expected learning outcomes;
- A curriculum designed specifically to perform the activities in a structured and objective way should be prepared;
- Properly constructed Standardized Patients can have a positive impact on the simulation experience;
- Student self-efficacy, confidence and competence are key principles to consider when measuring the effect of a simulation environment.

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