Clinical simulation in surgical center with participation of nursing professionals: an Integrative Review

Simulação clínica em centro cirúrgico com participação dos profissionais de enfermagem: revisão integrativa

Simulación clínica en centro quirúrgico con participación de profesionales de enfermería: una Revisión Integrativa

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ABSTRACT: Objective: To verify the scientific production on clinical simulation in the surgical center with the participation of the nursing team. **Methods:** An integrative review was carried out based on articles available in the Scopus, CINAHL, PubMed, LILACS, and Web of Science databases. The collection considered publications between 2019 and 2024, in Brazilian Portuguese, English, and Spanish. **Results:** The 18 articles analyzed were written abroad. The following types of simulations were performed: eight *in situ*, five virtual reality, four medium- and/or high-fidelity, and one not identified. The technical skills addressed in the simulations were: in five, surgical instrumentation and assistance; in one, safety and risk management. The nontechnical skills were: five concerning communication and teamwork, and one concerning the importance of the work itself. Five simulations reviewed workflows and two focused on acquiring new knowledge. **Conclusion:** We evidenced that clinical simulation, with the participation of the nursing team, has been applied to improve technical and nontechnical skills, review of workflows, and acquisition of new knowledge, promoting a more robust learning and aligned with the requirements of care practice.

Keywords: Simulation. Operating room. Nursing.

RESUMO: Objetivo: Identificar a produção científica sobre simulação clínica em centro cirúrgico com a participação da equipe de enfermagem. **Métodos:** Uma revisão integrativa foi realizada a partir de artigos disponíveis nas bases de dados *Scopus*, CINAHL, PubMed, LILACS e Web of Science. A coleta considerou publicações entre 2019 e 2024, em português, inglês e espanhol. **Resultados:** Os 18 artigos analisados foram produzidos no exterior. Tipos de simulações realizadas: oito *in situ*, cinco de realidade virtual, quatro de média e/ou alta fidelidades e uma não identificada. Habilidades técnicas trabalhadas nas simulações: em cinco, instrumentação e assistência em cirurgias; em uma, segurança e gestão de risco. Habilidades não técnicas: cinco direcionadas à comunicação e ao trabalho em equipe e uma à importância do próprio trabalho. Cinco simulações revisaram fluxos de trabalho e duas dedicaram-se à aquisição de novos conhecimentos. **Conclusão:** Evidenciou-se que a simulação clínica, com participação da equipe de enfermagem, vem sendo aplicada para aprimoramento das habilidades técnicas e não técnicas, revisão dos fluxos de trabalho e aquisição de novos conhecimentos, promovendo um aprendizado mais robusto e alinhado às exigências da prática assistencial.

Palavras-chave: Treinamento por simulação. Salas cirúrgicas. Enfermagem.

RESUMEN: Objetivo: Verificar la producción científica sobre la simulación clínica en el centro quirúrgico con la participación del equipo de enfermería. **Métodos:** Se realizó una revisión integrativa basada en artículos disponibles en las bases de datos *Scopus*, *CINAHL*, *PubMed*, *LILACS* y *Web of Science*. La recopilación consideró publicaciones entre 2019 y 2024, en portugués brasileño, inglés y español. **Resultados:** Los 18 artículos analizados fueron elaborados

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en el exterior. Se identificaron los siguientes tipos de simulación: ocho *in situ*, cinco de realidad virtual, cuatro de fidelidad media y/o alta y una no identificada. Las habilidades técnicas abordadas en las simulaciones fueron: en cinco estudios, instrumentación y asistencia quirúrgica; en uno, seguridad y gestión del riesgo. Las habilidades no técnicas fueron: cinco relacionadas con la comunicación y el trabajo en equipo, y una relacionada con la importancia del propio trabajo. Cinco simulaciones revisaron flujos de trabajo y dos se centraron en la adquisición de nuevos conocimientos. **Conclusión:** Se evidenció que la simulación clínica, con la participación del equipo de enfermería, se ha aplicado para mejorar habilidades técnicas y no técnicas, revisar flujos de trabajo y adquirir nuevos conocimientos, promoviendo un aprendizaje más robusto y alineado con los requisitos de la práctica asistencial.
Palabras clave: Entrenamiento simulado. Quirófanos. Enfermería.

INTRODUCTION

The surgical center (SC) is a critical and dynamic unit. Complex and interdisciplinary practices are carried out in the SC, which take place by a variety of procedures: anesthetics, surgical, diagnostic, and therapeutic. The several types of interventions involve the use of varied and specific materials and equipment, requiring highly-qualified professionals to carry out the work[1,2].

The increasing technological development in the health area, especially in the SC, poses challenges to nursing professionals. New features — such as instruments, equipment, and work techniques — are often implemented, which requires constant updating of these professionals in order to ensure safe assistance[1,3].

The provision of care to surgical patients has high potential for incident occurrence, compromising their safety not only by the risks inherent in the surgical procedure, but also by the complexity of the care provided[1,3,4]. Thus, patient safety is a permanent concern in health services, with frequent discussions about educational actions and methods. The training and updating of the nursing team are constantly necessary to develop, put into practice, and improve skills seeking to avoid harm to the patient. In this context, a strategy has been used by perioperative nursing: clinical simulation[1,5,6].

Realistic simulation, a teaching and active learning strategy widely used in the health area, replicates everyday work situations with scenarios in a safe and controlled environment. Its objective is to create educational spaces that enable professionals to practice and refine their technical and non-technical skills, allowing reflection, testing, improvement, and implementation of work processes[1,7,8].

Considering that the main author of this study works as a nurse in the SC of a hospital that uses clinical simulation to qualify her team, recognized as an important tool for nursing education, the following research question was proposed: What are the objectives and skills developed in realistic/clinical simulations performed in surgical centers with the participation of nursing professionals?

OBJECTIVES

To analyze the scientific production on the use of clinical simulation in surgical centers with the participation of nursing professionals.

METHODS

This is an integrative review, a method that allows to gather and synthesize published knowledge on a particular subject or issue, aiming to contribute to deepening knowledge[9]. For the elaboration of the research question, the PICO acronym was considered, in which "P" stands for surveyed population: nursing team; "I," intervention: clinical simulation; and "CO," context: SC.

Data were searched and collected in articles indexed in the following databases and libraries: Scopus (Elsevier), Cumulative Index to Nursing and Allied Health Literature (CINAHL), National Library of Medicine (PubMed), Latin America and the Caribbean Literature on Health Sciences (LILACS), and Web of Science. For the search, controlled descriptors were used according to Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH). The descriptors with the selected Boolean operators were *Simulation AND Operating Room AND Nursing*. The same strategy was applied in the five databases.

The following inclusion criteria were considered: original national and international studies indexed in the researched databases, in Brazilian Portuguese, English, and Spanish, published between 2019 and 2024, identified by Boolean descriptors and terms in the title or in the abstract, which addressed graduate nursing professionals.

As exclusion criteria, the following were considered: articles from areas other than Medicine and/or Nursing, those whose study objects were not realistic/clinical simulation in SC with the participation of professionals from the nursing team, and studies in which simulation was applied exclusively to nursing students.

For data collection, a spreadsheet prepared by the researcher in the Excel® software was used, containing the following variables: journal, country of origin, title, year of publication, objective, method, type of simulation addressed, and conclusions. After data extraction, the results were analyzed with the objective of identifying the topics most discussed in the selected articles.

Considering the bibliographical nature of the research, approval of the project was waived by the Research Ethics Committee.

RESULTS

Initially, we identified 6,646 bibliographical references through electronic search in the five databases. After applying the inclusion and exclusion criteria, 5,993 references were withdrawn. Subsequently, after reading the titles and abstracts, 36 articles were selected for reading in full. The final sample consisted of 18 articles. In Figure 1[10], we present the selection of studies for this integrative review.

All selected articles were published in the English language and originated from 11 countries: United States of America (n=6), Australia (n=3), Canada (n=1), Spain (n=1), United Kingdom (n=1), New Zealand (n=1), Iran (n=1), Sweden (n=1), China (n=1), Republic of Korea (n=1), and Japan (n=1). We evidenced the lack of national production on this topic, as none of the selected articles was produced in Brazil. In Chart 1, we present the characteristics the 18 articles included[1,11-27].

According to all articles, clinical simulation allows, to some extent, the development of technical or nontechnical skills. However, for a better understanding of the applicability of the simulation, the articles were grouped by themes, according to the objective and skills developed in each study (Chart 2)[1,11-27].

DISCUSSION

Clinical simulation, as a teaching tool, has been increasingly used in the perioperative scenario to reduce gaps between theory and practice as well as promote safe care to patients. Nursing professionals who participate in simulation training, when compared to those who performed conventional training, present higher results regarding the level of compliance with patient safety standards and the perception about safety culture[11].

Simulation training allows professionals to reproduce complex situations or procedures in a safe and controlled environment, enabling the development of technical and nontechnical skills[15,22]. It can be classified according to the experience's degree of proximity to reality, and may be of low, medium, or high fidelity[6]. In the studies of this review, high-fidelity simulation was the most used, highlighting *in situ* simulation with or without simulators and virtual reality (VR) simulation.

Regarding the topics addressed by the articles, the use of VR simulation was the most used in technical skills. Of six studies, five[14,21,22,26,27] opted for this simulation method in order to develop instrumentation skills in complex surgeries, evaluating the effectiveness of this teaching method. The authors[13,14,21,22,26,27] demonstrated that simulation training, when compared to other teaching methods, presents superior results in terms of dynamics, realism, and safety.

In a study[14] whose authors aimed at gathering information for developing a VR tool directed to technical improvement in surgical instrumentation, the participants highlighted the importance of contact with the instruments and processes before working on an operating table, in a non-sterile environment, and free from the pressures of professional practice. The choice of this teaching method is aligned with the complexity of the processes to be developed in the SC, requiring techniques that allow to replicate the clinical practice more effectively.

Edwards et al.[27] showed high development of practical skills after four VR simulation sessions. Surgical time decreased by 47%, while skill in practice increased from 11% before training to 84% after training. It is also noteworthy that, although the main focus of the studies lies on the development of technical skills, even in VR simulation, professionals can develop nontechnical skills such as decision-making, situational awareness, and confidence.

While VR simulation stood out as a method to develop individual technical proficiency, *in situ* simulation was the most used method to improve nontechnical skills[11,12,17,25] such as team dynamics, system testing, and promotion of safety culture[13,17]. This teaching technique, associated with the possibility of training in a multidisciplinary team, allows to work

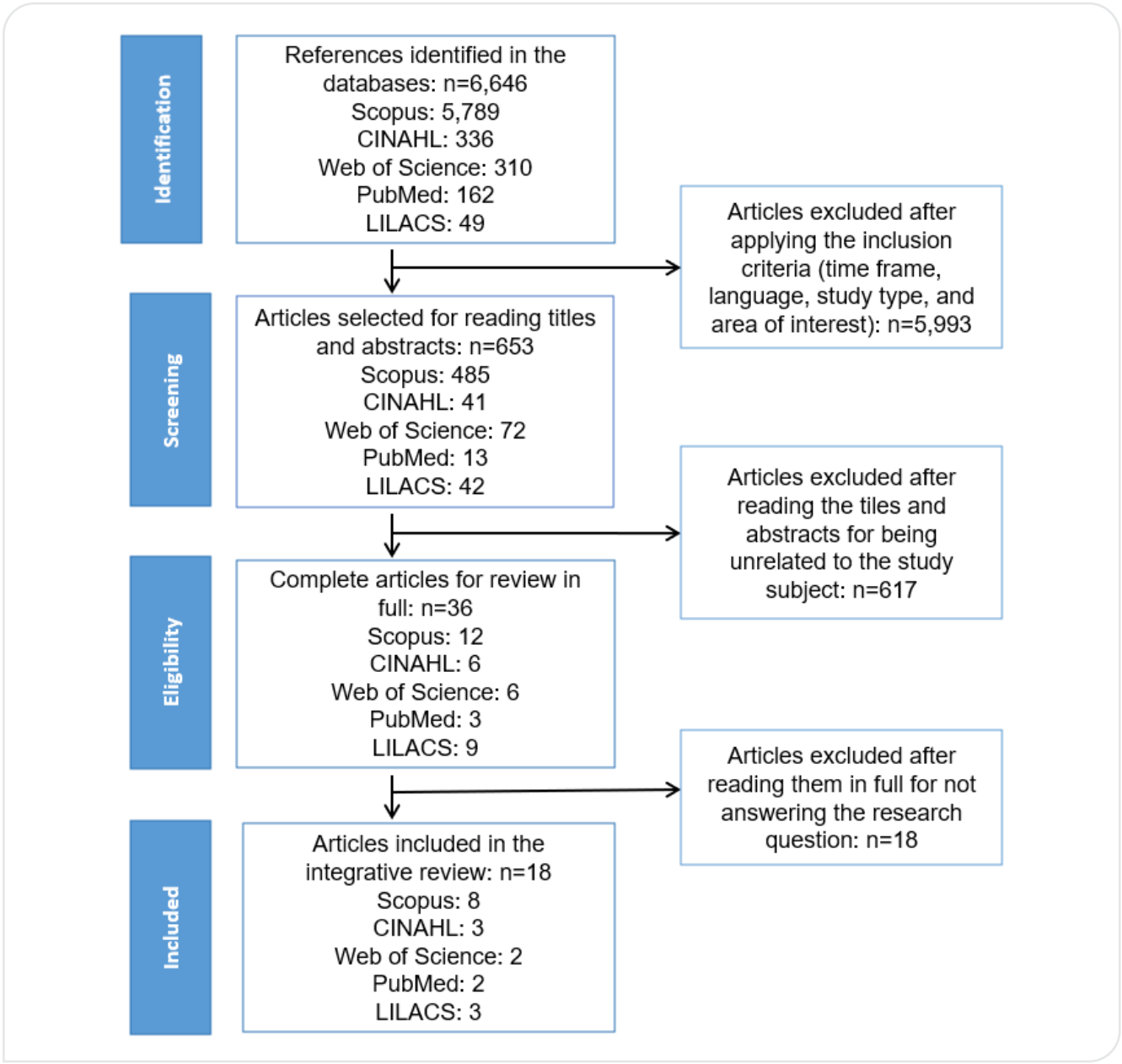

Figure 1. Flowchart of search and selection of articles adapted from PRISMA Flowchart 2020[10].

on communication[12,25] and improve teamwork[11,12,25], in addition to developing confidence[12] and situational awareness[11].

In the analyzed articles, only five authors address the use of simulation exclusively by the nursing team[13,17,22,26,27]; the remaining[1,11,12,14-16,18-21,23-25] were performed with a multidisciplinary perioperative team, including nursing. The complexity of the perioperative environment requires cohesive collaboration of surgeons, anesthesiologists, and nurses.

Researchers, such as Jowsey et al.[1] and Escher et al.[12], showed that interprofessional simulation can positively transform the culture of the operating room, improve team relationships, and break with professional barriers that traditionally prevent communication. According to the results of the study conducted by Khalafi et al.[11], interprofessional education was superior to single-profession education in improving almost all nontechnical skills, including teamwork, situational awareness, and decision-making. This suggests that joint learning, facilitated by simulation, is an essential element in improving team performance.

Chart 1. Characterization of the articles included in this integrative review. Porto Alegre (RS), 2025.

Articles	Title	Method
Khalafi et al.[11]	The effect of small group simulation-based interprofessional education on non-technical skills of anesthesia providers: a randomized controlled trial	Randomized clinical trial
Escher et al.[12]	All professions can benefit – a mixed-methods study on simulation-based teamwork training for operating room teams	Prospective study of mixed-methods intervention
Park et al.[13]	The effects of a simulation-based patient safety education program on compliance with patient safety, perception of patient safety culture, and educational satisfaction of operating room nurses	Randomized clinical trial
Kaitu'u et al.[14]	Determination of skill and knowledge requirements of an instrument nurse working in major vascular surgery for the development of a virtual reality training tool	Exploratory qualitative
Hibberson et al.[15]	Multidisciplinary simulation training for Australian perioperative teams: a qualitative descriptive exploratory study	Qualitative descriptive exploratory
Gallegos and Hennen[16]	Malignant hyperthermia preparedness training: using cognitive aids and emergency checklists in the perioperative setting	Descriptive-exploratory study
Hara et al.[17]	Effects of simulation-based scrub nurse education for novice nurses in the operating room: a longitudinal study	Longitudinal study
Vortman[18]	Using simulation-based education to improve team communication during a massive transfusion protocol in the OR	Method not informed
Ferguson et al.[19]	Integrated simulations to build teamwork, safety culture and efficient clinical services: a case study	Case study
Kennedy et al.[20]	A novel approach to operating room readiness for airborne precautions using simulation-based clinical systems testing	Observational study
Chen et al.[21]	Effect of virtual reality training to enhance laparoscopic assistance skills	Self-control study
Zabaleta et al.[22]	Clinical trial on nurse training through virtual reality simulation of an operating room: assessing satisfaction and outcomes	Open randomized clinical trial
Matsco et al.[23]	Setting the foundation for an *in situ* simulation program through the development of a malignant hyperthermia simulation in the operating room	Method not informed
Daly Guris et al.[24]	Systems-focused simulation to prepare for COVID-19 intraoperative emergencies	Report
Jowsey et al.[1]	Towards a safer culture: implementing multidisciplinary simulation-based team training in New Zealand operating theatres – a framework analysis	Observational study
Shah et al.[25]	Simulation-based education and team training	Method not informed
Nguyen et al.[26]	Using virtual reality for perioperative nursing education in complex neurosurgical surgeries: a feasibility and acceptance study	Feasibility study
Edwards et al.[27]	Immersive virtual reality enables technical skill acquisition for scrub nurses in complex revision total knee arthroplasty	Method not informed

The review of workflows is another application of clinical simulation used to qualify the team in emergency situations, such as the coronavirus (COVID-19) pandemic[19,23], allowing the identification of gaps in team's knowledge and potential failures in processes. This resource goes beyond individual training, as demonstrated in another study[18], whose authors reported the use of clinical simulation to test processes and train employees to open a new surgical service. This practice provided the team with the opportunity to familiarize themselves with the new physical structure, processes, and coworkers, developing technical knowledge, communication, and teamwork. In addition to qualifying the professionals, the evaluation of the service helps in the identification of possible structural or procedural failures before the actual implementation, mitigating risks and optimizing the planning phase.

The acquisition of knowledge was one of the purposes of simulation training in two studies. In one of them[16], the simulation was used to evaluate the team's adherence to a new cognitive aid tool, aimed at an effective response in

Chart 2. Types of simulation, objectives, and skills developed in realistic/clinical simulations performed in surgical centers, with the participation of nursing professionals, grouped by themes. Porto Alegre (RS), 2025.

Articles	Types of simulation	Study objectives	Skills developed	Themes
Effect of virtual reality training to enhance laparoscopic assistance skills[21]	VR	To assess laparoscopic skills of surgical center nurses, graduate students in clinical medicine, and residents before and after undergoing VR training.	Surgical instrumentation and assistance in laparoscopic surgery.	Technical skills.
Determination of skill and knowledge requirements of an instrument nurse working in major vascular surgery for the development of a virtual reality training tool[14]	VR	To gather content to create VR training to develop skills regarding instrumentation/assistance to large-scale vascular surgery.	Instrumentation and assistance in vascular surgery.	
Immersive virtual reality enables technical skill acquisition for scrub nurses in complex revision total knee arthroplasty[27]	VR	To verify whether an immersive VR training can qualify surgical technicians for revision total hip arthroplasty.	Instrumentation and assistance in knee arthroplasty surgery.	
Using virtual reality for perioperative nursing education in complex neurosurgical surgeries: a feasibility and acceptance study[26]	VR	To develop a VR simulation on the pediatric neurosurgical craniotomy procedure and evaluate the confidence of nurses in the operating room to assist in craniotomy procedures before and after VR simulation.	Instrumentation and assistance in neurological surgery.	
Clinical trial on nurse training through virtual reality simulation of an operating room: assessing satisfaction and outcomes[22]	VR	To evaluate the use of VR as a potential tool to train perioperative nurses for thoracic surgery procedures.	Instrumentation and assistance in thoracic surgery.	
The effects of a simulation-based patient safety education program on compliance with patient safety, perception of patient safety culture, and educational satisfaction of operating room nurses[13]	*In situ* simulation	To develop a simulation-based patient safety education program to manage patient safety in the operating room, assessing its effectiveness in order to propose a new training program.	Patient safety and risk management.	
All professions can benefit – a mixed-methods study on simulation-based teamwork training for operating room teams[12]	*In situ* simulation	To perform a simulation-based teamwork training in order to examine the responses of professional groups involved in the training, especially related to the development of self-efficacy and situational motivation.	Teamwork, communication, and confidence in the development of professional activities.	Nontechnical skills.
Simulation-based education and team training[25]	Medium- and high-fidelity simulation	To describe the use of simulation in medical education, especially in otorhinolaryngology.	Teamwork, communication, and practice of professional activity.	
The effect of small group simulation-based interprofessional education on non-technical skills of anesthesia providers: A randomized controlled trial[11]	*In situ* simulation	To assess the effect of simulation-based interprofessional education in small groups on the nontechnical skills of anesthesiologists and nurse anesthetists.	Teamwork, situational awareness, task management, and decision-making.	
Effects of simulation-based scrub nurse education for novice nurses in the operating room: a longitudinal study[17]	*In situ* simulation	To perform simulation-based training for novice nurses in the operating room in order to develop nontechnical skills.	Development of mental image of professional activity and sense of importance of one's own work.	
Multidisciplinary simulation training for Australian perioperative teams: a qualitative descriptive exploratory study[15]	Medium- and high-fidelity simulation	To assess the experiences of members of the Australian multidisciplinary perioperative team who conducted multidisciplinary simulation training.	Communication, collaboration, and leadership.	

Continue...

Chart 2. Continuation.

Articles	Types of simulation	Study objectives	Skills developed	Themes
Systems-focused simulation to prepare for COVID-19 intraoperative emergencies[24]	*In situ* simulation	To identify potential failures and successes in the practice of intraoperative emergency care in patients with COVID-19 and establish safe response procedures.	Emergency management/protocol review.	Review of workflows.
Integrated simulations to build teamwork, safety culture and efficient clinical services: a case study[19]	*In situ* simulation	To describe the simulation methodology used to build teamwork, safety culture, and efficient clinical services in a new procedure center.	Testing, review, and training of patient safety workflows and protocols, teamwork, and knowledge consolidation.	
Towards a safer culture: implementing multidisciplinary simulation-based team training in New Zealand operating theatres – a framework analysis[1]	High-fidelity simulation	To understand whether the national implementation of a simulation-based multidisciplinary team training program was taking place according to the perspective of the local team in charge of its implementation.	Training of work processes, communication, and interdisciplinary collaboration.	
A novel approach to operating room readiness for airborne precautions using simulation-based clinical systems testing[20]	*In situ* simulation	To test a new *in situ* simulation model that integrated the concepts of clinical systems based on simulation and rapid-cycle deliberate practice. The aim was to provide training and identify knowledge gaps related to surgical center assistance during the COVID-19 pandemic.	Emergency preparation/ management.	
Setting the foundation for an *in situ* simulation program through the development of a malignant hyperthermia simulation in the operating room[23]	*In situ* simulation	To analyze the journey for building an *in situ* simulation program based on the development of a malignant hyperthermia simulation in the operating room.	Development of technical knowledge, situational awareness, decision-making, and process review.	
Malignant hyperthermia preparedness training: using cognitive aids and emergency checklists in the perioperative setting[16]	Simulation not specified	To know the perception of the perioperative team of a military outpatient surgical center about the use of a cognitive aid tool to effectively respond to a crisis of malignant hyperthermia.	Emergency response and clinical protocols.	Acquisition of new knowledge.
Using simulation-based education to improve team communication during a massive transfusion protocol in the OR[18]	High-fidelity simulation	To describe an educational activity on the massive transfusion protocol involving a simulated scenario recorded in video.	Emergency response, task management, situational awareness, and communication.	

VR: Virtual reality.

emergency situations. The other[18], in turn, used clinical simulation associated with audiovisual media to quickly train an expressive number of employees concerning the new institutional protocol.

According to the analyzed literature, simulation learning represents a fundamental strategy for strengthening training programs in perioperative nursing. The knowledge of simulation training methods in surgical centers used in other countries can contribute to the structuring and implementation of these programs in Brazilian institutions, allowing to reduce the gap between theory and practice, qualify nurses, and support processes for incorporating new work practices and technologies in hospitals.

Considering our results, we reiterate simulation as a strategic instrument for the consolidation of a safety culture. Although patient safety is not the main objective of all studies included, this topic permeates the results in a transversal way, being reflected as greater adherence to institutional

protocols and strengthening the perception about safety culture. The expansion of simulation training practice, in this sense, can be a support tool to ensure the reduction of adverse events, the standardization of care practices, and the preparation of professionals for critical scenarios.

Despite the evidence that simulation-based education is a fundamental pillar to improve quality and safety in the perioperative environment, barriers to its development were mentioned. Jowsey et al.[1] identified the lack of structural management support as a critical obstacle — such as difficulty in scheduling and personnel release. Also in the study by Jowsey et al.[1], psychological factors were pointed out as significant barriers; fear of being judged or "looking foolish" were mentioned, especially by senior professionals. This highlights the importance of creating a "safe space" psychologically speaking, as highlighted by Hibberson et al.[15]

Among the limitations, we highlight the greater use of virtual reality during the COVID-19 pandemic, possibly reflecting the need to adapt to new technologies for teaching and training due to the epidemiological context. Furthermore, the lack of Brazilian studies represents a significant limitation, as the findings reflect realities of other contexts, preventing the generalization of the results for our reality, thus emphasizing the need for local research.

CONCLUSION

We evidenced that clinical simulation with the participation of the nursing team has been applied to the improvement of technical and nontechnical skills, the review of workflows, and the acquisition of new knowledge, promoting a more robust learning and aligned with the requirements of care practice.

Among the simulation approaches, the most used were the *in situ* high-fidelity simulation and the use of VR, due to its ability to reproduce, with great detail, scenarios and situations of professional daily life. Therefore, the immersion of the participants is promoted, providing a highly-realistic and contextualized learning environment.

Clinical simulation proved to be a dynamic and effective teaching-learning technique. It is dynamic for being able to promote the simultaneous development of multiple skills, and effective by presenting evidence of its superiority when compared to other teaching methodologies, especially regarding knowledge retention, engagement, and satisfaction of participants.

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CONFLICT OF INTERESTS

The authors declare there is no conflict of interests.

AUTHORS' CONTRIBUTION

CBR: Project administration, Data curation, Investigation, Methodology, Writing – original draft, Resources. AH: Data curation, Investigation, Writing – review & editing. VBB: Data curation, Investigation. CES: Data curation, Investigation. DDT: Writing – original draft, Writing – review & editing, Resources. RCAC: Conceptualization, Writing – original draft, Resources, Supervision, Validation.

Statement of use of artificial intelligence

While writing this article, the authors used the *GPT-4o Mini* and *Gemini 2.5 Flash* tools/services for proofreading and improvement of the fluidity of the manuscript. The responsibility for the final content and the presented ideas is entirely of the authors.

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